CARDI Annual Report 2011

Improving lives through agricultural research
CARDI Annual Report
2011
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<td>AAACP</td>
<td>All ACP Agricultural Commodities Programme</td>
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<td>ACP</td>
<td>Africa, Caribbean and Pacific Group of States</td>
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<td>AI</td>
<td>Artificial Insemination</td>
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<td>AISWG</td>
<td>Alien Invasive Species Working Group</td>
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<td>APHIS</td>
<td>Animal and Plant Health Inspection Services (US)</td>
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<td>CAAS</td>
<td>Chinese Academy of Agricultural Sciences</td>
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<td>CACHE</td>
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<td>CAES</td>
<td>Caribbean Agro-Economic Society</td>
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<td>CaFAN</td>
<td>Caribbean Farmers Network</td>
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<td>CAMI</td>
<td>Caribbean Agro-Meteorological Initiative</td>
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<td>Caribbean Agricultural Research and Development Institute</td>
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<td>Caribbean Development Bank</td>
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<td>Caribbean Community Climate Change Centre</td>
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<td>CI</td>
<td>Cutting Interval</td>
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<td>CIAT</td>
<td>International Centre for Tropical Agriculture</td>
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<td>CIMH</td>
<td>Caribbean Institute for Meteorology and Hydrology</td>
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<td>CIMMYT</td>
<td>International Centre for Maize and Wheat Improvement</td>
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<td>CIP</td>
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<td>CLAYUCA</td>
<td>Latin America and Caribbean Consortium to Support Cassava Research and Development</td>
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<td>CMV</td>
<td>Cucumber Mosaic Virus</td>
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<td>COLEACP</td>
<td>A European Corporation Programme for the ACP Horticultural Industry</td>
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<td>COTED</td>
<td>Caricom Council for Trade and Economic Development</td>
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<td>CPGCA</td>
<td>Christiana Potato growers Cooperative Association</td>
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<td>CTA</td>
<td>Technical Centre for Agricultural and Rural Cooperation</td>
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<td>CTV</td>
<td>Citrus Tristeza Virus</td>
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<td>DM</td>
<td>Dry Matter</td>
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<td>DTC</td>
<td>Demonstration Training Centre</td>
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<td>EC$</td>
<td>Eastern Caribbean dollar</td>
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<td>EU</td>
<td>European Union</td>
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<td>EUFF</td>
<td>European Union Food Facility</td>
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<td>FAO</td>
<td>Food and Agriculture Organisation of the United Nations</td>
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<td>Acronym</td>
<td>Full Name</td>
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<td>FAVACA</td>
<td>Florida Association for Volunteer Action in the Caribbean and the Americas</td>
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<td>GAP</td>
<td>Good Agricultural Practices</td>
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<td>GEF</td>
<td>Global Environment Forum</td>
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<td>GMP</td>
<td>Good Manufacturing Practice</td>
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<td>Global Water Partnership—Caribbean</td>
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<td>Hazard Analysis Critical Control Point</td>
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<td>Global Crop Diversity Trust</td>
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<td>Inter American Institute for Co-operation on Agriculture</td>
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<td>International Plant Genetic Resources Institute</td>
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<td>IRTA</td>
<td>Institut de Recerca i Tecnologia Agroalimentàries (Spain)</td>
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<td>ISTRC</td>
<td>International Society for Tropical Root Crops</td>
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<td>IT</td>
<td>Information Technology</td>
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<td>JGFA</td>
<td>Jamaica Goat Farmers Association</td>
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<td>JGGA</td>
<td>Jamaica Greenhouse Growers Association</td>
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<td>JPCA</td>
<td>Jamaica Pesticide Control Authority</td>
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<td>JICA</td>
<td>Japan International Cooperation Agency</td>
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<td>MIS</td>
<td>Market Information System</td>
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<td>MOU</td>
<td>Memorandum of Understanding</td>
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<td>MTP</td>
<td>Medium Term Plan</td>
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<td>Petroleum Corporation of Jamaica</td>
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<td>Trinidad and Tobago Agri-Business Association</td>
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<td>TTTGOA</td>
<td>Trinidad and Tobago Tropical Greenhouse Association</td>
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<td>UNCTAD</td>
<td>United Nations Conference on Trade and Development</td>
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<td>USAID</td>
<td>United States Agency for International Development</td>
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<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
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<td>UTT</td>
<td>University of Trinidad &amp; Tobago</td>
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<tr>
<td>UWI</td>
<td>The University of the West Indies</td>
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<tr>
<td>WB</td>
<td>World Bank</td>
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As we reflect on the achievements of the past year, the Institute can be justly satisfied that it responded to the agricultural research and development needs of Member States in keeping with our mandate and despite the challenges posed by insufficient resources.

The year under review was characterised by the collaborative efforts between the Agriculture Ministries of Member States, regional and international organisations and CARDI in the implementation of a number of projects and programmes. As the premier regional agricultural research and development institution, the Institute has strengthened the collaborative efforts with the Ministries by supporting and adding value to the national agricultural programmes and policies enunciated by the Member States.

CARDI is acutely aware of its responsibility to the agricultural sector in the Region and has implemented strategies to maintain minimum acceptable levels of activities in this environment of scarce resources. In this regard, the prioritisation of the work programme was one such strategy implemented through the development of the Medium Term Plan, 2011-2013, which is the successor to the previously completed MTP.

The successful initiation of many activities under the current MTP has been facilitated primarily by the funding provided under the CARDI/CFC/EU programme with funding provided by the CFC and the EU. The Institute continues to attract funding for other project activities. In addition to the project activities, the core activities have not been neglected. CARDI therefore continued work on the generation of appropriate technology to address the production needs of the sector, continued with its important hot pepper seed production for the rapidly expanding industry in the Region and being the focal point for a number of critical regional scientific committees.
Positive strides were made in other areas of the Institute’s activities under the Development of Strategic Linkages and Institutional Strengthening of the Medium Term Plan. The partnerships and initiatives developed with scientific and research and development agencies have been particularly beneficial to the Region and CARDI. The progress of some aspects of the Institutional Strengthening Axis of the MTP has been modest and one area of focus for the immediate future will be training in leadership and succession planning.

The achievements during the year under review were possible because of the dedication and hard work of the management and staff at all levels. Their commitment and loyalty have been evident in the personal sacrifices they have made and the Institute is indebted to them. The goodwill and contribution of our development partners is also greatly appreciated. We look to the future with the determination to make a positive contribution to regional agricultural development, particularly in this era of new and emerging challenges to our food and nutrition security.
After around 30 years of food production and agriculture being regarded as relatively unimportant compared to tourism and energy, Caribbean Governments are making serious attempts to transform the sector in order to provide a better level of food sovereignty and also to prevent the inflation caused by the increase in world food prices. However, the sector continues to be plagued by severe problems, such as, weather events and praedial larceny.

The need to reduce food imports and improve production levels requires, inter alia, research and technology generation to develop and identify better yielding varieties and to reduce losses due to pests, diseases and poor agronomic and post harvest practices. There is also the need to look at consumer preferences to ensure that locally produced food is as acceptable or more acceptable than the imported product.

Technology inputs are required all along the value chain from seed to fork. Towards the end of the value chain, innovative processing and packaging needs to be developed as consumers cannot be expected to revert to preparing their own food completely from primary products.

In the country reports that follow, there is considerable mention of national Gross Domestic Product (GDP) and agriculture’s contribution. Several reports by IICA and the World Bank have indicated that agriculture’s contribution to GDP is severely understated by government statistics, as they do not include the backward and forward linkages created by agricultural production.

This should be borne in mind when interpreting the reports below; however the general trends identified (upward or downward) are usually reliable.

**Antigua and Barbuda**

With Antigua and Barbuda’s focus on services as the means to achieve growth and development, the contribution of agriculture to annual economic output has declined to less than 2%.

The Government’s recent policy initiatives relating to food security and generation of foreign exchange brought renewed focus on agriculture. Food security initiatives are tied to preserving foreign exchange and increasing farmer incomes by improving local production. Emphasis has been placed on tomatoes, sweet peppers, other vegetables and sweet potatoes for the local markets; there is also focus on onions and carrots for export as well as local consumption.

To continue these thrusts, 120 ha of land has been earmarked to be put into use for crop production in 2012; another positive development is a EC$1M investment project for the sustainable establishment and management of eight...
varieties of avocado in Antigua and Barbuda.

Barbados

The 2008 to 2013 Medium-Term Strategic Plan for the agricultural sector seeks to attain eight broad goals, one of these being food security—“to contribute to the food and nutrition of the nation through the production of nutritious food at reasonable prices on a consistent basis”. The Government is also focusing on achieving food sovereignty, seeing the need to go beyond the concept of mere food security.

The emphasis is for agriculture to achieve levels of self-sufficiencies in domestic production that would ensure Barbados’ access to safe and nutritious foods. A significant number of incentives are available to the sector to support this thrust. There are duty-free concessions on agricultural inputs; rebates for costs, such as, land cultivation, irrigation systems, bringing land back into cultivation, provision of mulch, cleaning of canals and refurbishment of wells. Access to the purchase of duty-free vehicles is available to successful farmers; this also applies to refrigerated vehicles for agro-processors. Grants and assistance in financing are also available for certain activities.

Belize

Belize’s economy grew by 2.7% in the first nine months of 2011 compared with 1.8% during the same period of 2010. Although overall consumer prices only increased by 1.2%, food prices rose sharply. Vegetable prices increased by 19.8%, oils and fats 9.4%, dairy products 6.5%, seafood 4.8% and meats 3.5%.

The performance of the local agricultural sector was mixed, with double digit increases for sugar production and citrus deliveries, but production of banana declined.

Dominica

Dominica’s economic situation continues to be challenging with continuing declines in GDP. However, agriculture is still an important driver of the economy, contributing over 20% of GDP and employing around 40% of the work force. Nevertheless, the sector has been very vulnerable to weather conditions. In 2011, severe flooding caused much damage to infrastructure and to agricultural production; as a result the Government had to seek support from the IMF. There was major destruction of important access and farm feeder roads and to the Ministry of Agriculture’s propagation station at Layou.

Grenada

Grenada has rebounded from the hurricanes of 2004 and 2005, which severely damaged the agricultural sector, but is now saddled with the debt burden from the rebuilding process. Public debt-to-GDP is over 100%. The contribution of agriculture to GDP is listed as 5.3% compared to 80.5% for services, with industry accounting for the remainder. After two years of contraction in 2009 and 2010, the economy grew by 1.1% in 2011, the recovery was led by growth in agriculture of 8.1%. Nutmeg production doubled and cocoa production increased by 50%.

Jamaica

In 2011, there was a 10.6% increase in the contribution of the agricultural sector to GDP. Domestic food crop production increased by 30%, but the food import bill continues to be unsustainably high, above US$800 million compared to exports of just over US$200 million. In addition, 47% of arable lands are not under production, unemployment stands at 14.1% and approximately 20% of the population is below the poverty line. The scope for development is clear. The “Eat what we grow….Grow what we eat” campaign continued to drive increased
The consumption of locally produced foods.

**Montserrat**

The agricultural environment in Montserrat continued to be very challenging with frequent heavy rains making land tillage difficult. After an economic decline of 8.31% in 2010, for 2011 a preliminary growth of 4.3% was estimated.

Unfortunately, agriculture did not make a significant contribution to this performance and because of the volcanic activities, the land available for agriculture is limited. Nevertheless, food and nutrition security is a high policy goal of the Government. Greater local production and employment within the agricultural sector are being targeted. The introduction of backyard gardens will help to increase production of targeted crops: tomatoes, sweet peppers, carrots, bananas and sweet potatoes.

**St Kitts/Nevis**

The Prime Minister of the Federation noted in his 2012 budget speech that achievement of food and nutrition security remains the policy goal of his Government. Agriculture diversification has been made a priority since the closure of the sugar industry and is identified as one of the pillars of transformation to ensure food and nutrition security, provide employment and generate revenue.

Three 20 ha commercial farms have been established as well as four group farms, using the cluster farm model. The importance of agro-processing development for income generation has also been recognised. Because of the importance of water to agriculture, dams have been constructed in a number of communities. To facilitate storage of produce, a packing house is being constructed at the Department of Agriculture. There was a small amount of economic growth in 2011 but the debt burden is over 200% of GDP.

**St Lucia**

The Government continues with its priority to revitalize the agricultural sector. A number of initiatives were embarked upon to return producers, affected by Hurricane Tomas (October 2010), to a sustainable livelihood. These were:

- Assistance to banana and plantain farmers
- Assistance to vegetable farmers
- Reinstatement of farm roads
- Cleaning of main and lateral drains and the setting up of drainage systems
- Repairs to agricultural building infrastructure

Many other important initiatives were continued including the project to prevent praedial larceny; implementation of the youth agri-entrepreneurial project; institutionalising a national standards and certification system and improving infrastructure.

Despite these initiatives, the GDP for agriculture declined by 6.5% in 2011, contributing to the overall GDP decline of 0.3% for St Lucia. The main reason for this was the catastrophic fall in banana exports due to the damage from Hurricane Tomas.

**St Vincent and the Grenadines**

The agricultural sector in St Vincent and the Grenadines was severely tested by Hurricane Tomas in late 2010, by torrential rains and landslides in April 2011 and by Black Sigatoka disease affecting banana production. After a small decline in the economy during 2009 and 2010, St Vincent and the Grenadines is estimating a modest growth during 2011 of just under 1%. However, because of the problems identified above, agriculture showed a decline of over 15%. In common with other countries in the Region, the situation has not been helped by the cessation of market preferences internationally for banana and other traditional agricultural commodities.

The Government has in place the national Food Plan, which is promoting the production of a number of
commodities for domestic consumption. Seedlings are being produced at the Government Agricultural Station and at the Taiwanese Technical Mission and are sold to farmers at low prices ranging from EC$0.10 to EC$0.50 per vegetable seedling and EC$2.00 per fruit tree plant. Subsidies are also provided for inputs, such as, fertiliser and livestock feed. The Agricultural Producer and Livestock Prevention of Theft Act was proclaimed during 2010 and this has given farmers some renewed protection from praedial larceny.

Trinidad and Tobago

The economy of Trinidad and Tobago was weak in 2011, with GDP declines in both the energy and non-energy sectors. However, there was an estimated increase in the agricultural GDP of 2.0% with data from the National Agricultural Marketing and Development Corporation (NAMDEVCO) showing modest increases in the quantity of several crops put on the wholesale market. However, floods during October and November 2011 affected production at the end of the year and caused inflation to rise to 5.3% over the year, even though core inflation (excluding food) was only 1.5%.

The Government has identified agriculture as a central pillar to improve employment, control inflation and provide economic growth. During the year, several programmes were initiated to assist farmers overcome some of the challenges faced. These included:

- Revision of incentives to encourage sustainable development in agriculture
- Strengthening infrastructure pertaining to water resource management, drainage and irrigation
- Streamlining of credit policies by the Agricultural Development Bank
- Transferring deeds and titles of lands to farmers
- Strengthening the fishing industry by upgrading 13 landing sites
Strategic Axis 1

Development of Sustainable Industries
Overview

The main activities in the roots and tubers programme are being implemented primarily under the Common Fund for Commodities/European Union funded project *Increased Production of Root and Tuber Crops in the Caribbean through the Introduction of Improved Marketing and Production Technologies*. The main objective of this project is to contribute to the improvement of livelihoods along the Root and Tuber Crop Commodity Chain in the Caribbean through appropriate marketing and production technologies. This will be achieved with an integrated approach for the production and marketing of selected tuber crops thereby enhancing the incomes across the supply chain.

Stakeholder-identified constraints are alleviated through the use of appropriate technologies, proven training techniques, strengthened farmer organisations and support for the maintenance of quality standards. The focus is the development and promotion of efforts on regional markets where the selected roots and tuber crops could effectively compete with imports. The project aims at adaptive technology transfer and upgrading with existing processing and product development technologies.

The purpose of the project will be achieved by fulfilling the following five objectives:

1. To produce and distribute high quality planting materials of cassava, sweet potato and yam through the establishment of appropriate propagation facilities
2. To demonstrate and, as necessary, validate technological innovations in root and tuber crop production and use
3. To increase the demand for fresh and value added products of the selected root and tuber crops in the local and regional market
4. To strengthen existing production groups and the formation of clusters that will improve the activities along the commodity value chain
5. To improve the knowledge and skill of actors along the value chain through training and dissemination of production, post harvest, processing, and marketing techniques

**Technological support for product transformation**

Towards achieving the sectoral goal of increasing the production of staples to meet national demands, several research for development interventions were undertaken along the value chains of selected roots and tubers in most CARDI Member States. These included: profiling of the production systems, identification and conservation of new varieties (yield and pest tolerance) and the development of efficient propagation systems, for cassava and sweet potato. In addition, on-farm training workshops and the establishment of plots that demonstrated Good Agricultural Practices (GAPs) were also key activities conducted. Efforts were also made to strengthen the infrastructure of medium-sized processing operations. Technical assistance was also provided to these processors in the development of Food Safety Management Systems.

With respect to the profiling and determination of production indices through the conduct of yield assessments, a series of surveys were conducted in two major growing areas in Trinidad. Information collected, included a description of the production systems, production and marketing practices undertaken,
yields as well as constraints being experienced. Yield assessments indicated that crop losses of over 30% of harvested yields are being experienced by farmers.

Toward the development of systems to improve the supply of appropriate germplasm for the industry, efforts were made to conserve suitable germplasm as well as to demonstrate efficient propagation techniques. A germplasm bank of 12 sweet potato varieties and 11 cassava varieties for use in the fresh and processed market channels, was established in Tobago. A small low input shed was established in a major sweet potato growing area in Central Trinidad (Cunupia) to demonstrate propagation techniques that enhance sweet potato production, specifically sprouting of storage roots.

Within the shed, two grow boxes each 5 m x 1.2 m were constructed and filled with media. Small storage roots of the variety, known locally as Chicken Foot, were established in the beds. Every three weeks, vine growth was measured and an assessment made as to the number of 30 cm slips that could be obtained. Data indicated that 600 to 800 stem cuttings can be harvested every three weeks (50 to 60 cuttings per square metre). Techniques, such as, trellising of vines and the use of hanging containers will be explored as a means to optimise the space in the facility.

A six module course, Good Agricultural Practices for Enhanced Root and Tuber Crop Production was developed and over 150 farmers and key industry stakeholders were trained. To supplement the training course, six 0.5 ha commercial sized plots (three each of cassava and sweet potato) were established to demonstrate GAP for root and tuber crops in major producing areas in Trinidad (2) and Tobago (1). These plots have yielded twice that of current yields being recorded in the farming communities. More than 100 farmers and key stakeholders visited these plots to view the practices that are being demonstrated. Towards improving the capacity of the farmers trained in GAP to capitalise on growing market opportunities, efforts were undertaken to establish a farmer group in Tobago and to strengthen the Rio Claro Farmers Group in Trinidad.

In Jamaica, in collaboration with the Rural Agricultural Development Authority (RADA), training modules on best practices were also developed for the producer groups. Four modules were developed for each commodity to help promote the employment of GAP among growers. Assistance was sought from RADA to have the relevant technical experts facilitate the training sessions with the producer groups within the respective focal areas. Modules developed include: Marketing and Business Management; Land Preparation; Integrated Crop Management; and Harvest and Post Harvest Treatment.

Using the pilot sites identified for the roots and tubers project in Jamaica, a total of 12 GAP training sessions were conducted in 2011, covering modules of Marketing and Business Management, Land Preparation, Integrated Crop Management, Pest Identification, and Integrated Pest Management (IPM). A total of 107 individual farmers and six extension officers attended the sessions across four of the pilot sites. Pre and post training evaluations indicated that the groups/communities increased their knowledge from 5% to 23% by participating in the training sessions. Groups ben-
efitting from the training sessions were: Airy Castle-St Thomas (cassava); Ninety Acres-Clarendon (sweet potato); and Tate-Clarendon, and Warsop-Trelawny (yam).

**Improving propagating facilities**

The tissue culture facility operated by the Christana Potato Growers Cooperative Association (CPGCA) in, Manchester, Jamaica, with CFC funding, is being expanded to increase production of clean plantlets (sweet potato, yam and cassava) derived from tissue-cultured meristems. The land preparation for construction of the weaning and hardening facilities at Devon have begun and construction should be completed by the end of August 2012. The facility will be approximately 500 m² of greenhouse space to accommodate a projected output of 38,400 plantlets every six weeks.

As at the end of December 2011, cultures of two sweet potato varieties have been initiated and disease indexing of six sweet potato varieties is underway with four varieties already indexed positive. Indexing of yams is also on-going with two varieties (Sweet Yam and Renta Yam) obtained from the Scientific Research Council (SRC). During November 2011, 33 sweet potato varieties were imported from the International Potato Centre (CIP). Sub-culturing of cassava is also being carried out at the tissue culture laboratory, and 10 varieties are now in culture. A germplasm bank of 25 varieties of sweet potato, seven varieties of sweet cassava, and two varieties of yam has been established and is being maintained in vivo at the CARDI Mona Demonstration and Training Centre. It complements in vitro collections at SRC and CPGCA. One variety of yam, round leaf yellow yam, has been added to the SRC in vitro collection.

In St Vincent and the Grenadines, construction of a tissue culture laboratory at Orange Hill and the erection and refurbishing of weaning and hardening facilities at Perseverance were all completed. The new laboratory has increased processing and growth chamber space by 189 m². This will increase tissue culture plantlet production capacity by 200%. Similarly, the new weaning and hardening structures were expanded by 334 m², thereby increasing the holding capacity of weaned and hardened plants by 200% and production of plantlets by 600%.

**Technology development**

The two methods (vertical-hanging and conventional flat bed) for multiplying disease-free planting material that were assessed in previous trials under greenhouse conditions will be used in the hardening facility and further evaluated.
**Sweet Potato**

During 2011, analysis of the results of an experiment that was repeated in **Antigua and Barbuda** in October 2010 to determine the effect of time of planting and zones on the performance of the ten most commonly grown sweet potato accessions was completed and published. It was shown that the highest marketable yields were obtained from the variety/accessions Catch Me (49,500 kg/ha), Hurricane (32,250 kg/ha) and Mandela (31,500 kg/ha). Comparisons of marketable yield between zones were not significant, but accessions/varieties and time of planting significantly influenced marketable yield. Similar results were obtained in the 2008–2009 experiments. This reaffirms that recommendations and yield projections on sweet potato crop performance must be governed by these factors. These findings will allow production, marketing, export and food security projections, to be more accurate.

Also, in **Antigua in Barbuda**, a study was undertaken to evaluate the cost effectiveness of irrigating sweet potato and irrigation trials were established at Cades Bay Agricultural Station at the end of July 2010 (wet season planting) and at CARDI’s Betty’s Hope Research Station at the end of November 2010 (dry season planting).

Yields for irrigated plots in the wet (2,860 kg per 0.25 ha) and dry (3,150 kg per 0.25 ha) season were higher than the non-irrigated plots. Revenues for irrigated plots during the wet (EC$15,873) and dry (EC$17,482) season were also higher. Further work on the economics of this finding has to be conducted.

**Pest management**

In collaboration with the Ministry of Agriculture in **Barbados**, a commercial biocontrol agent (**Beauvaria bassiana**), Naturalis L® was field tested for the control of the “Scarabee” weevil, **Euscepes postfasciatus** (Fairmaire), on sweet potato. Five treatments were used in which Naturalis L® was applied at one week and varied weekly times of application thereafter. Very little damage occurred even in the control treatment. However, the lowest occurrence of damage was observed when the bioinsecticide was applied at one-month intervals for up to three months. A low ‘Scarabee’ weevil population in the field was the probable reason why there was little overall damage.

In **St Kitts and Nevis**, efforts were made to control the main sweet potato pest, **Cylas formicarius**. Two rates of Naturalis-L® along with the insecticides, Pronto® and Caprid®, were evaluated to assess their efficacy in weevil control. There were no significant difference between yield, and no incidences of pest damage. The trial will be harvested in January 2012 and pest damage assessed.

**Germplasm improvement**

In March of 2011, tissue culture plantlets of seven sweet potato varieties—AVRDC CR 1517-139, AVRDC-Crisio, CARDO Big Red, CIP RO 150, Papota, Unknown and Viola—were imported into **Grenada** from the tissue culture laboratory in St Vincent and the Grenadines and grown in a seedling nursery for five weeks after which they were planted out in the field to observe their initial performance. All of the varieties have performed well under local conditions and will be put into a varietal trial to determine their yield performance.

**Agroecological areas**

The best suited agro-ecological areas for growing sweet potato and cassava on **St Kitts** were identified are shown in Table 1.

**Table 1** Most suitable areas for producing sweet potato and cassava in St Kitts

<table>
<thead>
<tr>
<th>Agro-ecological areas</th>
<th>Average annual rainfall (mm)</th>
<th>Soil type</th>
</tr>
</thead>
<tbody>
<tr>
<td>St Paul’s/Dieppe Bay</td>
<td>1525-2030</td>
<td>Loam</td>
</tr>
<tr>
<td>Newton Ground/Fahies</td>
<td>3050-150</td>
<td>Clay loam</td>
</tr>
<tr>
<td>Farms/Wingfield</td>
<td>2030-3810</td>
<td>Clay loam</td>
</tr>
<tr>
<td>St Peter’s</td>
<td>1525-2030</td>
<td>Sandy loam</td>
</tr>
<tr>
<td>Lodge/Mansion</td>
<td>2030-3050</td>
<td>Sandy loam</td>
</tr>
</tbody>
</table>
Cassava

The catchment of Good Hope and the Kalinago (Carib) Territory in Dominica are both locations, which have a tradition of “value added” component to roots and tubers with particular emphasis on cassava. Both farine (sometime referred to as cassava flour) and to a lesser extent cassava bread are produced in small facilities, which are usually family operated. The facilities are generally undeveloped, traditionally with dirt floors, no side walls and doors. Good Manufacturing Practices (GMP) are rudimentary, there is no running water, floors cannot be kept clean, animals cannot be kept out of the facilities and equipment are generally left unwashed between use. Utensils are generally made of recycled plastic drums or wood. Food grade utensils are not used.

Three micro processors within the catchment were interviewed by CARDI, the Produce Chemist from the Division of Agriculture and the Bureau of Standards, to assess their infrastructure and equipment needs. Subsequently, three facilities were selected for structure upgrade and an additional two for equipment and utensil receipt.

The interventions were:

- Upgrade of the physical building structure of the processing facility
- Introduction of stainless steel utensils
- Introduction a stainless steel press to reduce the water content of the cassava
- Introduction of an electrical grater into two facilities
- Introduction of an electric peeler into one facility

Twenty-three farine processors from the Kalinago, Good Hope and Sauveur catchment area were trained in GMP and improved packaging procedures as a step forward in improving the use of their improved facilities.

A baseline survey conducted on seven farine producers in St Vincent and the Grenadines showed that of the farmers interviewed, 71.4% were registered under law, while 28.6% were not. Of those registered, 14.3% are owned by co-operatives and government, while 42.9% have limited liability status. Most of the facilities (71.4%) had open structures, while 28.6% were enclosed. When not in operation, the facilities were not sanitised. The minimum quantity of raw materials which can be processed in a day ranged from a minimum 50 kg to a maximum is 1000 kg. Five cassava agro-processing plants were completely refurbished and processors were trained in some of the sanitary expectations associated with GMP.

In Trinidad, two cassava washer/peeler machines were procured for two medium-sized processing operations and have improved the efficiency of the peeling operations by over 100%. Towards strengthening the Food Safety Management Systems of these processing operations, training workshops were conducted and over 160 persons were trained. GAP analyses were also undertaken to assist these operations to determine their requirements for attaining Hazard Analysis Critical Control Point (HACCP) certification.

An upgrade of the Cassava processing facility at Dispox/Good Hope, Dominica, before and after the facility was upgraded.
Science, Technology and Innovation

Other Roots and Tubers

Under an EU-ACP Aroid Project Adapting clonally propagated crops to climatic and commercial changes research activities will be carried out in St Lucia and the other Caribbean islands over a period of five years. The project is aimed at: safely transferring germplasm internationally in order to maximise the use of genetic resources from diverse gene pools; to produce new varieties of dasheen (*Colocasia esculenta*) with high agronomic and commercial potential by conventional and participatory breeding. Thirty-four dasheen genotypes were received from the tissue culture laboratory in St Vincent and the Grenadines and hardened at the Ministry of Agriculture tissue culture laboratory in St Lucia before being planted out at the CARDI DTC for multiplication.

Technology validation and training

Since its inception, the CFC/EU funded roots and tubers project has been using proven techniques to address producers’ constraints. Demonstration plots have been set up to accommodate experiential learning in the range of methodologies used. In Jamaica, training activities geared towards improvement of on-farm agronomic practices were done in collaboration with RADA and the Ministry of Agriculture and Fisheries. A Memorandum of Understanding (MOU) between CARDI and RADA was signed to facilitate this technical cooperation with RADA personnel. The training curriculum was developed to complement ongoing initiatives by the partner agencies. Training needs assessments and baseline surveys were conducted and the performance gaps identified among producers in the communities surrounding the pilot sites to determine the impact of project interventions on knowledge and increased use of best practices among producers. Draft brochures and technical guides have been developed and approved, for each of the roots and tuber crops (yam, cassava, sweet potato) providing general information on the crop profile, land preparation, planting techniques, planting material, cultivation, pest and disease management, harvesting and post-harvest treatments, and expected yields. Information for these documents represent a consolidation of ‘how to’ instructions from various CARDI manuals and fact-sheets along with recommendations from the Jamaica Pesticide Control Authority (JPCA) and the COLEACP PIP programme.

Using CARDI technologies, sweet potato demonstration plots were established in Akers, Chateaubelair, and Rabacca—the three main producing areas—which constitute three different agro-ecological zones in St Vincent and the Grenadines. When assessed over the three zones, Dorell (34.1 kg/plot), Agriculture (29.4 kg/plot), Viola (28.8 kg/plot) and CARDI K84-7 (27.8 kg/plot) gave the highest yields (p<0.001). The most popular variety, Black Vine, gave the lowest yield (12.9 kg/plot) P<0.001. Rabacca and Akers were the most productive zones.

A cost of production study was also carried out at Akers to compare the use of CARDI technologies in the production of the sweet potato variety CARDI K84-7 with the system used by farmers. Use of the farmer system in two trials produced marketable yields of 10,936 and 7,526 kg/ha at a cost of EC$0.52 and
EC$0.48 per kg. respectively. The farmer when using CARDI technology produced marketable yields of 14,032 kg/ha at a cost of EC$0.40 per kg. There was a 22% to 54% yield increase from the use of CARDI technologies and the cost of production was reduced by 8 to 12 cents per kilogram.

One hundred farmers, 20 extension officers and 15 stakeholders received training in all aspects of sweet potato production and handling. A laminated double sided flyer on sweet potato production and rodent control was drafted and will be massed produced for distribution.
Overview

The CARDI cereal and grain legumes crop research for development programme is directed at improving the production and marketing of cereal grains in Belize with some minor activities in Grenada. In Belize the focus is on the following:

- The annual evaluation of yellow and white corn hybrids to identify ones that perform better than the hybrids that are currently being planted by large-scale mechanised producers.
- The annual evaluation of yellow and white corn varieties to identify ones that perform better than the local varieties that are currently being planted by small scale producers.
- The evaluation of soybean and small red and black beans that perform better than those that are currently planted by producers.
- The development of handling and storage systems to reduce post-harvest losses at the small farm level.

Corn production: Belize

Evaluation of open pollinated white corn varieties

In 2009, 15 open pollinated white corn germplasm entries, originating from the International Centre for Maize and Wheat Improvement (CIMMYT), Mexico, were evaluated along with one from Guatemala (ICTA B1) and one local (Jalacte). Six entries among the CIMMYT germplasm were selected for further evaluation in 2010. Based on the results obtained in 2010, a request was again made to CIMMYT to supply seed of three selected varieties for evaluation in 2011.

A trial comprised of a total of nine entries, which included three from CIMMYT, four from a local seed supplier, one from Guatemala and one local variety was planted on 18 July 2011 at CARDI Field Station, Central Farm, Belize. There were highly significant differences (P<0.001) among the entries for number of ears harvested, field weight of cobs, grain weight and shelling percentage. Extrapolated grain yield showed that all entries yielded more than 1,918 kg/ha with an average of 5,253 kg/ha across all entries.

All three CIMMYT entries (S03TLW-3B, S03TLW LN-2, and S03TLW-ABOL) and P4063W from a local seed sup-
plier yielded more than 6,000 kg/ha. The Guatemalan entry, ICTA B-1 yielded 2,969 kg/ha and the local San Vincente white corn 1,918 kg/ha.

**Evaluation of yellow corn hybrids**
A total of 11 entries of yellow corn were evaluated. Included were eight hybrids from a local seed supplier, CARDI YC-001 yellow corn variety and two local farmers’ varieties. There were no significant differences among the entries for any of the parameters measured. However, four of the hybrids (P3862, 30S49, P3523 and P3340) yielded more than 6,000 kg/ha, two (30F87 and 30K73) and CARDI YC-001 yielded more than 5,000 kg/ha. The local varieties, PG-01 and PG-02 yielded less than 1,666 kg/ha.

**Corn production: Grenada**
Four corn varieties, Big Daddy Yellow, Jarvis Golden Prolific, Hickory and Truckers Favourite were introduced from the USA and planted out at the CARDI Field Station, Westerhall, Grenada. These varieties did not perform well under local conditions as all were severely affected by rust disease. Only Hickory produced a few cobs, with the cob diameter ranging from 3.0–3.2mm, which was less than the required minimum size of 3.8mm.

**Grain Legume: Belize**

**Varietal evaluation of small red beans (Phaseolus vulgaris) varieties (Varza Rojo)**
A large number of germplasm of small red beans and black beans were planted in several preliminary evaluation and seed rejuvenation and multiplications plots. These materials were received from the University of Zamorano through the Ministry of Agriculture of Belize. A total of 130 entries of small red beans and 64 entries of black beans were planted and seeds were recovered for planting in the 2011/2012 season.

**Demonstration of improved technologies for production of black beans**
In December 2010, a total 40 farmers were selected from Jalacte and San Vincente villages of the Toledo District to demonstrate the improved production practices, especially using closer spacing between plants, less number of seeds per hole, use of seed treatment and use of fertilisers and herbicides. In Jalacte an average yield was 1,055 kg/ha, while in San Vincente it was 1,247 kg/ha. The average cost of production per hectare in Jalacte was BZ$1,341 (EC$1,795) and in San Vincente BZ$ 1,117 (EC$1,495). The cost of production per kg worked out to be BZ$ 1.27 (EC$1.70) in Jalacte and BZ$0.90 (EC$1.20) in San Vincente. The selling price at the farm gate was BZ$1.98/kg (EC$2.65/kg) at the time of harvest.

**Demonstration on the use of improved mechanical threshers**
Some farmers have fields, which are inaccessible by motor vehicles and can only be reached on foot or by horse. Therefore, the mechanical shellers which were introduced into Belize in 2009 and modified in 2010 were used in 2011 on-farm. The shellers were used as stationary operating units under a shed.
Overview

The hot pepper industry in the Region continued to receive varied interest by Member States, with Belize, Jamaica and Trinidad and Tobago appearing to show signs of increased production. In Jamaica for example, production (tonnes) in 2011 reflected an 18.6% increase over the 2010 production. Presently, the varieties/landraces developed by CARDI are open pollinated and a concerted effort is being planned towards the development of hybrids.

The successful development of a sustainable industry calls for a high level of collaboration among the numerous stakeholders along the value chain. Some progress has been made in this regard with the quantity and varieties demanded by processors and seed distributor being discussed and CARDI gearing up to provide the required seeds.

An examination of CARDI’s activities as related to the development of hot pepper varieties, reveals that the focus is on seed production and technology development. In the contemporary agribusiness environment, the development of a sustainable industry calls for an intimate customer/consumer relationship and a high level of trust and information sharing between the numerous actors.

Hot pepper seed production and distribution

The CARDI/Caribbean Chemicals and Agenices Ltd seed distribution collaboration has been functioning for approximately one year and seeds are readily available in most Member States. As with all new arrangements there were some teething problems and farmers were not aware that the CARDI Country Units were no longer selling pepper seeds. Commercial production of hot pepper seeds in 2011 was restricted to two locations, Antigua & Barbuda and Belize. However, seed (Moruga Red) produced in Trinidad in 2010 was sold in 2011. Under the CARDI/Caribbean Chemicals Agreement approximately 45 kg of seed was distributed in 2011.

The projected demand of seed for 2012 is 275 kg, which represents a six-fold increase over the 2011 sales. In an attempt to ensure that an adequate volume of selected variety of seeds would be available 2012, the area in which production was started is shown in Table 2.

Table 2: Area in production for seed of selected hot pepper varieties required for 2012

<table>
<thead>
<tr>
<th>Centre</th>
<th>Variety</th>
<th>Area in ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antigua and Barbuda</td>
<td>Scotch Bonnet</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>Moruga Red</td>
<td>0.4</td>
</tr>
<tr>
<td>Belize</td>
<td>West Indies</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Moruga Red</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Hot pepper value chain collaboration

Facing uncertain environments, firms in the hot pepper industry in the Caribbean have to strive to increase their level of collaboration to effectively exploit opportunities both, regionally and internationally. In the USA from 2000 to 2009, per capita consumption of all chillies (fresh and processed) increased from 2.4 kg to 3.0 kg per capita.

There has been some effort between processors and berry producers to collaborate to ensure adequate availability of the volumes and varieties required for pepper mash. However, continued dialogue is required to leverage the true benefits of collaboration, such as, reduced transaction costs, access complementary resources and enhance productivity.
**Hot pepper productivity enhancement**

*Effect of planting density on yield*

In Barbados, the impact on yield of single (12,350 plants/ha) versus double (24,700 plants/ha) row planting for West Indies Red was investigated. Preliminary results after 21 weeks of harvesting resulted with a yield of 6,593 kg for the single row and 15,581 kg for the double row. However, the higher yield obtained in the double row plot also required a higher level of inputs, for example two drip lines per bed, and more fertiliser. From an economic perspective farmers will be interested in the profitability of the different systems and as such, in the repeat experiment efforts will be made to try and address this issue. Further, since hot pepper production is primarily undertaken by small, resource poor farmers, the cash flow requirements of the different systems will also be of importance.

In an effort to determine the plant population density that produce the highest yields of marketable berries from the Moruga Red variety, a field trial was established at the Sugarcane Feeds Centre, Longdenville in Trinidad. The trial included 16 plant population spacing treatments and parameters measured were weight of mature berries; plant height; width of plant canopy; and the number of secondary lateral branches per plant.

The data suggests there were no differences between the 16 treatments for the parameters measured. The evidence that berry quality (mean weight of fully developed berries) and size was not changed by the changing spaces between plants is very important both for field production and marketing. The analyses also clearly indicate that the 16 plant population densities, based on the yields of marketable berries, can be placed into three groups, viz.:

- Group 1 - highest yielding plant population densities (60x30 cm, 90x30 cm, 150x30 cm, 60x60 cm, 90x60 cm);
- Group 2 - second highest yielding plant population densities (120x60 cm, 150x60 cm, 60x90 cm, 90x90 cm);
- Group 3 - the lowest yielding plant population densities (120x90cm, 150x90 cm, 60x120 cm, 90x120 cm, 120x120 cm, 150x120 cm).

The data also indicated that the closer within-row spacing has a positive effect on berry yields. Work is scheduled to start in 2012 to examine at least two of the best plant population densities in large scale field trials with a view to compare their cost benefits and conclude the search for the optimal production system for the hot pepper landrace, Moruga Red.

**Germplasm evaluation**

In collaboration with the Ministry of Agriculture and Fisheries (MAF) in Belize, two separate trials were conducted for the evaluation of ten hot pepper varieties, under a screened structure and in the open field. Six varieties were yellow in colour (Scotch Bonnet, Phyllis, Yellow Congo, Car 6-98, Joyce and Car 7-81), two were orange in colour (Kukulkan and Habanero) and three were red (Caribbean Red, West Indies Red and Moruga).

In the screened structure harvesting was achieved for 7 months (from January to July 2011), while in the open the harvesting lasted for 5 months (from February to June 2011). Plants were healthier in the screened structure than those in the open field due to the exclusion of insect pests. In the screened structure, Kukulkan yielded significantly higher (154,294 kg/ha) than West Indies Red (96,412 kg/ha) and Scotch Bonnet (80,294 kg/ha) and all the other variet-
Berries of the hot pepper variety Kukulkan

In the open field Kukulkan also gave the highest yield (30,766 kg/ha) while West Indies Red yielded 23,302 kg/ha and Scotch Bonnet 20,578 kg/ha. These results indicate that there is a potential for much higher productivity if pests, especially insect pests are managed well and higher fertility levels are applied.

In order to address the challenge for water faced by farmers in St Kitts, research on sustainable methods for hot pepper production was continued with a repeat of the 2010 mulch trial with grass and plastic mulch.

Data were again collected on plant height, berry yield and weight. The results of the analysis showed that the mulched plants produced more and heavier berries from bigger plants.

This suggests that mulching is a production practice that can be recommended to hot pepper farmers in St Kitts, particularly those whose plots experience water shortages during the growing period. An estimate of the cost of producing hot pepper under these conditions was conducted and it is shown that, even with adding mulch, the farmer can make a profit.

Technological support to the hot pepper industry

In St Lucia, the demand for local hot peppers (*Capsicum chinense*) for processing is increasing. Local hot pepper sauce processors are importing pepper mash as traditional sources have dwindled over the years due to shortfalls in production. The local processors seek to take advantage of both local and export market opportunities and are encouraging local pepper producers to increase their production to satisfy their needs and have offered to pay the producers 50% more for fruits (EC$3.00/kg) than is currently being paid (EC$2.00/kg) for the fresh fruit export market.

To satisfy the processors’ demand, a Fact Sheet on the production of hot pepper for processing was produced and was circulated to hot pepper seedling producers and hot pepper farmers through the main hot pepper processors. A hot pepper demonstration plot containing three varieties of hot peppers was established at the CARDI Field Station demonstrating two production systems (with and without plastic mulch). CARDI has collaborated with vegetable seedling producer, Mr Francois Henry, in using his commercial seedling nursery facility for the production of hot pepper seedlings for sale to farmers.
Fruits

Training Workshop on Pineapple Production

A training workshop entitled Sustainable pineapple production for domestic and export markets took place during June 2011 in Dominica. The workshop was one of three that make up the field level training component of a larger project funded by the Food and Agricultural Organization of the United Nations, (FAO). It was executed by CARDI, aimed at strengthening the production and post harvest skills of stakeholders in the value chains.

The workshop covered:
- Pineapple production—best practices
- Pest and disease control
- Yield forecasting
- Postharvest handling

Under the European Union Special Framework of Assistance (SFA) 2005, the Supervising Agency, the Banana Industry Trust (BIT) and the implementing Agency IICA in consultation with MALFF, a commercial pineapple production demonstration plot of 0.23 ha was established at the CARDI Demonstration and Training Centre, St Lucia, using the Antigua Black Variety. The objective was to allow pineapple farmers to observe at the field level the agronomic practices involved in commercial pineapple production in a wet zone in the Eastern Region without supplemental irrigation.

Technology development

In order to meet quarantine requirements for the export of mature green golden apples (Spondias cytherea Sonn.) from Grenada to the USA trials were conducted in 2010 to develop a hot water treatment protocol that would successfully kill any larvae of the West Indian Fruit fly, Anastrepha obliqua L. in the fruit and at the same time maintain the fruit quality. Another hot water treatment trial was conducted in August and September 2011, to test suitable temperature by time combinations that would maintain fruit quality. Green mature fruits were subjected to temperature by time combinations of 48 °C for 30 minutes and 48 °C for 35 minutes to see if there were any differences on the days to ripening.

No significant differences between treatments as to days to ripening were observed, even though the degree of ripening in treated fruits was greater than in the un-treated. Ripening of fruits began three days after treatment and after six days treated fruit began crossing the threshold of 50% ripening.

Since the hot water treatments did not hasten ripening significantly, then it is possible that treated fruits may be acceptable to consumers in the USA markets where unripe fruits are required. The next step is to treat fruits which are known to be infected with eggs or larvae of the West Indian Fruit fly with hot water to see if they are killed by the treatment.

The dwarfing system for tall golden apple trees that began to be developed in Grenada in 1994 continued to be validated in a trial that was established on farm in La Digue, St Andrews in August 2009. The site was divided into two equal plots of 864 m² with one plot planted with golden apple seedlings of the tall type and the other planted with grafted golden apple seedlings—scion from the tall type grafted on to seedling rootstock of the dwarf type. Each plot contained six plants spaced 12 m x 12 m.

Generally, the plants have continued to grow well throughout the year with the grafted trees showing a spreading, low growing pattern compared to the erect and taller growing pattern of the seedling trees. A setback occurred when three grafted trees were destroyed by cows that were tethered too close to the plot. These trees were replaced. One grafted tree
bore five fruits during the year. As yet, none of the seedling trees has produced fruit.

The spreading pattern of the grafted trees and their earlier bearing as compared to the taller growing seedling trees has thus initially verified the validity of the dwarfing system technology. This therefore continues to set the stage for dissemination to interested farmers in the years to come.

Watermelon is a popular crop cultivated by farmers in St Lucia. There is an increase in demand on the local market particularly in the hospitality industry where farmers can obtain much needed income from the sale of their fruit. Watermelons are usually grown during the dry months of the year (January to June), but when cultivated during the wet months (July to December) the crop is greatly affected by pests, diseases and waterlogged conditions resulting in low yields, poor quality fruit (< 12 °Brix). To overcome production shortfalls throughout the year, watermelons are imported in order to satisfy the demand particularly from the supermarkets and the hospitality industry.

A watermelon varietal trial was conducted in St Lucia during the wet months of the year to determine the best locally available watermelon varieties for wet season production. The treatments comprised four locally available popularly grown watermelon varieties, Crimson Sweet, Charleston Grey, Jubilee II and Royal Jubilee. No significant differences were observed between the four varieties (p < 0.05) for disease incidence, number of fruit/plot, weight/fruit, yield/plot and Brix. The disease incidence was high for all of the varieties and significantly affected yields. Further research need to be carried out with new watermelon varieties that are adapted to wet season conditions.

A coconut industry revitalisation project funded by the Ministry of Agriculture Lands, Forestry and Fisheries (MALFF) in St Lucia initiated to increase year round production of fresh water nuts. CARDI will produce 40,000 dwarf coconut seedlings over a period of 2.5 years in four phases for distribution to farmers. The first phase has been completed with 7,100 seedlings (equivalent to 41 ha.) distributed to 115 farmers. The project has been put on hold as the funding which was provided by MALFF had to be diverted to other areas as a result of damage caused by tropical storm Tomas.

Vegetables
Pest management
The Diamondback moth is considered the major pest of cabbage in St Kitts and Nevis. Efforts at control included a repeat of a trial that was conducted in 2010, to evaluate the efficacy of the reduced risk pesticides Enthrust® and Radiant® along with commercially available Phoenix in controlling the pest on the cabbage variety Oxylus. This trial was also conducted on two sites, CARDI Field Station and at the Department of Agriculture’s Outreach Centre at Tabernacle. Both trials were planted at the end of April and harvested in July. Data were collected on final yield. In addition insect counts were taken for all major pests and observations made on pest damage.

A field of cabbage damaged by the diamond back moth, St Kitts

It was found that the plots treated with Radiant and Enthrust, although not significantly different from each other, had significantly higher yields than those treated with Phoenix. The data collected on other pests which affect the crop apart from the diamondback moth, again showed as in the previous trial, that the reduced risk pesticides were not effective in controlling these pests and particularly in the case of white flies there was an increase in numbers as the crop grew. Other pests of note were aphids, loopers and army worms.
Commodity Development: Livestock
Small Ruminants

Overview
The 2011 initiatives, conducted by CARDI and partners in the small ruminants’ industry across the CARICOM Region, were buttressed by global, regional and national considerations and imperatives. These considerations and imperatives formed the institutional platform upon which the regional small ruminants’ strategic plan was built.

Production and import figures to 2011 show that the rate of imports is increasing faster than the rate of local production, except in Barbados where it appears that imports have been decreasing at a steady rate since 2008. An analysis of the data has indicated that this may be a direct result of the introduction of grades and standards in the local small ruminants’ industry with focus on hygiene and food safety. There has also been the development of specific policies targeting the local industry in Barbados, which has contributed to greater investment in the sub-sector.

This initiative was primarily led by the Ministry of Agriculture and Rural Development in Barbados. Current initiatives by IICA, CARDI and the Ministries of Agriculture in Barbados, Jamaica and Trinidad and Tobago seek to extend these gains through similar interventions in the value-added and marketing components of the industry. The industry at present remains largely underdeveloped. However, if the productivity gains made in Barbados since 2008 can be sustained, scaled up and extended across the Region, there is every opportunity for improved performance in the medium to long term.

CARDI’s leadership role in the industry has been recognised through the decision of CFC to designate the Institute as the executing agency for a small ruminants project in Jamaica and Trinidad and Tobago. The project focuses on breed improvement, forage based feeding systems, value-added development and capacity building through technology transfer mechanisms that include the use of multi-stakeholder processes.

Feeds and feeding systems
Several forage varieties tested for agronomic performances on mined-out bauxite lands at the Sam Motta Demonstration and Training Centre (SMDTC) in Jamaica were selected for grazing trials to assess animal performance before being fully incorporated into the feeding systems and introduced to the wider small ruminant population. The forage types that showed promise in terms of agronomic performance, and nutrient content were; African Star grass (*Cynodon nlemfuensis*), Tifton 85 (*Cynodon dactylon*), Brachiaria Mulato (*Brachiaria brizantha* x *B. ruziziensis*) and Pangola (*Digitaria decumbens*). The trial investigated how the selected forage types would stand up to grazing, their ability to recover during the grazing cycle and the performance of weaner goats on the selected forage types.

Four 0.256 sq ha plots of the selected grasses were planted on-mined out bauxite lands at the SMDTC with each plot being further subdivided into three equal sub-plots to facilitate a stocking rate of 44 goats per ha. The stocking rate was determined based on a semi-intensive system of management where animals are supplemented by concentrate feed. Each block was grazed by two weaner does of comparable age and weights at the start. Each section was grazed for a minimum of 14 days allowing for a rest period of at least 28 days and data collected weekly. The results indicated that the animals were responding similarly to the African star, Tifton and Pangola (P=0.284) but somewhat lower weight gains for those grazing on Mulato. The dry matter content of the Mulato forage was lower (P<0.001).

Work continued in Jamaica on the development and testing of best practices to enhance productivity in the industry. To this end a study was conducted upon the request of the Jamaica Goat Farmers Association (JGFA) and implemented with resources provided to the pilot sites and breeder units by the EU Food Facility (EUFFF) programme. The specific objective of the study was to determine animal performance on agro by-products as replacement for commercially prepared rations for...
weaner goats. The commercial diets had corn and soybean as main ingredients while the by-products ration was comprised mainly of rice bran and cracked rice. All diets contained leaf meal obtained from the mulberry trees being cultivated by members of the JGFA. The treatments were formulated to contain approximately 16% crude protein. The feeding trial was conducted in goats housed in well ventilated buildings using crossbred weaner bucks of the Boer breeds at two different locations.

The results of the trials indicated that there were similar weight gains when rice bran/cracked rice combinations were compared to commercial concentrate, but rice bran only and cracked rice only rations were inferior (P=0.001). Feed consumed per kg of weight gained was comparable for commercial concentrate and the combination ration, while more rice bran is needed (P=0.028) to put on 1kg of meat. The cost per weight gained was lowest (P=0.036) for the combination ration and highest for the commercial ration. The carcass characteristics for the animals on the different diets were similar. There were no negative effects of feeding any combination of rice or rice bran to weaner bucks since all parameters measured were fairly similar. The results underscore the need to encourage more goat farmers to cultivate more trees such as mulberry, which can be a useful component of goat feed.

In Trinidad and Tobago, activities sought to compare the dry matter (DM) yield of an improved forage species, Mulato II (a Brachiaria hybrid), to that of a local species, Tanner grass (Brachiaria arrecta), at three cutting intervals (CI) and three levels of nitrogen application. The trial was established in 2010 using a 3 x 3 factorial design and is located at the Sugarcane Feeds Centre, Longdenville. The three cutting intervals were 3, 6 and 9 weeks and nitrogen was applied at 0, 100 and 200 kg N/ha/yr.

No differences (P>0.05) were observed at different levels of N application within species at 6 and 9-week cutting intervals (CI). Nitrogen was applied twice a year and some leaching or volatilisation may have occurred making it unavailable to the plant. It is therefore suggested that applications be made at more regular intervals to maximise benefits. Between species differences (P<0.05) were observed at all CIs and N-application levels, with the exception of the 9-week CI at 100 kg N/ha/yr.

There is also evidence to prove that Mulato II produced significantly more DM at each of the CIs over the experimental period when yields were analysed cumulatively over the 21 months. The difference in DM yield between species at the 3, 6 and 9-week CI was 61,683, 43,390 and 34,133 kg/ha respectively. (Fig. 1) This data reflect the persistence of the species. It is not practical to cut or graze either species at 3 weeks when the height of the both species is usually less than 15 cm depending on weather conditions.

Interestingly, with the Mulato II, differences between the 6 and 9-week CI were negligible, with higher yields being obtained at the 6-week CI. With the Tanner grass, yields were higher at the 9-week CI than at the 6 or 3-week CI. Notwithstanding this, it is recommended that both species be cut at an interval of 6 weeks since it is known that the vegetative material at the 9-week CI will be of a lower nutritional quality.

Results show that Mulato II is a superior forage species. The data show that farmers can support between 34–71 % more small ruminant animals on a pasture of Mulato II than on Tanner grass. This field trial is due to be completed mid-2012, at which time a final recommendation will be made.
In order to disseminate the forage work to the farming community based on the recommendations by the Trinidad and Tobago Goat and Sheep Society (TTGSS), two farms were selected for the establishment of Mulato II grass. The farms are located in the Carlsen Field and South Oropuche areas. Before the introduction of the Mulato II, pastures consisted mainly of scrub vegetation. By the end of 2011, the field at Carlsen Field was planted. At South Oropuche, it was decided to sow seeds in a nursery and transplant in January 2012. Data on animal performance will be collected in 2012.

Towards the development of the impact of introduction of Mulato II grass on dairy production, a total of 18 dairy cattle farmers were interviewed to establish a profile of the farmer, farm, herd and farm operations and practices regarding establishment and management of Mulato II. The results indicated that approximately 40.4 ha of Mulato I (also a Barachiara hybrid) was established by respondents during 2007–2008, with one farmer establishing 0.8 ha in 2010. Presently, these farmers have a total of 28.3 ha of Mulato I pasture. Twenty-nine percent of the respondents were unsuccessful in their efforts to establish the Mulato I pastures. The main reason for the failure of the Mulato I to persist on some farms related to a lack of drainage in fields as well as the age of the farmers interviewed. Forty-one percent of the respondents were over the age of 60 and the majority expressed difficulties to undertake the work themselves. A lack of labour also contributed to poor maintenance of the pastures.

All respondents, regardless as to whether they were successful at establishing the pastures of Mulato I or not, thought that the species is a valuable forage for dairy farming, with many respondents reporting up to a 30% increase in milk yield when animals are fed Mulato I. Other positive experiences were that the Mulato I tolerates the dry season, seems to be resistant to attacks by pests and the re-growth after brush fires is quick.

Technological support to the industry
As a precursor to the expansion of the goat industry into dairy and other value added products, CARDI has been breeding dairy goats at the Sam Motta Demonstration and Training Centre (SMDTC) in Jamaica. Construction of a goat house and dairy was completed at the Centre and partially equipped with some of the materials that are necessary for the operation of the dairy. Breeding stocks for the Dairy Unit have been imported and are currently in quarantine. The Unit continued to market limited amounts of goat milk especially to cheese and cosmetics producers. The full commissioning of the Dairy Unit will assist in supplying what seems a viable market.

Under the FAO-implemented EU Food Facility (EUUFF) Small Ruminant project, some 845 persons of whom 35% were females, have benefited from 15 formal training sessions (conducted in six modules) and 29 on-site training sessions. To enhance training sessions, some 27 different information products on several aspects of goat production were developed and distributed. The project also provided training in artificial insemination, which resulted in 14 persons being certified through Human Employment and Resource Training (Trust/Na-
All certified AI officers were provided with AI kits and are now eligible to practice under the supervision of a Veterinary Officer. Among the information products developed under the project were: (i) a goat production video with a detailed section on AI in goats, (ii) an AI manual and (iii) a goat production manual. The AI programme could be described as moderately successful with 54% of the animals synchronised being successfully inseminated during inseminations done as part of the training process. At the time of reporting, 73 of the artificially inseminated goats have produced 143 kids, with an 81% success rate between conception and birth.

Also under the Agreement between CARDI and FAO, some 23 fodder banks benefitting some 380 farmers were established for the Jamaica Goat Farmers Association (JGFA) and the Jamaica 4H clubs. In addition to being taught to prepare by-product ration, the same groups were issued with over 16 tonnes of feed to enhance their nutrition programme.

CARDI was also instrumental in boosting the national herd improvement initiative by assisting in the facilitation of the importation of 52 purebred Boer and Alpine goats. The imported gene pool will widen the genetic base by providing more bloodlines for upgrading the local stock. The imported Alpines and Toggenburg stock will provide more diversification in the industry by providing superior stock for goat dairy production.

In 2009 and 2010, CARDI in collaboration with IICA, Ministry of Agriculture and ADM-Caribbean Agro Industries Ltd. commenced a pilot initiative to address some of the known constraints affecting the production of small ruminants in Grenada. The most limiting factors were reported to be high kid mortality rate, long kidding intervals, slow growth rates and dog predation. It was recognised that farmers needed continued training to improve their skills in goat production systems.

In a training exercise conducted by CARDI at the La Sagesse Training Centre, Grenada, nine goat farmers and eight extension officers were trained in several areas of goat husbandry, including milk breeds, dairy production, cheese manufacturing and farm building design.

While the breeding activities and tracking of pedigree by the Livestock Unit was somewhat compromised because of the unavailability of purebred males, a limited number of purebred and crossbred Boer, Alpine and Nubian crosses were available for distribution to farmers in Jamaica. At the end of the year, the herd comprised 218 animals made up of 110 mature does—nursing, pregnant or open, 16 weaner bucks mostly to be sold for meat, 21 replacement does, three mature bucks and 68 young kids. During the year, 34 crossbred animals were distributed for breeding with the possibility of another 20 to come from the existing weaner bucks and replacement does.
Overview

In the Caribbean, there continues to be an increased demand for large quantities of traditional herbs such as lemon grass (*Cymbopogon spp*.), shado beni (*Eryngium foetidum L.*) and cerasee (*Momordica charantia L*.), both in the pharmaceutical and culinary sectors, and the volumes required by the growing markets cannot be met. These plants also provide an alternative to traditional cropping systems and can lead to the development of downstream industries that increase income and generate employment. In most cases, very little is known on the cultivation of these plant species at commercial levels. Current research is therefore geared towards the determination of suitable agronomic practices for the commercial production of herbals.

Technology Development

In an attempt to contribute to the commercialisation of indigenous herbs, a field trial was established to determine optimal fertiliser recommendations for Shado beni (*Eryngium foetidum*) production in Trinidad and Tobago. Treatments included inorganic fertilizer at rates of 290 kg N/ha (farmer practice), 175 kg N/ha (recommended practice) as well as compost. No significant differences were observed in growth and development of the plants or the yields among treatments.

The cost and returns of producing Shado beni was also undertaken in collaboration with the Inter-American Institute for Cooperation on Agriculture (IICA). Data were collected from nine farmers in the Rio Claro area and indicated the average yield, was 50,255 kg/ha, with an average cost per unit of EC$2.79 and average selling price of EC$3.33. The average total revenue was EC$162,915, which is more than three times the average total operating cost of EC$50,850. These figures suggest that the farmers are making a profit.

All field work on developing agronomic packages for the growing of specific herbs and medicinal plants in Jamaica was completed and work begun on the preparation of a technical manual.

The selected herbs included cerasee (*Momordica charantia L*.), red sorrel (*Hibiscus sabdariffa*), spearmint (*Mentha spicata, syn. M. viridis*), peppermint (*Mentha x piperita*) and lemongrass (*Cymbopogon spp.*). The nursery, agronomy and postharvest sections of the manual have been completed and the sections on the history, origin and geographic distribution, botany, nutrition content and uses are being developed.
Emerging Issues

Agroenergy

Overview
Many agricultural crops and crop residues can be used to produce energy. These energy products include solid cellulose, ethanol and vegetable oil. Vegetable oils are produced from numerous oil seed crops. These oils have high energy contents and some have been evaluated as substitutes for diesel fuel. Oil seeds, particularly those which can be produced on marginal lands that are not being used for food production, are an important source of biofuels for the automobile industry. The current research is assessing the performance of Castor bean (*Ricinus communis*) and Jatropha (*Jatropha curcas*) varieties on mined out bauxite lands in Jamaica.

Technology Development
CARDI in collaboration with the Petroleum Corporation of Jamaica (PCI) is assessing the relative productivity of five castor bean (*Ricinus communis*) and two Jatropha (*Jatropha curcas*) varieties on reclaimed bauxite lands. The productivity of these crops is being assessed in relation to their adaptability to reclaimed bauxite land conditions and their productivity of vegetable oil to be converted to biodiesel. This study began in April 2011 and during the year the trial was successfully established. Data collection on the growth and development of the plants has been ongoing and the first harvest of oil seeds will be in early 2012.

An inflorescence of young capsules on one variety of Castor bean in Jamaica.

Castor variety, Nordestina, showing 100% germination and good growth in the nursery in Jamaica.
Overview
Capacity building and infrastructure strengthening were the focus of the activities being conducted within the Protected Agriculture (PA) programme. Interventions were made along the value chain to: (i) strengthen current marketing and trading linkages, (ii) enhance production systems through the demonstration of GAPs, (iii) increase the knowledge and skill of stakeholders through training, (iv) improve information access by stakeholders, (v) strengthen farmer groups and (vi) develop agri-business clusters. Of note is the on-going partnership with producers to establish PA structures to demonstrate GAPs.

Marketing
Towards the development of marketing and trading linkages, a survey was undertaken in Trinidad and Tobago to determine the market profile for selected produced PA vegetables and herbs and by so doing establish and/or strengthen market linkages, including contracts, between PA producers and existing or potential market outlets. The survey covered 22 supermarkets, 11 hotels, five restaurants and two distributors and indicated that the top three vegetable products purchased by the various buyers were tomatoes, cucumbers and sweet peppers. The total annual demand for all types of tomatoes was 445,399 kg; cucumber 253,986 kg and sweet peppers, 210,410 kg. Several purchasing characteristics of the buyers were identified. Amongst all of the segments, supermarkets are the largest buyers of local fresh produce. Customer demand for one stop shopping has resulted in the growth of fresh produce sales in supermarkets.

The results of the market survey established that there is a strong desire by the buyers to purchase local produce in preference to the imported products, which arrive once per week, is not considered fresh and there are challenges in getting the quantities required. The increase in imports of these fresh products has shown that there is an opportunity for PA producers to target production of tomatoes, lettuce and sweet peppers to replace these volumes from abroad.

In order to develop a sustainable PA industry, consideration should be given to development of an industry value chain. Consumers are becoming more conscious of quality when it comes to fresh produce and therefore supermarkets, hotels and restaurants must ensure that produce sold or used in the preparation of meals meets this criterion. In terms of ongoing development of the PA industry, there should be continuous emphasis on quality assurance in all stages of the production process. This data will be presented to the Trinidad and Tobago Tropical Greenhouse Operators Association (TTTGOA) and the process of initiating supply contracts will be undertaken.

To enhance product market and trading systems to create substantive and transparent business linkages and benefits for stakeholders in PA (smallholders, producer groups, both private sector and cooperatives) various forums for consultative dialogue and information exchange are being facilitated in Jamaica. These forums include both actual (directory of stakeholders, meetings, workshops, etc.) and virtual (databases, web-based linkages) platforms. Ultimately, easier access to available information will result in an improved and more integrated PA production and market information system.

Various stakeholders’ meetings were held with producers, researchers, policy makers, input suppliers, financial institutions and other stakeholders to discuss ways in which current market information systems could be improved. Directories and the names and contents of existing databases were reviewed and updated. Various experts have been recruited such as an IT Support Specialist, a Group Dynamics Consultant and an Administrative and Data Assistant to support the various activities.
The regional Marketing Expert, met with key producer groups in St Ann, Jamaica, and the Jamaica and Greenhouse Growers Association (JGGA) executive to explore the possibility of setting up a pilot project for producing grading, packaging and marketing of PA crops produced by the group. A pilot project will be initiated to facilitate proper registration of this association as one merged St Ann group and the development of a cluster and a joint marketing approach to the local hotel industry based on USDA grades and standards.

Key marketing data have been obtained and groups page identified with key areas mapped in terms of marketing flows. The status of greenhouse production was assessed and a dire need of a Strategic Plan that would serve as a guide to coordinating the actions of the supporting agencies was earmarked for project intervention.

Production system development: Structures
A profile of the PA production system was determined following a survey in Trinidad and Tobago. The findings indicated that there are over 30 PA farmers in the country with over 50 fully enclosed structures of which only 35–40 are in operation. Key production constraints reported by producers included, lack of adequate technical support and information, appropriate structures and credit.

In St Kitts/Nevis the CARDI shade house structure was completed with financial assistance from the Ministry of Agriculture to serve as a demonstration site for protected agriculture. Crop (tomato and sweep pepper) evaluation could not be carried out because of damage done to the roof by strong winds during the early part of the hurricane season.

With the goal of demonstrating the efficient production practices suited for protected systems in Trinidad, CAR-DI partnered with three protected agriculture farmers to retrofit their structures so as to optimise production. Retrofitting included improvement of ventilation systems, introduction of efficient growing systems (media, growing containers) and fertigation systems. The environmental conditions as well as the production practices and yield were monitored to determine the impact of the interventions. Based on the environment data collected to date, the retrofitting of the structures has improved the conditions within the structures.

Production system development: Potting media
Studies were undertaken in Dominica to evaluate the effects of bioclimatic factors, greenhouse covering material and type of media on tomato grown under protected agricultural (PA) systems technology. In a trial conducted in the north west of Dominica, two protected agriculture systems of identical design (ridge arched, 4.8 m high to the apex, 30.48 m long and 9.14 m wide) were used and tomato (cultivar TX54) grown on five types of media (soil, Promix, bay leaf industrial waste, coconut coir and organic compost). One greenhouse was covered with blue plastic (0.1 mm thick) allowing for 80% light transmission and the other with Griffolyn T x 1200 transmitting 80% diffused light, thus varying the quality of light available under the structures.
Although plant growth was the same for all media types and greenhouse covering during the first month, in subsequent months, plants grown under the Griffolyn Tx1200 were significantly taller than those under the blue covering. Plants grown in bay leaf industrial waste, coconut coir, Promix and soil were similar in plant height within each greenhouse. However, as demonstrated in both greenhouses, plants grown in Bellevue Compost were consistently shorter than plants grown in the other media. Further evaluations are continuing.

Training
A series of capacity building exercises for stakeholders along the protected agriculture value chain were conducted in Trinidad. More than 180 persons were trained/exposed to the principles and practice of protected agriculture. These training events comprised one workshop, one seminar, one study tour, one open day and diagnostic visits by a PA Consultant to members of the Trinidad and Tobago Tropical Greenhouse Operators Association (TTGOA).

Through CARDI’s linkage with the Florida Association for Volunteer Action in the Caribbean and the Americas (FAVACA) programme, Dr Josh Freeman of Virginia Polytechnic Institute and State University, conducted a workshop in Dominica on greenhouse and in-field production of tomatoes and sweet peppers to assist the local farmers to better understand crop requirements and best practices from seed to postharvest.

Dr Freeman shared research findings on the use of tolerant tomato rootstock for the management of bacterial wilt, as it affects tomato production and supplied CARDI with seven varieties of rootstock to be planted in infested soil to determine the best varieties for Dominica. The technique of using resistant rootstock is an attractive alternative for the small farmer for the management of bacterial wilt.

A 2-day workshop on Good Agricultural Practices was held for members of the JGGA in St Ann and St Mary, Jamaica on the topics of group strengthening, marketing, crop nutrition, pest/disease recognition and management. Participants comprised ten growers and five RADA extension officers. Improving market access of PA products was identified as a major need.

Group strengthening and agribusiness cluster development.
Through a series of sessions with PA farmers in Mayaro, Trinidad, a formal group was established as the Mayaro Greenhouse Growers Association. These sessions sensitised producers to the principles of group dynamics. Activities were initiated for the development of a sweet pepper agri-business cluster within the Mayaro area.

Group meetings were held in Jamaica with the St. Ann PA producers to carry out a needs assessment and initiate discussions towards formal group formation. The Department of Co-operatives and Friendly Societies were a part of the forum to provide detailed guidelines and indicate the benefits. A major concern of the farmers was identified as a heavy infestation by thrips, which caused total losses of some farmers’ crops and had become a critical threat to PA groups. A direct intervention was coordinated with collaborators from RADA, UWI, SRC and the Pesticide Control Authority to develop a planned schedule of activities to manage the pest infestation.

Information access
Improved information access on protected agriculture technology through e-technology was undertaken. The framework for the development of a database and regional website was developed at CARDI Headquarters.

To facilitate the development of web-based platforms to access market information systems (MIS) in Jamaica, eight protected agriculture websites were selected based on similar target audiences. A comparative analysis of them was done to determine which web pages, functionality, design elements and content were most popular and useful for a protected agriculture website. All secure pages were identified and noted for replication on the Protected Agriculture website. A draft prototype of the Protected Agriculture website was created using Adobe Photoshop and it was decided that it will be a sub-domain of the existing CARDI website.
Technical Systems and Services

Information and Communication

Information resource guides
The March issue of *R&D in Agriculture, a bulletin on information resources* was produced and distributed.

Three issues of *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 were published and circulated to staff.

**CARDI Success stories**
A draft of *Caribbean Agricultural Research and Development Institute (CARDI) Success Stories* (2p.) was prepared and featured:

- Success Story: Reinstating Callaloo to the USDA APHIS Preclearance List in Jamaica
- Success Story: CARDI Hot Pepper Seeds for Global Distribution
- Success Story: CARDI innovative golden apple (*Spondias cytherea* Sonn.) dwarfing technology

Support to CARDI staff, clients and stakeholders
The Unit responded to 61 requests from CARDI staff and conducted literature searches related to major CARDI activities. Support was provided for the World Bank and CFC Roots and Tubers Projects.

During preparation of the World Bank project proposal - re: developing training materials on risk mitigation for small holder agricultural production in the Caribbean. Researchers were provided with the following bibliographies and documentation

- Agricultural practices to mitigate Pest and Diseases Risks in small holder vegetable production systems
- Agricultural practices to mitigate Food Safety Hazards in small holder production systems
- Soil, nutrient and water management options available/used in the Caribbean

**Roots & Tubers Projects by CARDI over 25 years**
Background information for an overview of research done by CARDI on roots and tubers during the last 25 years was compiled.

**Agriculture information alerts to CARDI Staff**
CARDI staff received 84 SDI Alerts, which covered the latest news items, journal articles, research reports/publications and event notices pertaining to CARDI's priority commodity and thematic areas.

**Service to Agricultural Sector Stakeholders**
Seventy-two requests were received from external clients, particularly for information on hot peppers, roots and tubers, fruits and vegetables, and small ruminants. Referrals to agricultural institutions which would provide information required were given to clients. CARDI also provided print and e-copies of documents as well as bibliographies.

CARDI/Dgroup was set up in March 2011 to facilitate exchange of information among staff.
Marketing

The Marketing Unit continued to provide guidance to the Institute’s research activities to facilitate the development of a market oriented agricultural sector.

It facilitated the development of the hot pepper seed forecast for 2012. The estimates of seed for the CARDI/Caribbean Chemicals relationship was, Moruga Red (82 kg), West Indies Red (90 kg) and Scotch Bonnet (100 kg).

A cost of production bulletin for hot pepper was produced and disseminated to CARDI Country Representatives. This will enable data to be collected from crop production studies to be analysed. An analysis was conducted on Guyana price data for 2010 for hot pepper, pumpkin and sweet potato across the six major markets.

The following is a summary of the findings on hot peppers:

<table>
<thead>
<tr>
<th>Maximum</th>
<th>EC$/Kg = 15.22</th>
<th>Charity, December;</th>
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<tr>
<td>Minimum</td>
<td>EC$/Kg = 1.66</td>
<td>Parika Open Market January and March;</td>
</tr>
<tr>
<td>Average</td>
<td>EC$/Kg = 5.08</td>
<td></td>
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A study was made of cost/benefit ratios of CARDI commercial production of hot pepper seeds from Antigua and Barbuda (West Indies Red, 52 kg), Belize (West Indies Red, 25 kg) and Trinidad and Tobago (Moruga Red, 15 kg), which were sold under the CARDI/Caribbean Chemicals relationship.

Biometrics

In 2011, the Biometrics Unit was involved in assisting with CARDI experiments and surveys design and analyses. At least 30 experiments and/or surveys were designed and analysed for 19 staff members from the following member States: Antigua and Barbuda, Barbados, Dominica, Grenada, Jamaica, St Lucia, St Kitts/Nevis, St Vincent and the Grenadines, Trinidad and Tobago.

CARDI’s also provided biometric services to its stakeholders, clients and collaborators. These include the University of the West Indies (all faculties), University of Guyana, Tobago House of Assembly, Nutramix Feeds Ltd, Ministry of Food Production, Trinidad and Tobago Agri Business Association (TTABA), Department of Agriculture, St Kitts/Nevis, Nestle, University of Trinidad and Tobago (UTT), Caribbean Health Council.
**RISK MANAGEMENT**

Invasive Species Management

**Control**

*Citrus Tristeza Virus (CTV)*

In order to assist in reversing the widespread death of citrus trees as a result of transmissible citrus diseases and in particular *Citrus Tristeza Virus (CTV)*, Dominica has embarked on a citrus certification programme under which new CTV tolerant rootstocks seed material were introduced into the country. The rootstocks are: Cleopatra mandarin, Carrizo citrange, Swingle citrumelo, Troyer citrange, Ragpur lime and Citrus Volkameriana. Scion material was also imported as the disease status of the local material was unknown.

Rootstocks of Cleopatra mandarin, Carrizo citrange, Swingle citrumelo, Troyer citrange, Ragpur lime and Citrus volkameriana were selected for evaluation in a trial which is well under way. All of the plants have been propagated and are in the process of being established in various agro-ecological zones. Data will be collected during 2012.

In St Lucia, CARDI continues to maintain a germplasm bank of three CTV-tolerant lemon rootstock varieties, Volkameriana, Swingle citrumelo and Carrizo orange. Seeds were extracted from fruits, processed and given to a commercial fruit crop propagator.

**Coordination of Approach**

In continuing the fight to safeguard the Caribbean Basin from the introduction and ravages of invasive species CARDI continues its technical advisory role on the national Plant Health Coordinating Committee (PHCC) in Jamaica. Local monitoring and management activities such as surveys, rearing and releasing of biocontrol agents are ongoing with respect to invasive species such as, pink mealybug *Maconellicoccus hirsutus* (Green), red palm mite *Raoiella indica Hirst* and the more recently reported papaya mealybug *Paracoccus marginatus* Williams and Granara de Willink.

In 2009, Huanglongbing (HLB) also known as Citrus Greening disease because fruit tends to turn green after ripening was confirmed to be present in Jamaica and undoubtedly poses a serious to the citrus industry. A proposal developed for funding under the FAO Technical Cooperation Projects facility to tackle Citrus Greening was approved and activities initiated. CARDI continues to sit on the local steering committee of the CABI GEF Invasive Species Project and is also a member of the resuscitated Alien Invasive Species Working Group (AISWG).
Climate change for Agricultural Development

Overview
In 2007, The Fourth Assessment Report of the Intergovernmental Panel on Climate Change noted that “warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.” CARDI has a key role in the implementation and co-ordination of the Region’s agricultural research for development initiative, including research related to adapting to and mitigating global climate change.

Climate change is today widely recognised as one of mankind’s greatest challenges in the 21st century. The chief climate hazards that affect agricultural production in the Caribbean are rainfall variability, droughts, floods, temperature increases, severe weather events, such as, tropical storms and hurricanes, and saline intrusion as a result of sea level rise.

Trends in the last two decades suggest that the total economic losses caused by natural disasters in the Caribbean are on the increase. As a consequence of the drought in the Caribbean in the latter part of 2009 into the first three months of 2010, banana exports in Dominica were approximately 43% lower than normal in the first 11 weeks of 2010. In St Vincent and the Grenadines, agricultural production was similarly reduced to 20% of normal levels. In Antigua and Barbuda, where the 2010 onion crop was expected to be about 500,000 kg, 25% of it was lost, while about 30% of the tomato crop, which was estimated to total 250,000 kg, was lost.

Dry hot weather also increases the risk of bush fires, which can result in added crop losses. In Dominica, 160 such fires were attended to in the first quarter of 2010, which was more than the 103 fires for the previous year. St Vincent and the Grenadines reported 150% increase in the amount of bush fires and seven different farms reported the destruction of at least one hectare of crops.

Floods are estimated to account for 70% of all weather-related losses in the Region’s agriculture sector. For example, in Guyana, floods from January to February in 2005 resulted in US$55 million in damage to the agriculture sector. In 2006, floods also resulted in total losses to the sector of US$22.5 million.

CARDI has an important role in developing and articulating the sector’s response to the effects of global climate change. This is being done in close collaboration with national, regional and international organisations with similar and related mandates in climate change and agriculture to develop a requisite response to the threat of climate change.

Species/varietal adaptation

In collaboration with the University of the West Indies, Climate Changes Study Group in Jamaica field research was conducted on sweet potato varietal assessment.

Models and Modelling

The CARDI programme during 2011 encompassed many activities. Some of the major ones were:
- Caribbean Agro-meteorology Initiative (CAMI) project, which supports the training of agro-meteorologists and CARDI personnel in the climate data management technologies available to provide information to farmers
- Collaboration with the Technical Centre for Agricultural and Rural Cooperation (CTA) on the development of required Climate Change...
and agricultural operational policies.
- Crop modelling in relation to climate parameters in Jamaica.
- Collaboration with the Caribbean Community Climate Change Centre (5Cs) in the advancing of the Region’s climate change agenda through policy development, training and capacity development.

Other Activities
A CARDI staff member was nominated to participate in the on-line course in Statistics in Applied Climatology (e-SIAC) offered by the University of Reading. This participation was made possible through support from the 5Cs. As a result of the training, the staff member was able to utilise daily maximum and minimum temperature data from Piarco International Airport in Trinidad for the past 40 years (1970–2010) to show an average temperature rise of 1.6–2.0 oC over the period. Similar analyses are possible for other countries once the data is available.

Capacity building
Under the United Nations Institute for Training and Research (UNITAR) Agreement, 5Cs has obtained resources to upgrade weather data collection facilities, including the re-furbishing of all CARDI weather stations to facilitate the monitoring of crop performance in relation to climatic parameters, soil water and soil temperature. CARDI is presently in the process of receiving this equipment at ten of its research stations in the Region.
Seminal planting material

At its seed production centre in Belize, CARDI produced commercial, nucleus and stock seeds of selected varieties of open pollinated corn, soybean, peanut and other grain legumes, the quantities of which are given below in Table 3.

Table 3: Production of commercial and stock seed of various crops in Belize, 2011

<table>
<thead>
<tr>
<th>Crop Type</th>
<th>Seed type</th>
<th>Variety or (no. of lines)</th>
<th>Qty. of seed produced (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean</td>
<td>Commercial</td>
<td>CB 3296</td>
<td>613</td>
</tr>
<tr>
<td>Soybean</td>
<td>Commercial</td>
<td>CARDI S-89</td>
<td>935</td>
</tr>
<tr>
<td>Soybean</td>
<td>Commercial</td>
<td>CB 1088</td>
<td>5,682</td>
</tr>
<tr>
<td>Soybean</td>
<td>Commercial</td>
<td>CARDI S-15</td>
<td>24,227</td>
</tr>
<tr>
<td>Corn (white)</td>
<td>Commercial</td>
<td>ICTA B-1</td>
<td>4,318</td>
</tr>
<tr>
<td>Corn (yellow)</td>
<td>Commercial</td>
<td>CARDI Y-001</td>
<td>3,636</td>
</tr>
<tr>
<td>Corn (yellow)</td>
<td>Commercial</td>
<td>CARDI Y-001</td>
<td>3,909</td>
</tr>
<tr>
<td>Corn (yellow)</td>
<td>Commercial</td>
<td>CARDI Y-001</td>
<td>27,273</td>
</tr>
<tr>
<td>Corn (yellow)</td>
<td>Commercial</td>
<td>CARDI Y-001</td>
<td>318</td>
</tr>
<tr>
<td>Cowpea</td>
<td>Stock</td>
<td>1</td>
<td>216</td>
</tr>
<tr>
<td>Small red beans</td>
<td>Stock</td>
<td>2</td>
<td>66</td>
</tr>
<tr>
<td>Black beans</td>
<td>Stock</td>
<td>2</td>
<td>222</td>
</tr>
<tr>
<td>Mung beans</td>
<td>Stock</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>Urid beans</td>
<td>Stock</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Peanut</td>
<td>Nucleus</td>
<td>27</td>
<td>30</td>
</tr>
<tr>
<td>Peanut</td>
<td>Stock</td>
<td>4</td>
<td>227</td>
</tr>
</tbody>
</table>
In Antigua and Barbuda, the ICTA 7728 corn variety was established to produce planting material for the local farming community. The corn is mainly roasted and is sold by roadside vendors. During 2011, 98 kg of seed was sold to local farmers, 57 kg to the Central Marketing Corporation and 9 kg to the Agricultural Development Corporation. The amount of seed supplied to the local market contributed to the establishment of approximately 10 ha of corn.

Supply of corn and bean seeds to Haiti

CARDI has produced and shipped 31,500 kg of open pollinated yellow corn seed; 6,000 kg of red kidney bean seed and 4,000 kg of black bean to Haiti under CARICOM-CARDI support for the re-vegetation component of the resuscitation of agriculture in Haiti.

Maintenance of vegetative germplasm

The unavailability of planting material for the sustainable production of root crops (sweet potato, sweet cassava, tannia and yams) has resulted in shortages for local consumption. This situation has resulted in increased prices for planting material thereby increasing the cost of root crop production and prices of the produce on the local market. The existing root crop planting material at the DTC in St Lucia was completely destroyed in November 2010 by Tropical Storm Tomas and had to be re-established. Funds were provided for this activity under the CARICOM/Japan Project Post-Disaster Restoration.

A one hectare plot of root crop planting material was re-established at the CARDI Field Station in St Lucia to be used as a source of planting material for distribution to farmers. This comprised of 0.15 hectare sub-plots of sweet potato (Mandela and Tomorrow cvs.), sweet cassava (M Col 22 and Y-Me cvs.), tannia (Red cv.) and yams (D. alata, D. rotundata and D. cayenensis. The amount of rootcrop planting material distributed to farmers is shown in Table 4. No yam planting material was distributed.

Table 4 No. of farmers to whom root crop planting material was distributed, St Lucia 2011

<table>
<thead>
<tr>
<th>Planting Material</th>
<th>No. of Farmers</th>
<th>Quantity Distributed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet potato</td>
<td>6</td>
<td>750 kg of slips</td>
</tr>
<tr>
<td>Sweet cassava</td>
<td>11</td>
<td>260 kg of sticks</td>
</tr>
<tr>
<td>Tannia</td>
<td>4</td>
<td>120 kg of plants</td>
</tr>
</tbody>
</table>
SOIL AND WATER MANAGEMENT
Soil Management

Overview

Geologically, the island states of the Caribbean are either volcanic in origin or consist of elevated limestone platforms. Consequently, the derived soils vary from rich fertile volcanic based soils, such as, those found in St Vincent and the Grenadines to the heavy clays of Barbados, Jamaica and Trinidad and Tobago. The mainland countries of Belize, Guyana and Suriname have low-lying coastal plains of heavy clays and sand ridges formed from alluvial deposits, which merge into upland forested areas with soils derived from igneous and metamorphic acid to basic rocks.

The wide range of soil types derived from this array of parent material coupled with variations in climate, vegetation and topography that are found across the Region, gives rise to certain unique ecological zones, such as, the Blue Mountains of Jamaica, the Northern Range of Trinidad and the Intermediate Savannahs of Guyana.

Manipulation of ecosystems to carry out commercial agricultural activities requires a close understanding of all the parameters involved as well as their interactions. Failing to do so can result in many of the soil related challenges that have developed across the Region. Some of these challenges are land degradation, declining soil fertility, soil erosion, low soil water holding capacity, drought and flooding.

The CARDI soil management programme and the related water management programme are geared to address all of the above challenges as they arise. The sub-programmes—soil rejuvenation and soil conservation—address the issues of land degradation, declining soil fertility, soil erosion and low soil water holding capacity.

Soil rejuvenation

The objective of this sub programme is to develop effective management systems for the rejuvenation of degraded soil resources in the Caribbean for sustainable agricultural production. This programme is concerned with the efficient management of reclaimed bauxite lands in Jamaica, from the time the mines are closed until the soils are restored to full economic productivity.

Over the years, production practices, including the use of both traditional and vermi-composts made from goat manure, 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. With increased resources, it is intended to show scientifically that these practices are sustainable.

Activities at the SMDTC in Jamaica were continued to demonstrate to the farming community the practices necessary for the viable production of crops on reclaimed bauxite soils. Although activities were affected by poor weather conditions, callaloo, corn red peas, sorrel, string beans and sweet pepper were successfully produced.

Soil conservation

In relation to soil rejuvenation of reclaimed bauxite lands for agricultural production there have been several initiatives over the years. CARDI is articulating an integrated crop/ruminant livestock production system, for the sustainable utilisation of these lands. In this integrated approach crop and livestock by-products from production are utilised so that manure and
crop residues are used in composts that are applied to crops to supply nutrients and improve soil health and fertility.

From the information already generated, the integrated production models envisaged can be analysed economically in desktop exercises and if found to be feasible, tested in pilot farms to determine their viability.

During the year, the process of monitoring the chemical characteristics of the soil under castor bean and Jatropha cropping was started with soil sampling and analysis being completed.
Overview

CARDI is a member of the consortium of CARICOM institutions on water. The Institute’s mandate is to assist Member States of CARICOM in coordinated consultation with national, regional and international partners in the formulation of Integrated Water Resources Management (IWRM) and Water Use Efficiency (WUE). In this regard, CARDI has direct responsibility for water management in relation to agricultural production in the Region. The sub-programme is currently involved in developing soil water enhancement technologies and extending water harvesting to the wider farming community in the Caribbean.

Water Harvesting, Distribution and Use

The objective of this sub-programme is to demonstrate the effectiveness of water harvesting techniques in enhancing water storage for sustainable agricultural production in the Caribbean and to extend water harvesting technology to the wider farming community. The programme finds synergy with the work of the Caribbean Environmental Health Institute (CEHI) and the Global Water Partnership-Caribbean (GWP-C), which seeks to extend this technology for both domestic and agricultural use in the Caribbean.

In this regard, a training workshop was held for stakeholders in St Kitts and Nevis in November 2011, where a dam with a top area of 332.64 m² and an average depth of 2 m has been constructed to collect rain water. This water catchment facility was lined with low density 0.075 mm thick polyethylene. The dam has a capacity of approximately 650 cubic metres. Participants were trained on water use efficiency using the Water Use Efficiency Manual developed by the GWP-C. A water harvesting and storage facility has also been established at the SMDTC in Jamaica to demonstrate the effectiveness of the technology.

Dam filled with water harvested from rainfall in St Kitts
Strategic Axis 2

Development of Strategic Linkages
Partnerships and Collaborative Initiatives

BUILD AND MAINTAIN RELATIONSHIPS
Regional R&D Strategies

Overview

Since 2008, CARDI has emphasised the development and/or maintenance of meaningful and strategic partnership. A major pillar on which CARDI stands is “Working Together”. This requires that work programmes of CARDI and other regional institutions be coordinated. Successful partnerships and co-ordination should complement and add value to the work programmes. No single institution has all the capacity and resources to fully execute projects, but by having partnerships – national, regional and global – this problem is overcome. Another advantage of partnerships is that they help to facilitate resource mobilisation efforts. Donors request details of collaborating institutions and, in some instances, the collaborators take an active part in helping to write proposals for funding. This section details some of CARDI’s collaborative activities.

Agricultural Research and Development Strategies

CARDI hosted a meeting of key persons involved in AR4D in the Region in Port of Spain in April 2011. A Caribbean AR4D Group was formed. CARDI will be using the feedback received from the Group discussions to take a proposal, through the TMAC, to COTED for Regional Coordination of AR4D. This should allow an agreed strategy to be implemented.

Relationships with Key Institutions and Partners

During this period the following were achieved with strategic partners, collaborators and international societies.

• Caribbean Agro Economic Society (CAES)
  CARDI provided five (main author or secondary author) presentations at the 29th West Indian Agricultural Economics Conference, which was held in St Vincent and the Grenadines in July.

• Caribbean Community Climate Change Centre (CCCCC)
  Through CCCCC collaboration, CARDI has updated weather stations across the region with new state of the art Davis Instrument Vantage Pro2™ weather monitoring systems. One station each has been provided to NARI, Guyana; UWI, Trinidad and the CARDI country units of Antigua and Barbuda, Belize, Grenada, Jamaica, St Kitts and Nevis, St Lucia and St Vincent and the Grenadines. CARDI Tobago has also received a new station.

• Caribbean Farmers Network (CaFAN)
  CaFAN continues to look to CARDI to develop relevant technology for the Region’s farmers. An example is the World Bank funded risk training modules mentioned above. CARDI has provided advice to farmers for mitigating risks provided by climate, food safety and pests and diseases. CARDI is collaborating with CaFAN on their efforts to export roots and tubers crops to the EU markets.
Partnerships and Collaborative Initiatives

- **Caribbean Institute of Metrology and Hydrology (CIMH)**
  CARDI continued collaboration with CIMH on the execution of the Caribbean Agro-meteorology Initiative (CAMI) project, which supports the training of agro-meteorologists and CARDI personnel in the climate data management technologies available to provide information to farmers. Four CARDI staff members received training in modelling weather information.

- **Centre for International Cooperation in Agricultural Research for Development (CIRAD)**
  In July at the 47th Annual Meeting of the CFCS in Barbados, CARDI participated in the CIRAD/INRA workshop dedicated to the initiative to create a Caribbean network in the field of agro-ecology and innovation (CAWAI). CAWAI held a meeting in Guadeloupe in March 2012 attended by the OECS Regional Coordinator, Dr G Robin. The Head Strategic Alliances, F B Lauckner was invited as an International Observer to the CAWAI Summer School in Martinique in June 2012.

- **Chinese Academy of Agricultural Scientists (CAAS)**
  In September, two scientists from the Academy presented a seminar on the “Development of Protected Horticultural Technology in China and Greenhouse Design” to stakeholders in Trinidad and Tobago.

- **Consorcio Latinamericano y del Caribe de Apoyo a la Investigacion y Dessarrollo de la Yucca (CLAYUCA)**
  CARDI organised a training course which was delivered by CLAYUCA at their location in Columbia. The course was entitled “Advanced course in modern technologies for cassava production and processing”. Participants were from St Kitts, Trinidad and Tobago, Jamaica, Dominica and Barbados. Participants were exposed to both theoretical (classroom) and practical (tissue culture laboratory, food processing laboratory and field) sessions. The course touched on several areas along the value chain, micro-propagation of planting material, production practices, harvesting, postharvest treatment and value addition.

- **Florida Association for Volunteer Action in the Caribbean and Americas (FAVACA)**
  The two year CARDI/FAVACA programme “Food Security and Competitiveness in the Eastern Caribbean” funded by USA terminated during 2011. The target of 15 volunteers served by FAVACA was met. These volunteers all filled gaps in the CARDI and stakeholders’ work programmes. Because of the success of this programme, FAVACA has obtained funds for a follow up and further gaps will be filled.

  Some of the volunteers received in during the year were:
  Dominica: greenhouse vegetable production (two volunteers), greenhouse technology
  Grenada: shade house production
  St Kitts: horticulture, sweet potato production, record keeping

- **Global Water Partnership–Caribbean (GWP-C)**
  CARDI organised for GWP-C a farmer training course in water management (St Kitts, October). CARDI serves as an executive member of GWP-C.

- **Indian Council for Agricultural Research (ICAR)**
  The Director and Secretary General of the Department of Agricultural Research and Education (DARE), Dr S Ayyappan and Sh Rajiv Mehrisi Secretary of DARE, visited the region in October. Dr Ayyappan gave a presentation in the CARDI public lecture series at the Crowne Plaza Hotel, Port of Spain. During the Caribbean Week of Agriculture (CWA) in Dominica, Drs Chesney and Ayyappan signed an MOU between CARDI and DARE. This will give the Caribbean access to Indian technical experts and also provide training...
opportunities for Caribbean scientists in India. Among the proposed areas of collaboration are germplasm exchange, crop improvement, crop protection, biosecurity and quarantine, policy research, capacity building and farm mechanisation.

**International Biometrics Society (IBS)**
The sixth biennial meeting of the Central America and Caribbean Region of IBS was held in honour of CARDI’s biometrician. The meeting was held at UWI, Mona Jamaica.

**Inter American Institute for Cooperation on Agriculture (IICA)**
The new 3-year Agreement with IICA (signed March 2010) provides support to December 2013 for the joint-actions of the Institutes, which include the following:

- **Herbs, condiments and beverages in Jamaica (lemongrass, mints, sorrel), Trinidad and Tobago (shado beni, lemongrass).** Hot pepper productivity development work in St Lucia, Barbados, Belize, Antigua & Barbuda, St Kitts and Nevis.
- **Protected agriculture in Dominica, St Kitts and Nevis, Montserrat and St Lucia related to the evaluation of appropriate structures, media and cost benefit analysis.**
- **Root crops, primarily sweet potato and cassava development work along the value chain, improved technologies and dissemination of information and integrated pest management in Barbados, St Lucia, Jamaica, Antigua and Barbuda, St Kitts and Nevis and Grenada.**
- **Work on small ruminants was undertaken in Trinidad and Tobago, Barbados, Jamaica, Grenada with focus on improved technologies (feeding systems and herd management), training of stakeholders and value-addition (‘Pilot’ goat diary).**
- **Knowledge sharing, coordination and management; emphasis was placed on the documentation of Farmer Field School experience (Trinidad and Tobago), strengthening relations with Caribbean media houses for reporting on the agriculture sector and improving public perceptions of agriculture.**
- **Cereal and grain legumes: primary focus was the evaluation of introduced open pollinated corn (for food production) in Grenada and rice productivity in Guyana.**

In addition, the IICA Director General Competitive Fund for Technical Cooperation approved two projects in which CARDI is participating.

1. Small ruminants in Jamaica, Barbados and Trinidad and Tobago to examine market demand, improve hygiene and meat fabrication technique
2. **Root and tuber crops (cassava, and sweet potato) spanning seven countries, Trinidad and Tobago, Guyana, Jamaica, Barbados, St Vincent and the Grenadines, St Kitts and Nevis and Dominica.** This project will strengthen the processors’ capacity for quality, product and process enhancement and availability of appropriate raw materials (for processing).

**Natural Resources Institute (NRI)**
With funding from the ACP Science and Technology Programme, The Natural Resources Institute of the University of Greenwich, UK is partnering with CARDI and other institutions from Africa and the Pacific to execute a project entitled “Science and Technology for Enhancing the Contribution of Tropical Root Crops to Development in ACP countries”.

Partnerships and Collaborative Initiatives

• **Scientific Research Council (SRC)**
  During this reporting period, the collaborative interaction between CARDI and SRC has been mainly with respect to germplasm collection and conservation. SRC is one of the institutions providing technical support under the CFC Project, “Increased Production of Roots and Tuber Crops in the Caribbean through the Introduction of Improved Marketing and Production Technologies”.

Germplasm exchanges between SRC and CARDI were two-way with CARDI receiving accessions of cassava, sweet potato and yams, to augment/complete the in vitro collections at Christiana Potato Growers Cooperative Association (CPGCA) tissue culture laboratory as well as plantlets for the in vivo collections being maintained by CARDI. SRC expressed interest in receiving varieties being maintained in vitro by CARDI St Vincent and the CARDI Jamaica Unit facilitated the transfer of nine cassava, four sweet potato and one yam varieties.

CARDI participated in the third Steering Committee Meeting of the CAMI project in Georgetown, Guyana in Jamaica. Among the conclusions were:
  - There is an important inter-linkage of agriculture–weather and climate
  - Weather, climate and agriculture have to be managed to obtain the option benefits
  - There is a lack of homogeneity of needs in agriculture relation to weather and climate
  - The Hydro-Met services need to be developed and enhanced to meet the farmers’ needs.
  - Information on weather needs to be packaged so as to be exciting and interesting to the user

• **Sugar Cane Feeds Centre (SFC)**
  The partnership with this Centre continues to be very fruitful for the execution of CARDI field work. The institute’s hot pepper programme is doing successful work investigating optimum spacing.

• **Technical Centre for Agricultural and Rural Cooperation (CTA)**
  CARDI signed a contract with CTA to promote the Institute’s Outreach Programme. This project was a follow up to the 2010 project, which was designed to enhance CARDI’s capacity to disseminate findings of its work and activities. CARDI and its partners the Inter-American Institute for Cooperation on Agriculture (IICA) and the Association of Caribbean Media Workers (ACM) through the support of CTA, collaborated on a project to improve the capacities of media professionals, to share and/or communicate agricultural and rural development information. This one year project officially ended in December 2011. Specific activities were the training of regional journalists, an Agriculture Round Table between journalists and agriculturalists and the hosting of the first regional media awards during the Caribbean Week of Agriculture in Dominica.

CARDI and CTA in August 2011 signed a contract aimed at promoting adaptive agricultural water management policies and technical measures to treat with the declining water resources associated with climate variability and change. The major activities were:
  - Workshop on Climate Change Adaptation in Caribbean Agriculture—Enhancing Water Management
  - The development of three policy briefs on:
    - Soil water management for sustainable agricultural production in a drier climate
    - Enhanced water resources management in the Caribbean
    - Climate Change and water availability in the Caribbean

The information products produced by CARDI with CTA support are described in the Advocacy section below. Also described in that section are the journal subscriptions, provided with CTA funding, which serve to update staff.
Partnerships and Collaborative Initiatives

- **The Global Crop Diversity Trust (GCDT)**
  The project in which CARDI is assisting CAPGERNET was due to end on 31 March 2012. However, an extension has been achieved. The regeneration and characterisation of the four collections were partially completed, viz: beans in Cuba, cassava in Guyana, cush-cush yam in Guadeloupe and sweet potato in Trinidad and Tobago.

- **USDA/APHIS.**
  CARDI continues to host the Trinidad and Tobago office of USDA/APHIS and has also assisted in providing secretarial support.

**EU/ACP All Agricultural Commodities Programme**

After running for 4 years, this programme ended in December 2011. CARDI was designated the Caribbean Focal Point for the final two years along with similar Focal Points for the regions in Africa and the Pacific. This followed a mid-term review criticism of the lack of integration in the regions (including the Caribbean).

During 2011, CARDI achieved the following:

- Developed Risk Management On-line Farmer Training Modules on contract to the World Bank (WB) as part of its work in the AAACP. The modules were rolled out by CARDI and CaFAN at a training workshop in St Lucia. They are available worldwide on-line on a World Bank website. Efforts are being made to place it on the CARDI website.
- Hosted the FAO/CARDI Regional Workshop on Market Oriented Agricultural Extension in Port of Spain, Trinidad from 1 to 4 February. The proceedings (41 pages) were published by CARDI.
- Hosted the CARICOM/UNCTAD/CARDI Workshop on the Establishment of a Regional Agricultural Market Intelligence System and Development of a Sustainability Claims Portal for the Caribbean on 17 February, Port of Spain.
- Produced five commodity profiles for the United Nations Council for Trade and Development (UNCTAD). Under their commitment for the AAACP, UNCTAD was responsible for global profiles of many commodities. The five produced by CARDI were spices (hot pepper and nutmeg), pineapple, corn, tomato and coconut. These were selected because of their relevance to agriculture in the Caribbean and/or their focus within CARDI’s work programme.

- Hosted the AAACP Caribbean Dissemination Workshop in Barbados in September, 2011.
- Participated in the AAACP Pacific Dissemination Workshop in Nadi, Fiji in October, 2011.

**CARDI Membership**

1. After experiencing problems in obtaining the go-ahead from the UK Government, the Cayman Islands appears to be more confident of joining CARDI during 2012. The Annual Membership Fee has been agreed and a work programme is being developed.
2. Discussions with Guyana continued as to its reengagement in CARDI.
3. Discussions also continued with the Minister of Agriculture of The Bahamas related to that country becoming a member of CARDI. These discussions were held up pending a ruling for the legal department of CARICOM Secretariat as to the ability of The Bahamas to negotiate its contribution to CARDI and on what basis. The ruling was in the affirmative.
4. Although Haiti is not a member, CARDI has an active programme of work in that country in the CFC/EU funded projects, which end in December, 2013 and the CARICOM/Australia project which ends in March 2012. CARDI uses IICA as its base in Haiti.
PROMOTION OF CARDI
Branding CARDI as the Preferred Agricultural R&D Institution in CARICOM

Promoting CARDI

CARDI continued to promote its activities by participating in exhibitions in all of its Member States. These included major events, such as World Food Day (Trinidad and Tobago), Agro Fest 2011 (Barbados), National Agricultural and Trade Show (Belize). CARDI Open days were held to share with stakeholders the Institute's achievements and current activities in generating and transferring appropriate technology for improving the production and marketing of commodities within the essential food groups.

ROC Ambassador, David Wu, Mr Anil Sinha, partially hidden, Mr Garbino Canto and the Honourable Rene Montero, Minister of Agriculture and Fisheries of Belize, at CARDI field day.

Participants who attended a workshop on the cassava industry held in Dominica.

US Ambassador Vinai Thummapally addresses farmers in the RedSicta Project, Belize.

CARDI's booth at the CARDI Open Day, Nevis.

World Food Day, Grenada.
Advocacy

Demonstration of fertigation system in Belize.

World Food Day, St Lucia.
Participants and facilitators at the World Bank sponsored workshop on Agricultural Risk Management at Rodney Bay, St Lucia.

Francesco Gibbi, CFC representative (left) discusses his impressions of the display of goat leather craft with (left to right), Dr H. A. D. Chesney, Executive Director, CARDI, FAO observer and Dr Janet Lawrence and Dionne Clarke-Harris of CARDI.

Dr Honourable Timothy Harris, Minister of Agriculture, St Kitts and Nevis, addresses a training workshop.

CARDI’s work was showcased at Jamaica Agricultural Society 15th Agricultural Show.

Presenters from CAAS, Professors Weijie Jiang and Yang Qichang at a lecture on Protected Agriculture flanked by, (from left) Mr Luther St Ville (CDB), Dr Arlington Chesney (Executive Director), Dr Francis Asiedu (Technical Services Manager) and Dr Janet Lawrence (Programme Leader Protected Agriculture) from CARDI.
Advocacy

Selected Publications

CARDI Annual Report 2011
Strategic Axis 3

Institutional Strengthening
**Overview**

The Institute, through its Resource Mobilisation, Monitoring and Evaluation Unit, maintained focus on:
- ‘Jump starting’ of approved externally funded projects
- Internally conceptualising/developing of pipeline project proposals to be submitted for donor/collaborator funding considerations
- Implementing efficient/effective systems for the Institute’s programmes

The above items are discussed below within the relevant portfolio of institutional programmes under which they fall.

**Proposal development and management**

Discussions with traditional and new funding agencies as well as collaborator institutions continued in the formulation and subsequent implementation of projects. These discussions involved projects with the CARICOM/Japan Fund, CCCCC, CDB, CTA, the EU, 10th EDF, FAO, IICA and the World Bank sponsored Pilot Programme for Climate Resilience (PPCR). Additionally, indirect funding overtures have been initiated through commodity and thematic based networks/groups such as CAFaN, JAS and the TTABA.

The Institute continued to attract external resources for the implementation of programmes within its medium-term plan. Within the period, January 2008 to December 2011, approved external funding approximated EC$44.9 million. Major donor/collaborator sources were the CARICOM/Japan Fund, CFC, CTA the EU and the IICA-CARDI Fund. Commodity and thematic programmes that attracted the principal share of funding were, Crops (mostly roots and tubers-97.6%), Livestock (totally small ruminants), Emerging Issues (mostly protected agriculture-97.6%) and Climate Change & Agriculture Development (mostly varietal adaptation-94.1%). Additionally, income was generated from ‘commercial’ initiatives and sale proceeds from field station activities.

A summarised portfolio of externally funded activities is presented in Table 5. The estimated total value of grant funds pursued as at December 2011 amounted to EC$51.2 million of which approximately EC$44.9 million have been approved, while the balance (EC$6.3 million) is under approval/consideration by donors/collaborators.

The following proposals were prepared and submitted for funding consideration:
- Climate Change for agricultural development
Table 5: Funding mobilised/being mobilised from donors/collaborators ($EC,000)

<table>
<thead>
<tr>
<th>Source of Project Funds: Donors / Collaborators</th>
<th>Approved/In Progress</th>
<th>Awaiting Approval</th>
<th>Total Portfolio Value (Cumulative/as at December 2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALPART</td>
<td>124</td>
<td></td>
<td>124</td>
</tr>
<tr>
<td>CAPERGNET</td>
<td>108</td>
<td></td>
<td>108</td>
</tr>
<tr>
<td>CARICOM/Haiti</td>
<td>216</td>
<td></td>
<td>216</td>
</tr>
<tr>
<td>CARICOM/Japan</td>
<td>778</td>
<td>839</td>
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<td>CDB</td>
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<td></td>
<td>1,172</td>
</tr>
<tr>
<td>CFC/EU</td>
<td>19,491</td>
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<td>19,491</td>
</tr>
<tr>
<td>CTA</td>
<td>3,370</td>
<td></td>
<td>3,982</td>
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<tr>
<td>EU/10th EDF</td>
<td>1,762</td>
<td></td>
<td>1,762</td>
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<tr>
<td>FAO</td>
<td>675</td>
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</tr>
<tr>
<td>IFDC</td>
<td>27</td>
<td></td>
<td>27</td>
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<tr>
<td>IICA / CARDI</td>
<td>2,160</td>
<td></td>
<td>2,700</td>
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<tr>
<td>International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)</td>
<td>807</td>
<td>807</td>
<td>807</td>
</tr>
<tr>
<td>Intra-ACP</td>
<td>10,452</td>
<td></td>
<td>10,452</td>
</tr>
<tr>
<td>International Society for Tropical Root Crops (ISTRC)</td>
<td>509</td>
<td></td>
<td>509</td>
</tr>
<tr>
<td>MOA (St. Kitts &amp; Nevis)</td>
<td>20</td>
<td></td>
<td>20</td>
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<tr>
<td>MOA (St. Lucia)</td>
<td>40</td>
<td></td>
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<tr>
<td>SPC</td>
<td>370</td>
<td></td>
<td>370</td>
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<tr>
<td>World Bank (PPCR)</td>
<td></td>
<td>3,240</td>
<td>3,240</td>
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<tr>
<td>Sub Total</td>
<td>41,274</td>
<td>6,309</td>
<td>47,583</td>
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<tr>
<td>Technical Assistance/Consultancy Services</td>
<td>3,620</td>
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<td>3,620</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>44,894</strong></td>
<td><strong>6,309</strong></td>
<td><strong>51,203</strong></td>
</tr>
</tbody>
</table>
Income Generation

- ‘Plant Genetic Resources for Food and Agriculture,’ submitted to the International Treaty for Plant Genetic Resources.
- ‘Applicable production systems to aid in adaptation and mitigation efforts against the stresses of Climate Change,’ submitted to the CARICOM Japan Fund.
- ‘Facilitating trade of selected agricultural commodities through the production and dissemination of improved germplasm in CARICOM countries,’ submitted to the CDB.

- Invasive species management
  - ‘Regional control and management of Black Sigatoka,’ submitted to the FAO.

CARDI was actively involved (along with IICA and CARICOM Secretariat) in the development of a proposal under the INTRA-ACP Agricultural Programme of the 10th EDF Programme. The Caribbean regional programme is valued at Euro10.0 million and is to be spread across 15 CARIFORUM member countries.

The following Concept Notes were prepared:
- Training
  - Scientific Writing Workshop (Phase 2), submitted to the CTA
- Climate change for agricultural development
  - Sustainable production and post-harvest systems within a dynamic environment, submitted to the World Bank sponsored Pilot Programme for Climate Resilience

Implementation

Action implemented by the Project Implementation Unit within existing relationships are exemplified below:
- A CFC approved funded regional small ruminant development project (EC$4.0 million) was launched in Jamaica
- Memoranda of Understanding were signed for 3 new projects funded by the CARICOM-Japan programme. These projects were in the areas of sweet potato production and processing, cassava production and post-disaster mitigation
- CARDI implemented a CARIOM/Haiti support initiative which involved the supply of approximately 25,000 kg corn seed and 10,000 kg beans to Haiti

Monitoring and evaluation

The Institute continued to promote the use of the Gantt Project Management Programme (GPMP) as an effective and inexpensive project management tool and steps were initiated to accelerate monitoring and evaluation (M&E) activities.

The following initial activities are highlighted:
- Assignment of an M&E project officer to the RMM&E Unit
- Introduction of ‘Red Flag’ project monitoring system and subsequent monitoring of selected projects
- Preparation of draft Terms of Reference for the conduct of internal audits
Technical assistance

CARDI continued to service requests by regional stakeholders and agencies in the provision of technical support in a diverse range of activities, including demonstration/training, workshop coordination, proposal development and international tenders.

The Institute conducted/initiated the following:

- Completion of FAO Study entitled Provision of a baseline study on existing sustainable practices, models and technologies used by farmers in Barbados and six OECS countries
- Technical assistance to the Petroleum Company of Jamaica (PCJ) in the execution of a project entitled Evaluating the productivity of bio-fuel based crops (in particular, alternative castor and Jatropha varieties) on mined out bauxite lands
- UNCTAD sponsored workshop on the Establishment of a Regional Agricultural Market Intelligence System
- FAO sponsored workshop: Market Oriented Agricultural Extension Services
- AAACP sponsored Dissemination Workshop
- GWP-C sponsored workshop: Water Efficiencies in the Agricultural Sector
Human Resource Capacity
Training, leadership and succession planning

The Institutional Capacity Building Unit continued in its role to support the Institute as management continued to recognise its obligation to meet and treat with staff associations and unions towards meeting the challenge of improving staff remuneration. CARDI’s changing environment has seen a significant shift to managing and implementing externally funded projects as opposed to core funded activities. As such, special efforts are made to ensure that projects are completed according to the requirements of the Donors. The expertise available to the Institute has increased by the employment of consultants (long and short term) to execute its programmes.

Training

Capacity building is important to the needs of the Institute and in 2011 training was targeted for all levels of staff. Twenty-five persons were trained in various disciplines related to their growth and development as well as to building technical competencies within the Institute. A detailed list with the type of training/workshops and seminars that were provided to staff is present in Table 6.

Development of an Review of Policies and Procedures

The revised Human Resource Manual has been presented to staff for comments. However feedback is awaited. The Institute will present to have the revised Manual to the Board of Director for approval and subsequent adoption.

Implementation of the performance management system

The new Performance Management System has been implemented and is being used as the official tool for assessing staff performance in a very objective manner. The tool is tied to CARDI’s Annual Programme of Work.

Refurbishing of CARDI Offices

CARDI continues to work to ensure that its office buildings particularly in Belize, Jamaica, St. Lucia and Trinidad and Tobago provide a comfortable work environment for its staff. This is part of a phased programme to continuously refurbish its buildings. Simultaneously when it is financially feasible replacement of office
### Table 6: Staff benefitting from training events in 2011

<table>
<thead>
<tr>
<th>Training/Seminar/Workshop</th>
<th>Month</th>
<th>Number of staff benefiting</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARDI/CTA/IICA/ACM Training Workshop on Agricultural Journalism in the Caribbean.</td>
<td>April</td>
<td>Two</td>
</tr>
<tr>
<td>International Society for Tropical Root Crops (ISTRC) Project Management Committee (PMC) Meeting and Training Workshop</td>
<td>April</td>
<td></td>
</tr>
<tr>
<td>CFC Project Review; Planning and Co-ordinating Meeting.</td>
<td>July</td>
<td>Thirty-two (including consultants).</td>
</tr>
<tr>
<td>ISTR/CARDI/NRI - Caribbean Regional Training for Young Scientist.</td>
<td>July</td>
<td>Nine</td>
</tr>
<tr>
<td>CARDI/CDB/Graduate School of Chinese Academy of Agricultural Science – Lecture Development of Protected Horticultural Technology in China and Design and Environment Control of Greenhouses.</td>
<td>September</td>
<td>All staff from HQ and T&amp;T Unit</td>
</tr>
<tr>
<td>Caribbean Dissemination Workshop for the European Union, African Caribbean Pacific All Agricultural Commodities Programme (AAACP).</td>
<td>September</td>
<td>Two</td>
</tr>
<tr>
<td>CaFAN/FAO Workshop Meeting of the Caribbean Invasive Species Working Group (CISWG) 14th October 2011, Dominica.</td>
<td>October</td>
<td>Ten</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>All staff at HQ and T&amp;T Unit</td>
</tr>
<tr>
<td>Public Lecture Series – Agricultural Research and Development to fight Poverty and Hunger.</td>
<td>December</td>
<td>Six</td>
</tr>
<tr>
<td>CARDI/CTA/ECLAC - Web 2.0 Learning Opportunity</td>
<td>December</td>
<td>All CARDI Staff at HQ and T&amp;T Unit</td>
</tr>
<tr>
<td>CARDI/World Bank/CaFAN Roll Out of Training Materials for Farmers Risk Mitigation.</td>
<td></td>
<td>Ten</td>
</tr>
<tr>
<td>T&amp;T Unit – Open Day CARDI S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFC Small Ruminant Launch – Diversification of the Caribbean Livestock Sector through the production of Small Ruminant.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
equipment has begun.

**Preparation for Retirement**
While there have been no formal conduct of seminars on retirement, staff have continued to be directed to instruments for retirement investments for their future.

**Recruitment and Selection**
The Institute has employed on a temporary basis in the capacity as Consultants, persons to complete the programme of work in the areas for which they have resigned and/or retired.

**Resignations and Retirement**
During the year, six persons resigned and were replaced by personnel engaged as Consultants from throughout the Institute. Post retirement contracts were issued to retirees in those areas of critical skills to the Institute and the Region’s agricultural sector.
FINANCIAL RESOURCES

Overview
Economic conditions in the Caribbean in 2011 showed signs of improvement over 2010 with a number of countries showing signs of marginal to moderate growth. However, there we some marginal declines in Antigua and Barbuda, St Kitts and Nevis, St Vincent and the Grenadines and in Trinidad and Tobago with the largest decline of 1.4%.

Moderate increases in tourism, agriculture, mining and manufacturing activities accounted for the general improved regional performance with the outlook of growth of between 1% and 2.5% in 2012. Agriculture across the region had mixed fortunes. While some member countries were held back by bad weather and crop disease, others were able to capitalise on higher food crop prices on the international market.

Output of bananas, along with root crops and citrus in Dominica and cocoa and nutmeg in Grenada, staged a moderate recovery. However St Lucia and St Vincent and the Grenadines suffered setbacks to their recovery, due to recurring leaf-spot disease and severe flooding.

Core and External Resource Management
As described in the overview, the challenges of Member States continued to impact on contributions to CARDI. Seventy-three percent (73%) of total contributions were received. However, it is noteworthy that a significant majority of Member States paid their contributions.

CARDI received EC$5.6M or 85% of the EC$6.6M the Institute had actually budgeted to receive in Members’ Contributions. This situation meant an even closer monitoring of expenditure and working capital management. These Core challenges were reduced by external funding as detailed in Table 7. This allowed the project activities to be successfully implemented.

Some highlights of CARDI’s financial results are presented hereunder based on the Audited Financial Statements for 2011 (See table 7).

Table 7 Summary of the Income Statement of 2011 compared with year 2010

<table>
<thead>
<tr>
<th></th>
<th>Amount in EC$’000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2011</td>
</tr>
<tr>
<td>Total Revenues</td>
<td>15,951</td>
</tr>
<tr>
<td>Core</td>
<td>8,429</td>
</tr>
<tr>
<td>External</td>
<td>7,522</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>Total Expenditure</td>
<td>15,072</td>
</tr>
<tr>
<td>Core</td>
<td>8,027</td>
</tr>
<tr>
<td>External</td>
<td>7,045</td>
</tr>
<tr>
<td>Net Surplus/(Deficit)</td>
<td>879</td>
</tr>
<tr>
<td>Core</td>
<td>402</td>
</tr>
<tr>
<td>External</td>
<td>477</td>
</tr>
</tbody>
</table>
The surplus on the externally funded co-operative programmes reflects work started in 2011 to be completed in 2012. Funding not yet allocated to projects at year end is shown as Deferred Revenue in the Balance Sheet (Table 8) and would be taken to Revenue in 2012 when allocated.

Revenue from Externally funded programmes increased from EC$3.19M in 2010 to EC$7.52M in 2011. CFC (EC$ 4.65M), CTA (EC$ 0.69M), EU AAACP (EC$0.35M), IICA (EC$0.28Mn) and World Bank (EC$0.28M) were the major contributors, accounting for 83% of total external funding.

As highlighted in Table 8, the Balance Sheet shows CARDI’s Net Assets as at December 2011 being valued at EC$2.48M. This was comprised of Non Current Assets of EC$8.97M and Net Total Liabilities of EC$6.49M.

**Table 8 Summary Balance Sheet as at 31st December 2011**

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASSETS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non Current Assets</td>
<td>2,613</td>
<td>2,091</td>
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<tr>
<td>Current Assets</td>
<td>6,355</td>
<td>6,258</td>
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<tr>
<td>Total Assets</td>
<td>8,968</td>
<td>8,349</td>
</tr>
<tr>
<td><strong>LIABILITIES &amp; FUND</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non Current Liabilities</td>
<td>1,004</td>
<td>454</td>
</tr>
<tr>
<td>Current Liabilities</td>
<td>5,486</td>
<td>6,264</td>
</tr>
<tr>
<td>Total Liabilities</td>
<td>6,490</td>
<td>6,718</td>
</tr>
<tr>
<td>Accumulated Fund</td>
<td>2,478</td>
<td>1,631</td>
</tr>
<tr>
<td>Total Liabilities &amp; Fund</td>
<td>8,968</td>
<td>8,349</td>
</tr>
</tbody>
</table>

The need for and value of agricultural research and its relationship to the reduction of global poverty and hunger has been well ventilated. CARDI as the only regional research and development institute has demonstrated research for development results while making a positive net investment in Member States. CARDI would continue to encourage Member States in arrears to meet their obligations while seeking new ways to increase Core financing.
LIST OF PUBLICATIONS


Hall-Hanson R, Lawrence J L and Jones D A. 2011. Evaluating the effects of the sweet potato leaf beetle *Typophorus nigritus viridicyaneus* (Coleoptera: Chrysomelidae) on marketable yields of sweet potato produced in Jamaica. CARDI Review 12:9-15


Robin G and Browne B. 2011. Evaluating the effects of different agro-ecological zones, time of planting and accessions, on sweet potato yields in Antigua and Barbuda. CARDI Review 11:21-30


Titus P. 2011. Research and development efforts in agro-processing of sweetpotato by the Caribbean Agricultural Research and Development Institute. Sweetpotato Research Front. No.25, January:8

# DIRECTORATE

## Board of Governors

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Country</th>
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<tbody>
<tr>
<td>Honourable Timothy Harris</td>
<td>Chairman, St Kitts/Nevis</td>
<td>St Kitts/Nevis</td>
</tr>
<tr>
<td>Honourable Hilson Baptiste</td>
<td>Antigua &amp; Barbuda</td>
<td>Antigua &amp; Barbuda</td>
</tr>
<tr>
<td>Honourable David Estwick</td>
<td>Barbados</td>
<td>Barbados</td>
</tr>
<tr>
<td>Honourable Rene Montero</td>
<td>Belize</td>
<td>Belize</td>
</tr>
<tr>
<td>Honourable Matthew Walters</td>
<td>Dominica</td>
<td>Dominica</td>
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<tr>
<td>Honourable Michael Dennis Lett</td>
<td>Grenada</td>
<td>Grenada</td>
</tr>
<tr>
<td>Honourable Robert Persaud</td>
<td>Guyana</td>
<td>Guyana</td>
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<tr>
<td>Honourable J.C. Hutchinson</td>
<td>Jamaica</td>
<td>Jamaica</td>
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<tr>
<td>Honourable Easton Farrel</td>
<td>Montserrat</td>
<td>Montserrat</td>
</tr>
<tr>
<td>Honourable Ezechiel Joseph</td>
<td>St Lucia (until November 2011)</td>
<td>St Lucia</td>
</tr>
<tr>
<td>Honourable Moses Jn Baptiste</td>
<td>St Lucia (w.e.f December 2011)</td>
<td>St Lucia</td>
</tr>
<tr>
<td>Honourable Montgomery Daniel</td>
<td>St Vincent and the Grenadines</td>
<td>St Vincent</td>
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<tr>
<td>Honourable Vasant Bharath</td>
<td>Trinidad and Tobago</td>
<td>Trinidad and Tobago</td>
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## Board of Directors

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Dr Richard Harrison</td>
<td>Chairman</td>
</tr>
<tr>
<td>Mr Sharon Peters</td>
<td>Antigua &amp; Barbuda</td>
</tr>
<tr>
<td>Mr Barton Clarke</td>
<td>Barbados</td>
</tr>
<tr>
<td>Mr Gabino Canto</td>
<td>Belize</td>
</tr>
<tr>
<td>Mr Samuel Carrette</td>
<td>Dominica</td>
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<tr>
<td>Mr Aaron Francois</td>
<td>Grenada</td>
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<tr>
<td>Mr George Jervis</td>
<td>Guyana</td>
</tr>
<tr>
<td>Mr Donovan Stanberry</td>
<td>Jamaica</td>
</tr>
<tr>
<td>Ms Camille Thomas-Gerald</td>
<td>Montserrat</td>
</tr>
<tr>
<td>Dr Hermia Morton-Anthony</td>
<td>St Kitts</td>
</tr>
<tr>
<td>Mr Hubert Emmanuel</td>
<td>St Lucia</td>
</tr>
<tr>
<td>Mr Nathanial Williams</td>
<td>St Vincent &amp; the Grenadines</td>
</tr>
<tr>
<td>Ms Edwina Leacock</td>
<td>Trinidad and Tobago</td>
</tr>
<tr>
<td>Ms Desiree Field-Ridley</td>
<td>CARICOM Secretariat</td>
</tr>
<tr>
<td>Mr Lawrence Lewis</td>
<td>University of Guyana</td>
</tr>
<tr>
<td>Prof Dyer Narinesingh</td>
<td>The University of the West Indies</td>
</tr>
<tr>
<td>Mr Luther St Ville</td>
<td>Caribbean Development Bank</td>
</tr>
<tr>
<td>Dr H Arlington D Chesney</td>
<td>Executive Director</td>
</tr>
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</table>

## Observers

<table>
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<tr>
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<tbody>
<tr>
<td>Mr Gregg Rawlins</td>
<td>Inter-American Institute for Co-operation on Agriculture</td>
</tr>
<tr>
<td>Ms Florita Kentish</td>
<td>Food and Agriculture Organisation of the United Nations (FAO)</td>
</tr>
<tr>
<td>Mr Michael Hailu</td>
<td>Director, Technical Centre for Cooperation on Agriculture and Rural Development (CTA)</td>
</tr>
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</table>
## Members of Staff

### Antigua and Barbuda

<table>
<thead>
<tr>
<th>Name</th>
<th>Designation</th>
</tr>
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<tbody>
<tr>
<td>Robin, Gregory, PhD</td>
<td>Agronomist/CARDI Country Representative</td>
</tr>
<tr>
<td>Adams, Sylvester</td>
<td>Field Assistant</td>
</tr>
<tr>
<td>Batchelor, Delvin</td>
<td>Technician</td>
</tr>
<tr>
<td>Browne, Bradbury</td>
<td>Technician</td>
</tr>
<tr>
<td>Josiah, Carol</td>
<td>Laboratory Assistant</td>
</tr>
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</table>

### Barbados

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<tbody>
<tr>
<td>Roberts, Cyril, PhD</td>
<td>Biotechnologist Breeder/CARDI Country Representative</td>
</tr>
<tr>
<td>Best, Paul</td>
<td>Field Assistant</td>
</tr>
<tr>
<td>Holder, Julia, BSc</td>
<td>Research Assistant, Quality</td>
</tr>
<tr>
<td>Niles, Marcia</td>
<td>Administrative Assistant</td>
</tr>
<tr>
<td>Waithe, Jennifer</td>
<td>Laboratory Assistant</td>
</tr>
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</table>

### Belize

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Sinha, Anil, MSc</td>
<td>Agronomist/CARDI Representative</td>
</tr>
<tr>
<td>Garcia, Angel</td>
<td>General Farm Worker</td>
</tr>
<tr>
<td>Lindo, Martin</td>
<td>Technician</td>
</tr>
<tr>
<td>Reynolds, Tenesha</td>
<td>Administrative Assistant</td>
</tr>
<tr>
<td>Robateau, Leroy</td>
<td>General Farm Worker</td>
</tr>
<tr>
<td>Tzib, Cornelio</td>
<td>Technician</td>
</tr>
<tr>
<td>Vanegas, Ambrocio</td>
<td>General Farm Worker</td>
</tr>
</tbody>
</table>

### Dominica

<table>
<thead>
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<th>Designation</th>
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</thead>
<tbody>
<tr>
<td>Jones, Sharon, MPhil</td>
<td>Plant Pathologist/CARDI Representative (Ag)</td>
</tr>
<tr>
<td>Augustus, Dionne</td>
<td>Administrative Assistant</td>
</tr>
<tr>
<td>Esprit, Natoya</td>
<td>Field Assistant</td>
</tr>
<tr>
<td>Etienne, Dorian, BSc</td>
<td>Graduate Assistant</td>
</tr>
<tr>
<td>Laurent, Miranda, BSc</td>
<td>National Coordinator</td>
</tr>
<tr>
<td>Smith, Limbert</td>
<td>Field Assistant</td>
</tr>
</tbody>
</table>

### Grenada

<table>
<thead>
<tr>
<th>Name</th>
<th>Designation</th>
</tr>
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<tbody>
<tr>
<td>Andall, Reginald, MSc</td>
<td>Agronomist/CARDI Representative</td>
</tr>
<tr>
<td>Bruno, Janielle</td>
<td>Administrative Assistant</td>
</tr>
<tr>
<td>Raymond, Reuben</td>
<td>Technical Assistant</td>
</tr>
</tbody>
</table>

### Jamaica

<table>
<thead>
<tr>
<th>Name</th>
<th>Designation</th>
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</thead>
<tbody>
<tr>
<td>Clarke-Harris, Dionne, MPhil</td>
<td>Entomologist/CARDI Representative (Ag.)</td>
</tr>
<tr>
<td>Asiedu, Elizabeth</td>
<td>Accounting Assistant</td>
</tr>
<tr>
<td>Barnes, Ralston</td>
<td>Technical Assistant</td>
</tr>
<tr>
<td>Beswick, Paula Kay, MSc</td>
<td>IT Support Specialist</td>
</tr>
</tbody>
</table>
Black, Sean P
National Project Coordinator
Davis, Winsome
Accounts Clerk (Mandeville)
Fearon, Albert, MSc
Animal Productionist
Gordon-Sangster, Andrea
Secretary
Hanson-Hall, Rasheeda, BSc
Graduate Assistant
Jackson, Michael
Technician–Germplasm Collection
Johnson, Lloyd, BSc
Graduate Assistant
Jones, Denise
Group Dynamics Specialist
Jones, Desmond
Technical Assistant
Lawrence, Wayne, MBA
Marketing Facilitator
Lighthourn, Gordon, PhD
Tissue Culture Specialist
Matherson-Powell, Sandra
Receptionist
Maxwell, Ervin
Agricultural Labourer
Minott, Annika, PhD
Cluster Facilitator
Morris, Caroline
Office Assistant
Morris, Eileen Marjorie
PA Technician
Morris, Erna
Administrative Officer
Rowe, Jervis, ASc
CFC Specialist-Greenhouse Technology
Simpson, Leslie, PhD
Soil and Water Management Specialist
Smith, Rohan
Group Dynamics Specialist
Temple, Renae, BSc
Administrative and Data Support

Montserrat
Titus, Pathleen, MPhil
Agronomist/CARDI Country Representative
Murraine, Robert
Technician

St. Kitts/Nevis
Titus, Pathleen, MPhil
Agronomist/CARDI Country Representative
Browne, Roderic
Technician
Knight, Laurence
Technician
Nisbett, Sherry
Administrative Assistant

St. Lucia
Pilgrim, Ronald, MSc
Post Harvest Technologist/CARDI Country Representative
Frederick, Sylvester
Field Station Supervisor
O’Brien, Sharon
Administrative Assistant
Thomas, Jacob
Field Assistant

St. Vincent and the Grenadines
Robin, Gregory, PhD
Agronomist/CARDI Country Representative
Haynes, Tasheka
Laboratory/Field Assistant
Harper, Ruthvin, MSc
Integrated Crop Management (ICM) Technician
Joseph, Rose Marie
Technician
Mc Donald, Rohan, MSc  National Coordinator
Smart, Kraig  Administrative Assistant

Trinidad and Tobago Unit
Lawrence, Janet, PhD  Entomologist/Head Trinidad and Tobago Unit (Ag)
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Bedasie, Simon, BSc  Agronomist TT Unit
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Dyer, Ronald, PhD  Group Dynamics Specialist TT Unit
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Kennedy, Helen, MSc  HCCP Training
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Mohammed, Aziz, MSc  Marketing Facilitator
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Quashie, Selby  Technician
Ramtahal, Reyamatie  Technician
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Head Quarters

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Basdeo, Krishna  Messenger/Driver
Gibson, Norman, MPhil  Scientific Officer
Maharaj, Debra  Executive Assistant

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Georges, Bradley MBA  Regional Project Coordinator
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Publications and Printing Unit
Hamilton, Elizabeth  Supervisor, Desktop Publishing
Roach, Keith  Senior Production Assistant
Resource Mobilization, Monitoring and Evaluation Unit

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Alvarez, Tristan, BSc  Graduate Assistant

Strategic Alliances Unit

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Jones, Edison Marcus  Statistical Assistant

Secretariat

Auguste, Mirriam, BSc  Administrative Assistant
Daly-Vire, Cyndi-Anne  Administrative Secretary
Edmund, Marcia  Administrative Secretary
Ferguson, Angela  Administrative Assistant
Hudson, Rachel  Clerk
Stephen, Melissa  Receptionist/Telephone Operator

Technical Services Unit

Asiedu, Francis, PhD  Technical Services Manager
Brathwaite, Latchier  IT Coordinator
Iton, Ardon, PhD  Head, Marketing
Morris, Opal, BA  Librarian
Petersen, Joan, BSc  Scientist 1

Corporate Services Unit

Vacant

Finance Unit

Nero, Curtis, ACCA  Head, Finance Unit
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Dookie-Hamil, Rajdaye  Junior Accounting Assistant
Hart, Abegail  Junior Accounting Assistant
Kalloo, Leslie-Anne  Senior Accounting Assistant

Institutional Capacity Building Unit

Malcolm, Margo, MSc  Head, Institutional Capacity Building Unit
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The 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.

The Mission:
To contribute to the sustainable development of Caribbean people by the generation, transfer and application of appropriate technologies through agricultural research for development.

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