Strengthening the Food Basket of the Caribbean Region:
CARDI's contribution to the development of the cassava industry over the past three decades
PROFILE OF CARDI

The Caribbean Agricultural Research and Development Institute (CARDI) is the leading Agricultural Research and Development Organisation in the Caribbean. The Institute was established in 1975 to serve the agricultural research for development needs of the Member States of CARICOM. Currently, the Institute operates within the context of three Strategic Axes; Strategic Axis 1 – Development of Sustainable Industries, Strategic Axis 2 – Development of Strategic Linkages and Strategic Axis 3 – Institutional Capacity Building.

Strategic Axis 1 is the principal framework for conducting the Institute’s business and delivering on its mandate. It is concerned with the deployment of Science, Technology and Innovation to contribute to the Region’s food and nutrition security within the context of the optimal utilisation and conservation of our natural resources. However, there is the recognition that CARDI does not have all the resources (human, physical and financial) to deliver effective research and development support to the Region’s agricultural sector. Therefore, Strategic Axis 2 ensures that the Institute works closely with allied Agencies/Institutions in pursuing its mandate. Strategic Axis 2 also offers the platform for the promotion of CARDI as the leading agricultural research and development Institution in CARICOM and its contribution to food and nutrition security and economic well-being of the peoples of the Region. Strategic Axis 3 seeks to ensure that the Institute is equipped with the appropriate resources (human, financial, physical).
Strengthening the Food Basket of the Caribbean Region: CARDI’s contribution to the development of the cassava industry over the past three decades
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PREFACE

Over the past five years, the increasing recognition of cassava as an important staple to support food and nutrition security goals, reduce the increasing food import bill and develop climate resilient production systems, has prompted the need to review the past and present research and development efforts; so that an appropriate strategic framework can be developed for the sustainable development of the industry. Within this context, this booklet seeks to highlight CARDI’s interventions over the past three decades towards the development of the cassava industry. Specifically, the Institute’s research for development actions as it pertains to production, processing and marketing of the commodity are summarized within the context of the value chain. In addition, actions to promote an enabling environment are also outlined.
Traditionally, Cassava, *(Manihot esculenta Crantz)* has been an important staple in the historical and cultural space in both the food basket and livelihoods of many thousand rural households in the Caribbean Region. The crop therefore plays a role in the alleviation of poverty and hunger in several rural communities. Cassava is one of the most important root and tuber crops and is considered the third important source of calories in the tropics, after rice and maize, supplying large quantities of dietary energy (FAO 1998).

The agricultural sector and food trade systems in the Caribbean Region are largely influenced by global factors, as there is a large dependence on imported foods. Over the past 7 years with the rise in prices of imported staples and their reduced availability; there is the concern within the Region of the increasing dependence on imports (and the related expenditure of scarce foreign exchange) and food and nutrition security of countries. In 2010, the CARICOM Region imported more than US$5 billion in cereals and grains; this increase in imports of these commodities (including processed forms) has been attributed to the change in consumer preferences (Carmichael et al 2009). Thus, in spite of the superior nutritional qualities of roots and tubers such as cassava, they are being replaced by processed refined carbohydrates which are cheaper and easier to prepare and use.

Given these trends within the food trade arena and consumer demands, the Governments of the Region have signaled their desire to reduce food imports and several Caribbean countries have established national targets towards attaining...
25% level of food and nutrition security, as it pertains to staples (CARICOM 2010). Thus, to reverse this growing reliance on imports, there is an increasing thrust to increase the production of a range of crops such as cassava, that offer a healthy alternative carbohydrate source.

Profile of Cassava Production, Marketing and Processing Systems in the Region

(i) Profile of production and marketing systems

The cassava industry is supported by several thousand small and medium sized farmers who plant the crop for several reasons including in part, the price, ready market, profitability and ease of planting. Traditionally in the CARICOM Region, cassava is grown by small, resource-poor farmers on marginal lands with less than one hectare of land in production. In many cases the crop is cultivated with minimal inputs, with little attention given to the agronomy and the protection of the crop from pests (arthropods and pathogens). Cultivations are pure stand as well as mixed with other root and vegetable crops (e.g. corn, beans and tannia). Over the past decade however, within some of the larger CARICOM countries, there has been a shift in the profile of the production system, in that larger areas are being cultivated (i.e. more than two hectares); albeit on various parcels of land. There is also the use of high levels of inputs (fertilisers, growth stimulants, pesticides etc) and in some cases there is some mechanisation. Marketing of the crop is predominantly fresh and sold at the farm gate and the municipal market with less than 10% of the harvested product being channelled into processing.

There are several constraints to production and marketing including the unavailability of high quality planting material, poor agronomic practices, poor harvesting techniques, inadequate labour, inadequate infrastructure (especially for irrigation), limited land availability, low prices offered for the fresh product, limited market information and distribution channels, e.g., linkage to processing entities and fragmented/unorganized farmer groups.
Despite these constraints, collectively the CARICOM Region produces on average, 35 million tonnes of cassava per annum (review period 2007-2011) with Guyana and Jamaica producing approximately 85% of the total (Table 1). Productivity within the Region ranges from 6.25 to 18.53 tonnes/ha. When compared to world productivity these levels are similar to countries in Latin America and Asia.

(ii) Profile of processing systems

There are fewer than 100 processors of cassava in the Caribbean. The majority are small scale processors with low input operations. Most operate within a home environment and possess over 10 years of experience processing cassava with limited formal training (Jacque, 2012). Most of the processors acquired cassava processing technology from traditional knowledge. There are medium sized processors however that have developed efficient and innovative processing methods for improved product development.

The most popular cassava products produced in the Region are flour, farine, bread, chips, bammy and fries. Minimally processed frozen products such as cubes, wedges, chunks, slices and logs and “easy-to-use” packages with other commodities such as a soup-pack are also produced (Table 2). The majority of processors indicate that they have a ready market with demand outweighing supply.

Constraints to the development of the processing industry include: appropriate machinery for small scale processing, market support, training and
Historically cassava produced by small resource farmers with limited inputs used, however as the importance of the crop increases, larger acreages are planted with high levels of inputs.
Traditional method of making farine, St Vincent and the Grenadines.

Modern method of making farine, Orange Hill Factory, St Vincent and the Grenadines.
technical support, cost of labour, quality and cost of raw materials. In addition, limited knowledge of the suitability of local raw materials (i.e. crop varieties) for processing has limited the diversity of value added products available to consumers. In addition, there is very little investment into the promotion of processed root and tuber crops; as such there is limited information on the consumer demands and acceptance of these products. These constraints therefore need to be addressed to expand value added product development for cassava.

CARDI’s Roots and Tubers Programme

CARDI embraces the ‘New Agriculture’, a concept recognised by CARICOM Heads of Government, where industry development: spans the entire value chain, is market oriented, technology driven and acknowledges and supports the importance of linkages with other productive sectors.

CARDI’s programme in roots and tubers is guided by the research and development mandate articulated in the Regional Transformation Programme for Agriculture (RTP) of 1996. The Institute embraces a value chain approach to strategically strengthen the root and tuber crop industries in the Region. Such an approach seeks to determine through stakeholder consultation, the constraints along the various nodes of the value chain and thereafter determine the appropriate technologies, practices and processes required.
for improving production and productivity of the target commodities.

The stated goal of the CARDI’s Root and Tuber Crops programme is “To support the development of a commercially viable and sustainable regional root and tuber crop industry that facilitates the improvement of livelihoods and overall food and nutrition security/sovereignty.”

Strategic Repositioning of Cassava in the Agriculture Sector For Improved Food and Nutrition Security

Key for the strategic repositioning of the cassava industry to meet the food and nutrition security goals established by the Governments is the recognition that success involves innovative change and requires advocacy, capacity building and marketing (Onyango 2011). Within this context, the Institute’s programme has sought to strengthen the root and tuber value chain through:

- determining market signals and strengthening market systems
- improving access to high quality planting material through germplasm introduction, evaluation and conservation; as well as improving the infrastructure of propagation facilities
- enhancing production and productivity through improved agronomic and pest management techniques
- strengthening infrastructure and processes of processing operations as well as value addition
- capacity building of stakeholders along the value chain
CARDI's Interventions

Strengthening marketing systems

For the food and nutrition goals established by the Governments of the Region as pertain to staples to be attained, it will be necessary that the demands and preferences of consumers for fresh and processed forms of local staples, such as cassava are known. In addition, the crop's potential use in new and growing industries will need to be explored. This information will be necessary for establishing production targets and identifying the appropriate value added products (food and non-food) for development.

Within this context, the Institute recently has undertaken initial actions to: (i) assess the market for cassava in the CARICOM Member States, United States, Canada and the United Kingdom, (ii) develop market profiles for fresh and processed cassava and (iii) improve the current access to information by key stakeholders. The latter has been achieved through the development of a database which outlines relevant marketing information for producers and processors.

The Institute will continue to work with key partners such as IICA and FAO to strengthen these efforts; in particular to determine potential niche markets for cassava products. For example, cassava flour is growing in demand by householders and there is a growing interest by bakeries to substitute wheat flour with varying levels of cassava. Developing market profiles for products that can be marketed for individuals with coeliac disease could be very important.

Germlasm introduction, evaluation and conservation

The use of high quality planting material is essential for improving the Region's productivity and production levels. CARDI for decades has sought to introduce, evaluate and conserve new High Yielding Varieties (HYV) through strategic linkages with local regional and international centres such as the Latin American Consortium for Cassava
Research and Development, CLAYUCA and the International Centre for Tropical Agriculture, CIAT.

(i) Importation of new HYV to improve productivity

The introduction of new cassava accessions into the Region, was initiated in the 1980’s in Barbados; where from the period 1984 – 2000 over 50 accessions were introduced from CIAT. These accessions were evaluated for food and feed and the most promising ones multiplied and distributed to cassava farmers throughout the country.

Significant introductions were also undertaken in 2003 in St Vincent and the Grenadines, where 29 improved cassava varieties (sweet, intermediate and bitter) were imported from CIAT and evaluated at the CARDI field station and then assessed as to their suitability for farine processing. These selected high yielding varieties are being conserved both in-vivo and in-vitro and selected varieties have been and continue to be multiplied in-vitro for distribution to farmers in the Region. This thrust continues and in 2013, seven new sweet varieties were imported by CARDI into Trinidad and Tobago. The importation of new genetic lines is one of the underpinning elements of the root and tubers programme and will therefore be vigorously pursued not just for productivity and appropriateness for processing, but also for resilience to the vagaries of climate change (i.e. drought tolerance, flooding, salinity and pests).

(ii) Germplasm conservation of popular varieties for fresh and value added markets

Developing the cassava industry requires a diversity of varieties to support the fresh and processed markets. The Institute is conserving over 150 varieties of cassava both in-vitro and in-vivo (gene banks). In relation to in-vivo collections, varieties/accessions are being maintained in several CARDI Units including Dominica, Grenada, Jamaica, St Kitts and Nevis, St Vincent and the Grenadines and Trinidad and Tobago. Many of the varieties/accessions have been characterised not only for their morphological traits but also with respect to physio-chemical properties and product suitability. These conservation plots also provide farmers with seed material for nursery establishment.
Over the past 30 years, CARDI has imported over 80 accessions of cassava and evaluations have been conducted to determine yield potential and suitability for processing into popular products.
Under the Caribbean Plant Genetic Resources Network (CAPGERNET), a Regional Germplasm Network, CARDI is collaborating with the Ministry of Agriculture to regenerate, conserve, multiply, and disseminate landraces of cassava in Guyana. Over 40 landraces have been conserved and have been sent to CIAT for further conservation.

In relation to in-vitro collections, improved varieties are being held in tissue culture laboratories within the Ministry of Agriculture in St Vincent and the Grenadines, University of the West Indies (St Augustine Campus) and the Scientific Research Council (Jamaica).

(iii) Increasing the availability of high quality planting material.

The increased yield resulting from the use of high quality planting material is well documented; as such, towards increasing the production, processing and marketing of cassava within the Region, efforts were made to improve the supply of planting material to producers. The Institute has been instrumental in the strengthening the
Cassava accessions/varieties that are conserved are being characterized for their physical and chemical properties.

Many of the cassava accessions/varieties being conserved in field collections (in-vivo) are also being conserved in laboratories across the Region (in-vitro).
capacity of the Region in the mass production of cassava varieties through biotechnology (tissue culture) and the establishment of community based propagation sheds.

Strengthening the capacity of the Region to produce tissue culture plantlets for distribution to farmers was achieved though the upgrading of the tissue culture laboratories in the north and south of the Region. The locations of these laboratories are strategic for servicing the Region’s needs. In the north in Jamaica, tissue culture facilities of the Christiana Potato Growers Cooperative Association and its related propagation facilities were upgraded, thereby permitting the Association to distribute over 30,000 plantlets of cassava and maintain popular market varieties in culture.

In the south in St. Vincent and the Grenadines, the tissue culture laboratory was expanded. This laboratory has been able to distribute plantlets to a wide range of countries including Dominica, Montserrat, St Lucia, St Kitts and Nevis and Barbados. In order to ensure that the highest quality of plantlets are being distributed from the St Vincent laboratory, a fully-equipped virus testing laboratory for new in vitro material was refurbished in Barbados in 2011.

Hardening facilities which are important to wean plants received from tissue culture facilities, have been constructed and/or upgraded by the Institute in Dominica, Barbados, Jamaica, St Kitts and Nevis, St Vincent and the Grenadines and Trinidad and Tobago. These facilities are important in the introduction and supply of clean planting material to producers.

Recognising the need to improve the capacities of producers to mass produce clean planting material, within several major producing communities in Dominica, St Vincent and the Grenadines, Barbados, St Kitts and Nevis and Trinidad and Tobago; propagation bins (humidity bins) and sheds were constructed to demonstrate mass production techniques to farmers. The technique used is that of “two-node” cuttings. These facilities serve as centres for farmers to also obtain small quantities of material for multiplication.
In order to strengthen the capacity of the Region to conserve and produce high quality planting material, over the past three years, CARDI has upgraded the tissue culture laboratory of the Christiana Potato Growers Cooperative Association, North Central Jamaica as well as the national tissue laboratory Orange Hill, St Vincent and the Grenadines.
Toward the development of quality assurance systems for the plantlets being produced in tissue culture laboratories in the Region, a virus testing laboratory was established at the CARDI Barbados Unit.
Across the Region, CARDI has established propagation facilities for mass producing planting material for the farmers as well as to train farmers in propagation techniques.
and a source for obtaining new varieties.
It is important that technical support personnel improve their capability and capacity to sustain these interventions. Over the years several trainings in tissue culture techniques and mass production of the clean planting material have been conducted for technicians as well as producers within communities. The upgraded laboratories have also been used to facilitate the training of local tissue culture technicians and University undergraduates.

**Improved production and productivity for increased competitiveness**

A critical component for improving the competitiveness of the cassava industry is reducing the cost of production through increased productivity. As such, CARDI’s work has sought to evaluate, demonstrate and validate technologies and practices to producers that improve productivity. Areas of focus over the past 20 years have been the demonstration of Good Agricultural Practices (GAP) and evaluations of new HYV.

To demonstrate the impact of GAP on productivity of local traditional cassava varieties, demonstration plots were established in major producing areas in Jamaica and Trinidad and Tobago. The practices demonstrated included the use of clean planting material, fertilisation and Integrated Pest Management (IPM) to reduce pest incidence. The GAP plots yielded significantly higher yields when compared to current yields being recorded in the farming communities. In south-east Jamaica (Parish of St Thomas) the demonstration plot established yielded 46,394 kg/ha, which is approximately four times that of the current yields obtained within the farming community i.e. 11,208 kg/ha. Similarly in demonstration plots established in South Trinidad and South Tobago, the GAP plot yielded one and a half to twice that of the farmer practice plot; GAP plot yields obtained ranged from 21,000 - 46,000 kg/ha; this is twice that of the national yields of ~ 16,000 Kg – 18,000 kg/ha. Several hundred farmers from major producing communities visited these plots to view the practices being promoted.
Towards the introduction of HYV to farming communities, trials were conducted with HYV from CIAT in St Vincent and the Grenadines in 2004-2011. The new varieties showed yields three times higher than that of local traditional varieties. Such trials will be conducted in various countries within the Region to scale up the introduction of these new HYV.

The work at the Institute has not only focussed on improving production of cassava for human consumption but also included evaluations to determine the potential of the crop as an alternative to imported grains in livestock feed and feeding systems. A trial conducted by the Barbados Unit, in which two experimental rations with different levels of cassava meal were evaluated against a typical all corn commercial broiler ration, indicated that with a substitution level of 25% and 40% in the broiler starter and finisher diets respectively, cassava fed birds performed equally as well as those fed on the commercial corn. In the case of pigs, 100% of the corn in the pig diet was replaced with cassava. The control group was fed the commercial diet and no significant differences were observed between the groups. These data are very promising for developing low-cost feeding systems for livestock.

Moving forward, the Institute will seek to increase the number of available technologies and practices that can assist farmers to improve their competitiveness and livelihoods from this commodity; some specific areas for investigation over the next 3 years include: (i) evaluation of new varieties that are bred with high beta-carotene levels as well as those that are resilient to the vagaries of climate variability and change, (ii) determination of the role of bio-stimulants to increase productivity, (iii) development of IPM strategies for major pests.

<table>
<thead>
<tr>
<th>Cassava Varieties</th>
<th>Cyanide content (mg/kg)</th>
<th>Detection Limit (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>0.06</td>
<td>0.05</td>
</tr>
<tr>
<td>CM 4843-1</td>
<td>1.31</td>
<td>0.05</td>
</tr>
<tr>
<td>CM 4910-1</td>
<td>0.34</td>
<td>0.05</td>
</tr>
<tr>
<td>CM 7514-7</td>
<td>1.38</td>
<td>0.05</td>
</tr>
<tr>
<td>CM 7514-8(1)</td>
<td>0.44</td>
<td>0.05</td>
</tr>
<tr>
<td>CM 7514-8(2)</td>
<td>0.72</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Farmers from the St Thomas Women’s Initiative proudly celebrate their harvest from plots in which Good Agricultural Practices were used on traditional varieties. The yields from the GAP plots were four times the current yields obtained in the farming community.

Field trials have been conducted to determine the yield of High Yielding Varieties (HYV) introduced from CIAT. The yields obtained have been more than two times that of traditional varieties.
Improving value addition

As consumers are encouraged to transition from imported grains and cereals to more traditional staples such as cassava, there will be a growing demand not only for fresh but also various forms of processed product, that is, minimally processed “ready to eat” and “easy to prepare” forms to fully processed forms such as flour, farine, snacks and pudding/pone mixes. Over the past ten years, the Institute has supported the increasing thrust towards value addition through the conduct of studies to determine product suitability and to ensure consumer safety by evaluating cyanide content in selected products. In addition, the infrastructure of various small and medium sized processing operations was strengthened to improve their efficiency and profitability.

(i) Value added product development

An important aspect of product development with cassava is determining the cassava variety most suited for processing into the key products being demanded by the consumer. The Institute, in collaboration with the Inter-American Institute for the Cooperation on Agriculture (IICA), determined the physico-chemical properties of 12 popular varieties from Dominica, St Kitts and Nevis and Trinidad and Tobago so as to identify their suitability for product development. The value added products identified as being most suitable for these varieties included: flour, fries, chips/crisps and juice/punch. In relation to flour, products identified were bread, cakes, thickeners and extruded snacks.

Farine yields were also determined from local and improved varieties. In St Vincent and the Grenadines, 29 newly introduced high yielding varieties were evaluated for their suitability for processing into farine by a local processor and at the Government’s cassava processing facility. Apart from the superior fresh product yields when compared to the local varieties, these introduced improved accessions, gave higher meal and farine yields. The farine yield ranged between 40% - 52% as compared to 25% for the local cultivars (Table 4). A similar assessment was conducted
for six local varieties in Tobago; traditional farine yield was much lower than the new high yielding varieties; farine yield averaged 35% of the fresh weight.

Cyanide testing to ensure consumer safety. Consumers are increasingly concerned about the cyanide levels in value added products made from cassava. Over the past 10 years, CARDI has assessed the presence of this compound in popular cassava products; namely bread and farine. Cassava bread, a popular carbohydrate in the diets of Montserratians was tested for cyanide levels; the levels recorded were well below international safety limits. Similarly, cyanide levels were determined in farine, a popular cereal in many CARICOM member states; results demonstrate that the levels (0.34 – 1.72 mg/kg) were again below the 10 mg/kg which is considered FAO/WHO CODEX maximum permissible level. It is imperative that tests such as these are conducted on a routine basis to ensure consumer safety (Table 5).

| Table 4: Potential of new high yielding cassava cultivars for farine “cereal” production |
|-----------------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| New High Yielding Varieties                   | Cassava weight (kg) | Meal weight (kg) | % Meal weight to cassava weight | Farine weight (kg) | % Farine to meal weight |
| RRA 383                                       | 16.8              | 7.3              | 43.5                          | 3.6               | 49.3               |
| SM 1411-5                                     | 10.0              | 3.6              | 38.0                          | 2.4               | 39.0               |
| CM 537-37                                     | 20.0              | 7.3              | 36.5                          | 2.6               | 35.0               |
| CM 619-5                                     | 21.0              | 9                | 42.9                          | 3.0               | 33.3               |
| SM 1471                                      | 4.1               | 2.3              | 56.1                          | 1.0               | 43.5               |
| SM1555-15                                    | 18.6              | 7.3              | 39.3                          | 3.0               | 41.1               |
| CM 4174-7                                    | 2.7               | 2                | 13.3                          | 0.45              | 25.0               |
| CM 532-7                                     | 13.2              | 2.3              | 22.3                          | 2.2               | 30.1               |
| CM 8327-3                                    | 14.5              | 1.5              | 58.8                          | 5.2               | 47.2               |
| SM 1450-1                                    | 3.2               | 1.8              | 25.3                          | 0.82              | 45.5               |
| CM 6138-14                                   | 6.0               | 3.6              | 30.0                          | 1.1               | 30.5               |
| TAU 8                                        | 6.0               | 3.6              | 50.0                          | 1.0               | 27.3               |

| Table 5: Assessment of cyanide content of farine made from local and introduced varieties |
|-----------------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Cassava varieties | Sample value total cyanide (mg/kg) | Detection* Limit (mg/kg) |
| Local            | 0.66              | 0.05              |
| CM 4843-1        | 1.31              | 0.05              |
| CM 4939-1        | 0.34              | 0.05              |
| CM 7516-7        | 1.36              | 0.05              |
| CM 7514-8(1)     | 0.44              | 0.05              |
| CM 7514-8(2)     | 0.72              | 0.05              |

FAO/WHO CODEX maximum permissible levels (mg/kg) – 10 mg/kg
Improving the efficiency of small and medium sized cassava enterprises

Towards the strengthening of the processing industry, the Institute sought to assist small to medium sized operators in Dominica, Jamaica, St Vincent and the Grenadines, and Trinidad and Tobago to attain improved efficiency of operations through the provision of food safe equipment and processing utensils and by establishing processes that ensure food safety standards. These interventions have yielded significant impacts/outputs towards improving these operations. Some of the achievements have included:

Equipment and upgrading of infrastructure

- A 300% increase in the demand for fresh cassava by processor “Twickenham Bammy Industries” in Jamaica due to assistance in acquiring oven equipment and HACCP training of personnel.
- Increased efficiency of processing operations through the introduction of washer peelers into two processing operations in Trinidad & Tobago; specifically the peeling of cassava for the production of value-added products.
- An increase in the demand for cassava due to higher volumes of farine produced by five processing facilities owned by small village processors in St Vincent and the Grenadines that were upgraded by the Institute.
- Improved infrastructure through the reconstruction in Dominica of two community cassava bread processing facilities operated by 55 resource-poor processors. The processors were formed into organized groups.

Food safety management systems

- Increased awareness and adoption of food safety management systems through gap analyses and training of personnel from small and medium sized enterprises in Dominica, Jamaica and Trinidad and
Through funding by the CFC, CARDI was able to provide Twickenham Industries, a small scale value added operation in Jamaica, with purpose-built oven racks and a mill. The number of value added products made by the Twickenham Industries operation has increased three-fold. The pieces of equipment are being used to dry and grind cassava for flour, cereals, and pancake mixes.
A washer peeler was purchased for the Trinidad and Tobago Agri-business Association to improve the efficiency of the processing operation to make minimally processed products.

The infrastructure of several small cassava processing facilities were upgraded; including a farine making operation at Tranto/Dispax, Dominica.
Tobago. These interventions have assisted in sensitising the operators to interventions needed for compliance to international standards.

**Improved value added product development**

- Improved capacity by a community women’s bakery in South Haiti to produce breads and cakes using mixtures of wheat: cassava flour in an effort to substitute for wheat. Evaluations of palatability and nutritional quality of the final products indicated commercial acceptance.

**Capacity building**

- Across the Region, over the past 3 years over 300 persons have been sensitised or trained in food safety management systems.

These interventions to improve the capacity of the processing operations will continue over the next 3 years to assess their potential for various products.

**Empowering farmers, processors, extension and key stakeholders through technology transfer of improved technologies and practices**

Improving the knowledge and skills of producers in order to promote the awareness and application of modern, innovative and appropriate techniques within the cassava industry for improved production and reduced post harvest losses, CARDI has been committed to empowering producers through the hosting of seminars, workshops, field days and the establishment of demonstration plots on farmers’ holdings. In some cases a modified farmer field school approach (principle based) has been utilised to empower the producers. These sessions have highlighted the use of GAPs, post harvest technologies, processing, food safety management and marketing. Several hundred persons have been trained over the years.
To support these training sessions, more than ten technology products on cassava production including factsheets, bulletins, posters have been developed and distributed through various traditional and e-platforms to the stakeholders in the agricultural sector (www.cardi.org).

**Strengthening technical support available to producers**

Improving the competence of the technical support personnel along the value chain is pivotal for the sustainable development of the industry. CARDI has therefore worked to build the capacity of technicians, extension officers and other agricultural professionals. The Institute over the past three years the Institute has funded short term training experiences for professionals working on cassava production systems from the Ministries of Agriculture at national centres; Scientific Research Council, Jamaica (8); Orange Hill Tissue Culture Laboratory, St Vincent and the Grenadines (3) and International centers (Latin American Consortium for Cassava Research and Development, CLAYUCA (8). These trainings have focused largely on mass propagation and hardening techniques, germplasm conservation and production system technologies.

**Strengthening farmer groups for improved agribusiness cluster development**

Recognising the importance of strong farmer groups for sustainable industry development has led the Institute to contract the services of group dynamics professionals to strengthen four cassava farmer groups in major producing areas in Dominica, Jamaica, and Trinidad and Tobago. These interventions have led to the formalisation of the farmers’ groups as well as the development of strategic plans and actions plans. These farmer groups are now building strategic linkages with value chain actors; a critical aspect of developing viable agribusiness clusters. The information generated from these interventions is being used as case studies to build the capacity of other non-cassava groups and other agricultural professionals working with farmer groups.
Farmers in South Trinidad being trained in innovative and appropriate techniques to improve yields. Training consists of lectures and field demonstrations.
Workers of small and medium sized operations have been trained in Food Safety Management System; over 300 persons have been trained over the past 3 years.
Advancing the cassava industry through creation of strategic linkages and advocacy

**Strategic alliances**
Selecting the correct strategic partners to collaborate is key for the promotion and advancement of cassava industry. As such, the Institute has established important strategic alliances with national, regional and international organisations involved in various aspects of marketing, production, processing, technology generation and capacity building.

Strategic alliances with National and Regional entities:
- Barbados Agricultural Development and Marketing Corporation (BADMC), Barbados
- Scientific Research Council (SRC), Jamaica
- The University of the West Indies (UWI) St. Augustine Campus, Trinidad and Tobago
- Trinidad and Tobago Agribusiness Association (TTABA), Trinidad and Tobago
- Tobago House of Assembly, Division of Agriculture, Marine Affairs, Marketing and the Environment, Trinidad and Tobago
- Ministries of Agriculture

International Agencies
- Latin American Consortium for Cassava Research and Development (CLAYUCA)
- International Center for Tropical Agriculture (CIAT)

**Industry development**
CARDI professionals have been playing an integral role developing strategic frameworks for the cassava industry in several countries. These professionals have assisted in the formation of national committees that seek to coordinate and implement activities that promote the production, processing, marketing and utilisation of the cassava. These committees have also assisted
in the development of strategic plans for various agri-business clusters.

With the recognition that the sustained development of the cassava industry requires the promotion of cassava in the food and non-food sectors, the Institute has partnered with key stakeholders to promote the utilisation of cassava at national exhibitions, field days and open days. Most recently, CARDI Jamaica joined forces with the University of Technology and other key industry stakeholders to host the first ever, local Cassava Day. The event sought to:

- increase networking and build relationships along the cassava value chain.
- increase stakeholder awareness (access to information) of trends, constraints and opportunities in cassava industry.
- increase consumer awareness, acceptance and utilisation for various cassava products.
- increase consumer awareness of the nutritional value of cassava products
- Promote a locally prepared recipe book which encourages cassava utilisation and is available to the public.

Towards the further development of the cassava industry, CARDI (Jamaica) is providing support to two large conglomerates, Red Stripe Jamaica and Jamaica Producers Group (JPG) on a project which explores the financial feasibility of using local cassava as input for brewing beer. The Institute has been asked to provide clean planting material of three HYV for the planting of 250 acres of cassava. These commercial sized plots will allow the companies to assess the feasibility of producing the crop for beer-making. Red Stripe aims to replace 30% of imported inputs with cheaper, locally grown cassava. Both companies see the utilisation of cassava based inputs as being a positive move to reduce imports and improve livelihoods.

**Impact and insight of interventions**

The future increase in the demand for energy and the volatility in prices of imported grains and cereals
Farmer groups have been strengthened across the Region and sensitized to the development of agri-business clusters.
CARDI facilitated the training of technical professionals from Barbados, Jamaica, St Kitts and Nevis Trinidad and Tobago at the International cassava center, CLAYUCA. The professionals have now been able to integrate the new knowledge and skills into their work programmes.
are major challenges for agriculture and food security. CARDI, as the only Agricultural Research for Development (AR4D) Institute in the CARICOM Region, has therefore given increasing importance to the repositioning of the cassava industry. The interventions through technology demonstration, infrastructure strengthening and capacity building have assisted in laying the foundation for the development of a viable cassava industry; improved the livelihoods of several hundred farm families in rural communities and assisted with the reduction of poverty and hunger. As we move forward, it is essential that the successes that have been achieved by the Institute are scaled-up within and outside of target countries.

For the potential of cassava to be realised in the food and manufacturing sectors, further attention needs to be given to: (i) intensification of current production systems; (ii) value added product development, with due care to meeting international standards; (iii) market intelligence and penetration into non-traditional channels, (iv) strengthening the infrastructure and technical services (e.g. extension) required to support the industry, (v) improved communication amongst key stakeholders, with emphasis on the full engagement of the private sector and (vi) developing the appropriate policy framework for creating an enabling environment. Such interventions need to be undertaken within the context of a Regional strategic plan for the development of the cassava industry; engagement of stakeholders is therefore necessary to craft a road map for the way forward. CARDI will continue to forge alliances with key national, hemispheric and international partners to assist the Region to address these issues; and by so doing facilitate employment, improved incomes and rural development.
With the recognition that the sustained development of the cassava industry requires the promotion of cassava in the food and non-food sectors, CARDI Jamaica joined forces with the University of Technology and other key industry stakeholders to host the first ever, local Cassava Day which sought in part to increase consumer awareness, acceptance and utilisation for various cassava products.
References and Other Source Materials

- CARDI 1984 – 2012. Annual Reports from all country Units.