Production, productivity, quality standards and product mixes of Roots and Tubers Crops in the CFC-funded project

PROJECT REPORT

By

Sharon Jones, Greg Robin, Jerome Garry, Lloyd Johnson and Alexander Benn

9 September 2013
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[This report is an output of the Common Fund for Commodities (CFC) /European Commission (EU)-financed project: “Increased Production of Root and Tuber (RT) Crops in the Caribbean through the Introduction of Improved Marketing and Production Technologies” being implemented by CARDI in Barbados, Dominica, Haiti, Jamaica, St. Vincent & the Grenadines and, Trinidad & Tobago].

Developed from:
Data on project yields, quality standards and product mixes (incl. baseline studies, survey reports)
Part I – Dominica (by Sharon Jones)
Part II – St. Vincent & the Grenadines (by Greg Robin)
Part III – Haiti (by Jerome Garry)
Part IV – Jamaica (by Lloyd Johnson)
Part V – Trinidad & Tobago (by Alexander Benn)

Introduction
Root and tuber crops are a main staple crop and are seen as a means of ensuring food security within the Caribbean region. The challenges experienced in the cultivation of these crops include low productivity, poor quality planting material and poor development of the industry value chain.

Throughout the Region, the true genetic potential of these crops is rarely manifested in the level of yields recorded. Inappropriate agronomic practices, that not only limit yield but also have deleterious environmental consequences, are the norm. Perishability of the crops is enhanced by less than optimal post-harvest handling, which is often linked to poor field practices. Although there have been attempts to develop acceptable value chains, activities of the various stakeholders are often disjointed. Within the region, the need to establish appropriate linkages among members of the value chains and the development of appropriate technical understandings is critical. Groups have to be identified and given the core developmental training in order to conduct good practices both in agricultural production and management. The CFC-funded project on Roots and Tubers aims to support and strengthen groups so that they can identify the benefits of working together and to be registered as legitimate groups in order to reap benefits from supporting Institutions. Core training alone in technical aptitude is not enough; there is a need to have reputable group structures and clustered interactions among the different stakeholders for effective development of the industry.
Cassava, yam and sweet potato are all considered ground provisions and tend to be primarily grown by small, often resource-poor, subsistence farmers. The crops are all vegetatively-propagated and a major issue has always been sourcing quality planting material. Over time, farmers have used vegetative pieces or slips from the previous crop for replanting leading to a buildup of pests and diseases that have contributed to poor productivity of farming systems.

**Production**
Total production of yam, cassava and sweet potato in the project countries of Dominica, Haiti, Jamaica, St Vincent and the Grenadines and Trinidad and Tobago (2007-2011) is shown in Figure 1. Haiti is by far the largest producer of all three crops.

**Figure 1.** Total production (tonnes) of cassava, sweet potato and yam in Haiti, Jamaica, St Vincent and the Grenadines and Trinidad and Tobago (2007-2011)  
(Source: FAO STAT, 2012)

**Productivity**
The productivity of sweet potato, cassava and yam in Dominica, Haiti, Jamaica, St Vincent and the Grenadines and Trinidad and Tobago (2007-2010) is shown in Figures 2, 3 and 4, respectively. It can be seen that Jamaica has the highest productivity of the three crops while Haiti the lowest except for sweet potato where Haiti’s productivity was marginally better than that of St. Vincent and the Grenadines. It should be noted that in 2010, the world average yield for sweet potato was 13.2 tonnes/ha (Ref: wikipedia.org).
**Figure 2.** Productivity (kg/ha) of sweet potato in the project countries (Source: FAO STAT, 2012)

**Figure 3.** Productivity (kg/ha) of cassava for the project countries (Adapted from FAO STAT, 2012)
Figure 4. Productivity (kg/ha) for yam in the project countries 2007-2010 (Adapted from FAO STAT, 2012)

Part I – Dominica

The product mix for sweet potato, yam and cassava in Dominica is shown in Figure 5.

Figure 5. Product mix in Dominica for Sweet Potato, Yam and Cassava (Source: FAO STAT, 2012)

Almost 80% of root crop production in Dominica is accounted for by yam. The main reason for this is due to the fact that yam is in great demand from the nearby French islands of Martinique and Guadalupe thereby accounting for a significant amount of the inter-island yam trade for Dominica.
Cassava farmers are concentrated along the east coast of the island and the crop is grown mainly for processing into farine and cassava bread by the indigenous Carib population. The value chain shows that the crop leaves the farm and is either processed into farine or flour for making bread or is taken by hucksters to the local markets.

The sweet potato crop is grown across the island but is concentrated in the Central and Eastern parts.

The yam crop is also grown across the island with concentrations along the North, Central and Eastern areas. The main varieties are White, Yellow, Lady’s and Antoine. The value chains for both sweet potato and yam indicate that the fresh produce is transported by hucksters to local and export markets.

**Outputs from GAPs/ICM field demonstration plots**

Twelve yam, three sweet potato and two cassava demonstration plots were established around the island in farmers’ fields and used for GAPs and ICM training of Farmers’ Groups in collaboration with the Ministry of Agriculture and Forestry (MoAF), the Dominica Export/Import Agency (DEXIA) and, the Bureau of Standards. Additionally, one satellite yam plot and one satellite sweet potato plot were established. The demonstration plots utilised the best production practices (previously validated by CARDI) that would optimise farmers’ marketable yields.

A survey was conducted prior to the establishment of the demonstration plots to have an understanding of the farmers’ technical and socio-economical situations and to identify gaps for project interventions.

In the establishment of all demonstration plots, pre-emergent weedicide was applied in efforts to reduce the cost of production. Post-demonstration impact assessment of cassava, sweet potato and yam farmers indicated that the farmers preferred to use a pre-emergent weedicide as demonstrated in the project (Figure 6) as it reduced the cost of weed control which is generally performed manually and thus costly.

The project also introduced the use of crates instead of plastic bags for transporting produce from the fields as there is less postharvest damage; this innovation was readily accepted by farmers.

Local cassava varieties Cent Livre, Bois Blanc, Sept Fey and Bois Bleu yielded an average of 8,012 lb/ac under farmers’ conditions while in the demonstration plots with improved technologies (GAPs and ICM) the yield was 21,120 lb/ac (that is, a 163% increase).

The availability of quality planting material was identified as a constraint to yam production in Dominica. Local varieties of yam include D’leau, Batard, Marron, Piquants noir, Bonda, Babaoulay, Antoine and Lady’s. Yields in farmers’ fields under their traditional technology averaged 7,500 lb/ac while in the demonstration plots with improved technologies (GAPs and ICM) the yield was 11,120 lb/ac (that is, 48 % increase).
Yam minisett (Figure 7)
The use of minisett yams for planting material was demonstrated to farmers as a technique to produce uniform marketable yams thus increasing marketable yields. It also demonstrated that farmers can produce more planting material from the equivalent limited supply of yams and thus establish a bigger acreage of land. It also confirmed that the technique produced a more homogeneous yam vine growth and uniform maturity of tubers.

Propagation bins at the Hillsborough Agriculture Station were improved with mist irrigation under the project in preparation for preparing yam planting material for the establishment of the yam demonstration plots. A total of 8,800 minisetts were prepared from locally-obtained yams and distributed to farmers involved in the project.

One young farmer, after the project workshop on yam minisetting, adopted the minisett technique of producing quality yam planting material and started a business producing yam minisetts for sale to other farmers; she produced 2,000 minisetts, with sales grossing US$740.
**Figure 7.** Demonstration of yam minisett preparation and propagation.

**Alternative trellising (Figure 8)**

- The alternative yam trellising method using wire and rope verses individual wooden stakes was demonstrated to farmers. In some of the yam producing areas, wood stakes were becoming difficult to find and farmers had to go deep into the forest in order to obtain stakes for yam production. With alternative trellising, the amount of individual stakes was reduced by 60% for the equivalent area of yam established. The rope and wire used in the alternative method of trellising can be reused, thus reducing costs and deforestation. Also, using this method of trellising requires the farmer to grow the crop in ridges rather than in individual mounds.

- Using a combination of ridges and wire trellising allowed for better and more efficient management of the crop particularly fertility management and weed control, thus saving time and labour. Farmers who established yam demonstration plots under the project have expanded their yam production using this management technique. In the demonstration plots where the trellises were introduced, yam yields were increased by up to 30%. Also, tuber quality in terms of uniformity in shape, size and weight was improved; tubers were straight, weighing an average of 3-5 pounds with an average length of 14 inches. This uniformity in size and shape of the tubers improved marketable yield and received greater acceptance by exporters.
Outputs of plant propagation activities
A hardening facility of 7,300 sq.ft (Annex I) was constructed at Portsmouth and the project team in Dominica collaborated with the project-constructed tissue culture laboratory in St. Vincent and the Grenadines and the virus-testing laboratory equipped by the project in Barbados to ensure quality planting material distribution to farmers in the Caribbean. Local and introduced elite cassava, sweet potato and yam varieties were being maintained in the propagation facilities.

Part II – St. Vincent & the Grenadines
The product mix for sweet potato, yam and cassava in St. Vincent & the Grenadines is shown in Figure 9 (Source: FAO STAT, 2012).

At the start of project activities, the following actions were taken:

- Convening of a committee, consisting of CARDI Country Representative, Manager of the Arrowroot Industry Association, Food Technologists, Ministry of Agriculture, Forestry and Fisheries and National Coordinator, CFC/EU project, to review collaboration under the project.
- Conduction of a baseline survey on farms to assess bio data, farm profile, germplasm types and propagation methods, production practices, pest and disease management, harvest and post-harvest, processing and, marketing.
The data in Figure 9 indicate that in St. Vincent and the Grenadines, production is almost evenly distributed between yam and sweet potato. Typically, St Vincent and the Grenadines is a source of these two crops for neighbouring islands such as Trinidad and Tobago, Barbados and Guadeloupe.

**Main outputs for sweet potato**
Increases in marketable yields of sweet potato were obtained on demonstration plots using CARDI-recommended (GAPs) technologies that were previously validated in similar locations using the same varieties. GAPs training and new varieties of sweet potato have improved farmers’ yields by 29 to 87% (Tables 1 and 2).

**Table 1.** Marketable yield and cost of production for sweet potato variety CARDI K84-7 in demonstration and farmers’ plots at Akers, St. Vincent.

<table>
<thead>
<tr>
<th></th>
<th>Marketable yield (lb/ac)</th>
<th>Cost of production (US cents/lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demo plot</td>
<td>12,592</td>
<td>15</td>
</tr>
<tr>
<td>Farmer #1</td>
<td>6,720</td>
<td>18</td>
</tr>
<tr>
<td>Farmer #2</td>
<td>9,765</td>
<td>20</td>
</tr>
</tbody>
</table>

The demonstration plot at Akers, St. Vincent, is shown in Figure 10.
Table 2. Varietal demonstration plot yields (lb/ac) of sweet potato (average across 3 locations, i.e., Akers, Chateaubelair and Rabacca) in St. Vincent.

<table>
<thead>
<tr>
<th>VARIETY</th>
<th>Agric.</th>
<th>Black Vine</th>
<th>CARDI Big Red</th>
<th>CARDI K84-7</th>
<th>Dorrel</th>
<th>Hubert Red Devil</th>
<th>Kizzie Red</th>
<th>Lovers Name</th>
<th>Viola</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plot yield</td>
<td>18,596</td>
<td>9,687</td>
<td>13,261</td>
<td>17,353</td>
<td>21,782</td>
<td>14,090</td>
<td>17,327</td>
<td>11,344</td>
<td>20,047</td>
</tr>
<tr>
<td>Market-able yield</td>
<td>17,042</td>
<td>7,356</td>
<td>10,956</td>
<td>15,877</td>
<td>19,451</td>
<td>11,163</td>
<td>15,203</td>
<td>9,195</td>
<td>16,447</td>
</tr>
</tbody>
</table>

Figure 10. Sweet potato demonstration plot at Akers, St. Vincent.

Main activities for cassava
A baseline survey was conducted for cassava similar to that for sweet potato. Plant propagation using hardwood mini-stem cuttings (Figure 11) was demonstrated to farmers. The technology was adopted by the Ministry of Agriculture Walliabou Agricultural Station and 500 plants were distributed to farmers.
Figure 11. Propagation demonstration of cassava hardwood mini-stem cuttings at the Walliabou Agricultural Station, St. Vincent.

Outputs of plant propagation activities

- A tissue culture laboratory (Annex I) was constructed at Orange Hill and equipped with an ELISA virus detection machine. The Government of St. Vincent and the Grenadines provided financing within its annual budget for the future operation of the facility and collaborated with CARDI in sourcing new improved varieties of cassava, sweet potato and yam from international institutions.

- A hardening shed was constructed at Perseverance (Annex I) and an adjoining worker/storage facility (Annex I) was renovated. Local elite cassava, sweet potato and yam varieties were stored in the propagation facilities.

- A virus testing laboratory (Annex I) was fully equipped by the project at CARDI in Barbados and was used to collaborate with the project-constructed tissue culture laboratory in St. Vincent in the screening of germplasm at the Regional level.

- As part of the project’s activities in the Eastern Caribbean, one fully-equipped shadehouse for rapid propagation (Annex I) was built at Graeme Hall in Barbados and produced 56,000 cassava plantlets from 1-node and 2-node cuttings planted in seedling trays; these were distributed to farmers for planting 10 hectares of farmland.

- One Barbadian technician was trained at the Latinamerican Cassava Consortium (CLAYUCA) in Colombia in rapid propagation methods for root crops and assisted in virus screening efforts at the Barbados facilities in collaboration with scientists at the St. Vincent and Dominica facilities.
Part III – Haiti

Roots and tubers are very important crops in Haiti and, according to the National Coordination for Food Security (CNSA), they can make up as much as 52% of the daily calorie consumption. Figure 1 above indicates that among the six project countries, Haiti is by far is the biggest single producer of the three crops (cassava, yam and sweet potato).

The crops are primarily grown by small, often resource-poor farmers. However, It has become noticeable that over the last few decades there has been a major reduction in the quantity and quality of available planting material as pests and diseases have built up in the material that is available. As a result, yields obtained in the country (Figures 2, 3, and 4) are far below the genetic potential of the species and, when combined with inappropriate agronomic practices and poor post-harvest handling, the result is that yields have been declining to almost uneconomical levels.

Product Mix

The product mix for sweet potato, yam and cassava in Haiti is shown in Figure 12.

**Figure 12.** Proportion of sweet potato, yam and cassava produced in Haiti 2007-2010 (Source: FAO STAT, 2012).

The data indicate that approximately half of the production of the three crops targeted by the project in Haiti is occupied by cassava followed by yam and then sweet potato. Data on the utilisation of cassava indicate that a large amount is processed into flat bread and flour by small artisan processors while yam and sweet potato are sold as fresh produce.

Results from demonstration plots in Haiti

Sweet potato

1. Tuberrisation: in Salagnac, Saint-Louis du Sud and, Les Cayes, it has been observed that the improved variety Tisavyen had started tuberising at 6-7 weeks after planting while local varieties such as Gaton Mari had not yet started tuberisation. Also, Tisavyen presented two or three tubers per node while the local varieties generally showed one tuber per node.
2. Yield: in Salagnac, Tisavyen planted between December and January gave higher yields than the local varieties. In Les Cayes, Tisavyen planted between March and April (later in the season) gave lower yields than the local varieties including Gaton Mari and LVT. It appears that Tisavyen is a short-day photoperiodic variety so that the suitable season to plant it is between December and January. Local varieties studied in Les Cayes seemed to be non-photoperiodic, so they can be planted at any time.

3. In demonstration plots in Salagnac using GAPs and ICM practices, the yield of Tisavyen averaged 5,698 lb/ac while the average for yield in farmers’ fields in the area was 4,500 lb/ac. In other demonstration plots in Salagnac, varieties Tisavyen, Gaton Mari and Boule de feu yielded 4,400 kg/ha, 8,800 kg/ha and 9,400 kg/ha, respectively.

Yam

The trellising put in place in Salagnac provided good wind resistance during Tropical Storm Isaac and the system has been adopted by many farmers. Even farmers who did not attend demonstration and training sessions related to trellising for yam production have adopted the system using local materials. Four yellow yam plots were harvested in Salagnac to demonstrate minisett propagation techniques (Figure 13). Yield and financial data (Table 3) indicate a 350% increase in profits using the technological package (including minisett and trellising) demonstrated.

**Table 3:** Traditional production of yellow yam versus production using techniques (GAPs/ICM) proposed by the CFC-funded project in Salagnac, Haiti.

<table>
<thead>
<tr>
<th></th>
<th>Average yield from four demonstration plots (lb/ac)</th>
<th>Production cost (US$) per acre</th>
<th>Profit per ac (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional production (Farmer’s field)</td>
<td>4,530</td>
<td>515</td>
<td>127</td>
</tr>
<tr>
<td>Production under project GAPs</td>
<td>8,890</td>
<td>688</td>
<td>572</td>
</tr>
<tr>
<td>% increase due to project GAPs</td>
<td>96%</td>
<td>34%</td>
<td>350%</td>
</tr>
</tbody>
</table>
In other demonstration plots in Salagnac in 2013, using minisett techniques and GAPs/ICM technologies, local yam varieties Yellow and Guinen yielded 13,500 lb/ac and 11,700 lb/ac, respectively.

**Outputs of plant propagation activities**
- Propagation facilities were completed at Salagnac (Annex I) and similar facilities were planned for Levy.
- The project assisted the University of Haiti in an assessment of its needs in *in vitro* (tissue culture) conservation of national roots and tubers germplasm.
- 35,000 cuttings of sweet potato were distributed to farmers at Les Cayes.
- Eight resistant varieties of taro (*Colocasia esculenta*) received from Vanuatu were adapted to Haitian agro-environmental conditions in collaboration with the Research Centre for Agricultural Development of the Ministry of Agriculture.
- Five Haitian Technicians were trained at the Scientific Research Council (SRC) in Jamaica in micropagation and conservation techniques.

**Conclusion**
- Sweet potato is an important component of food security to Haiti. Results from the project showed the possibility of increasing production in farmers’ fields by using improved planting material and agricultural practices (GAPs/ICM).
• Use of the trellising system for yam has a promising future in Haitian agriculture. It will largely decrease deforestation and will develop another market, that is, one for local trellising materials (rope and wire).

Lessons learned

• Improved planting material needs to be properly validated prior to its introduction to farmers’ fields.
• The project’s timeframe did not allow some necessary extension of the activities and useful repetitions in other farming areas.
• Many farmers were expecting to be compensated financially for their collaboration in the project although they were prime beneficiaries of training, planting material and technical assistance.
• Collection of data is very important in developmental projects such as the present one since the outputs and their documentation serve to disseminate improved technologies to be later used for development of the agricultural sector.

Future work

• There is a need to develop in situ and in vitro germplasm banks for roots and tubers in the country together with proper characterisation and cataloguing of the genetic material. Endangered local sweet potato varieties such as Tisavyen may be lost if farmers in L’Artibonite stop growing them. The same is true for various cultivars of white yam (Dioscorea alata ssp).
• There is a need to study the market related to roots and tuber crops in Haiti. Data on demand, supply and price of structures are lacking. Added to this is the fact that farmers do not know what varieties of sweet potato, cassava or yam they should produce and for which consumer.

Part IV – Jamaica

The product mix for sweet potato, yam and cassava in Jamaica is shown in Figure 13.

Figure 13: Product mix in Jamaica for sweet potato, yam and cassava 2007-2010
(Source: FAO STAT, 2012)
For the crops targeted by the CFC project, yam makes up almost three quarters of roots and tubers production in Jamaica. This can be attributed to the fact that Jamaica is a significant exporter of yam to the USA and UK and, therefore, the production in Jamaica is driven by the commercial demands of these export markets.

Cassava, on the other hand, only makes up 10% of the production. This can be explained by the fact that cassava is not heavily utilised as a fresh crop in Jamaica, but is seen as a side crop that is grown on marginal lands and mainly used for processing. Also, low yields and poor quality have hindered the full exploitation of cassava in Jamaica.

Sweet potato occupies 18% of the production and is mainly consumed in the fresh state with very little processing of sweet potato (fries) taking place in Jamaica.

**Results from demonstration plots in Jamaica (Table 4 and Figure 14)**

The yields in the demonstration plots were 27%, 57%, and 19-41% higher than in farmers’ fields for cassava, yam and sweet potato, respectively. The cost of production for each commodity was also lower than the national costs of production. This indicated greater marginal profits to be obtained from the use of demonstrated improved technologies (GAPs/ICM) than from farmers existing production systems. Costs of production can be reduced further if marketing arrangements are improved and input costs are brought down from existing levels. With increased awareness and compliance of appropriate good agricultural practices, it is expected that farmers will produce more efficiently and so improve their livelihoods.

**Table 4.** Production of root and tuber crops in demonstration plots in Jamaica, 2012.

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Location</th>
<th>Variety</th>
<th>Demonstration plot yield (lb/ac)</th>
<th>Farmers’ yield (lb/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava</td>
<td>Bernard Lodge, St Catherine</td>
<td>MCOLL22</td>
<td>41,424</td>
<td>32,670 (local var. Blue Bud)</td>
</tr>
<tr>
<td>Yam</td>
<td>Tate, Clarendon</td>
<td>Round Leaf</td>
<td>29,700</td>
<td>18,900</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>90 Acres, Clarendon</td>
<td>Ganja Leaf</td>
<td>11,951</td>
<td>8,500</td>
</tr>
<tr>
<td></td>
<td>Coco Walk, Manchester</td>
<td>Uplifter</td>
<td>11,744</td>
<td>9,900</td>
</tr>
</tbody>
</table>
Outputs of plant propagation activities

- The project rehabilitated the tissue culture laboratory (Annex I) of the Christiana Potato Growers Cooperative Association (CPGCA) doubling its floor space to 1,200 sq.ft and installing new shelving.
- The project rehabilitated the hardening shed (Annex I) of the CPGCA at Christiana and constructed four propagation sheds on the Association’s property at Devon; the facilities were being fully utilised by the Association.
- In situ collections of sweet potato, cassava and yam varieties were maintained at CARDI’s Field Station at Mona. Twelve minisett yam plantlets produced under the project were supplied to the Scientific Research Council (SRC) for multiplication; in return, the SRC supplied a cassava variety to the CARDI germplasm bank at Mona.
- The CPGCA tissue culture laboratory began elimination of bacteria from commercial sweet potato cultivars Uplifter, Fire-on-land, Clarendon, Brandol, Dor, Ganja, Big Leaf and Blue Bud. Four new sweet potato cultivars (Black Slip, Yellow Coby, Cock-up, LA44) introduced from the International Potato Centre (CIP) in Peru were multiplied and ten introduced varieties of cassava and two of yam were being conserved in the laboratory.
- In 2013, a large plot was maintained at Bernard Lodge, St. Catherine, to demonstrate GAPs using high yielding cassava varieties MCOL22 and CM516 vs. the Farmers Group’s Blue Bud variety.
- A demonstration plot was established in 2013 with four high-yielding cassava varieties MPER 183, CM 3306, CM 3299 and MCOL22 weaned and hardened from tissue culture acquired from the SRC. Also included in the demonstration plot were ministem-propagated plantlets of varieties MCOL22 and CM516.
- Two hundred yam plantlets were maintained in the germplasm bank at the CARDI DTC and 700 plantlets were distributed to the Tate Farmers Group in Clarendon.
• Three Jamaican technicians were trained at the SRC and one at CLAYUCA, Colombia, in micropagation techniques.

Lessons learned

• The producer is essential at several levels and must, therefore, have the necessary knowledge and skills to perform efficiently.
• Marketing is a major limitation for most producers. They require assistance in market intelligence if they are to improve their net returns.
• Despite several challenges in the cost of production, producers are still operating at a profit in the roots and tubers industry in Jamaica. However, their profit margin can be improved markedly through the use of GAPs/ICM and quality planting material.

Part V - Trinidad and Tobago (by Alexander Benn)

The product mix for sweet potato, yam and cassava in Trinidad & Tobago is shown in Figure 15.

Figure 15. Product mix in Trinidad and Tobago for sweet potato, yam and cassava  
(Source: FAO STAT, 2012)

![Pie chart showing product mix in Trinidad and Tobago](image)

Most of the root crop production (79%) in Trinidad & Tobago is from cassava; the majority of this is for the fresh market. There is some cottage processing into flour and bread. Of note is that yam production is only 1%. This is consistent with the fact that most of the soils and the environmental conditions in Trinidad & Tobago are not suitable for yam production. Sweet potato occupies 20% and is mostly consumed fresh; lately, there has been some processing of sweet potato for fries and mixtures with wheat flour for bread production. Additionally, a lot of the demand for sweet potato in Trinidad & Tobago is met by traders from St Vincent and Grenada.
Prior to the initiation of field activities, baseline surveys were conducted. The results indicated that the main problems encountered by farmers were:

- Low marketable yield and low market demand
- Need to increase plant density
- Need to improve crop nutrition and general management
- Need to develop alternate use for harvested produce, e.g. livestock feed
- High cost of production especially labour, input supplies, harvesting and transport
- Need to develop centralised peeling operations to reduce cost of transport.
- Need to increase use of mechanical harvesting
- Need to increase variety and quality of products from root crops

The Industry was characterized by:

- Small – medium farmers
- Flat to gentle sloping lands
- Farms of <0.02 - 15 hectares
- Minimal inputs were utilised
- Predominance of manual harvesting
- Predominantly rain-fed systems
- Local market (fresh and processed)
- Poor yields
- Inadequate infrastructure
- Limited market information and distribution channels, e.g., linkage to processing entities
- Fragmented/unorganised farmer groups
- Limited product diversity
- Disorganised value chain

**Results from project demonstration plots in Trinidad & Tobago (Tables 5 and 6 and Figure 16)**

Project-sponsored systems using improved planting material, GAPs and ICM have resulted in better productivity. The average yield from sweet potato demonstration plots with four varieties using GAPs/ICM technologies in Cunupia was 22,144 lb/ac while from adjacent farmers’ fields with the local variety Chicken Foot yielded 11,088 lb/ac, an increase of 100%.

In the case of cassava, demonstration plots in Trinidad and in Tobago with six varieties yielded an average of 24,590 lb/ac while in farmers’ fields with the variety Mex the average yield was 17,550 lb/ac, an increase of 40%.
Table 5. Average sweet potato yields in demonstration plots in Cunupia, Central Trinidad.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Yield, lb/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved varieties under GAPs</td>
<td></td>
</tr>
<tr>
<td>Carrot</td>
<td>29,925</td>
</tr>
<tr>
<td>Nina</td>
<td>9,072</td>
</tr>
<tr>
<td>TIS 9191</td>
<td>18,837</td>
</tr>
<tr>
<td>Chicken Foot</td>
<td>30,744</td>
</tr>
<tr>
<td>Farmer’s plot</td>
<td></td>
</tr>
<tr>
<td>Chicken Foot</td>
<td>11,088</td>
</tr>
</tbody>
</table>

Table 6. Average cassava yields in demonstration plots in Trinidad and Tobago

<table>
<thead>
<tr>
<th>Variety</th>
<th>Yield, lb/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved varieties under GAPs</td>
<td></td>
</tr>
<tr>
<td>Butter Stick</td>
<td>19,462</td>
</tr>
<tr>
<td>Yucca</td>
<td>34,706</td>
</tr>
<tr>
<td>CIAT hybrid</td>
<td>21,037</td>
</tr>
<tr>
<td>M. Mex 59</td>
<td>19,463</td>
</tr>
<tr>
<td>Maracas Black Stick</td>
<td>29,250</td>
</tr>
<tr>
<td>Mex</td>
<td>23,625</td>
</tr>
<tr>
<td>Farmer’s plots</td>
<td></td>
</tr>
<tr>
<td>Mex</td>
<td>17,550</td>
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</tbody>
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While the demonstration plots focused on increasing production in the field, the project also targeted group strengthening along the roots and tubers Industry value chains. The project implementation framework in Trinidad & Tobago with focus on strengthening of farmers’ groups for increased production and productivity is shown in Figure 17.
Figure 16. Cassava demonstration plot at Rio Claro, Trinidad

Figure 17. Project implementation framework in Trinidad & Tobago with focus on strengthening of Farmers’ Groups for increased production and productivity.
Outputs of plant propagation activities

- A sweet potato propagation shed (Annex I) was established in Cunupia during 2011/2012 and a cassava hardening facility constructed in Rio Claro in 2013.
- Hardening facilities (Annex I) were constructed at Goldsborough in Tobago.
- A germplasm bank (Annex I) was established in Tobago with 12 sweet potato and 11 cassava varieties; collections of local varieties were catalogued and four local technicians trained in germplasm collection techniques. A new germplasm conservation plot was established in 2013, and the number of cassava varieties increased to 13, with the inclusion of Pickney Muma, a commonly grown variety on the island. Twenty cassava sticks per variety were distributed to the Tobago Cassava Producers Association (TCPA) for propagation and multiplication in their recently-constructed propagation facility.
- Characterisation of 10 sweet potato varieties in the germplasm conservation plot at Cunupia was conducted using descriptors outlined by the International Potato Centre (CIP).
- Cassava variety HYV was multiplied for distribution to farmers from the Rio Claro Cassava Group in collaboration with the University of the West Indies (UWI), the Trinidad & Tobago Agribusiness Association (TTABA) and, the Ministry of Food Production (MFP).
- Plantlets of 15 varieties of sweet potato were ordered from the project-constructed tissue culture laboratory in St. Vincent.
- Three technicians were trained at CLAYUCA, Colombia in propagation and conservation techniques.
- The project facilitated a training attachment of the Manager of the tissue culture laboratory from the Tobago House of Assembly (THA) in the hardening of RT plantlets at the Tissue Culture laboratory constructed under the project in Orange Hill, St Vincent & the Grenadines.
ANNEX I – Plant Propagation Infrastructure constructed/rehabilitated by the project

DOMINICA

Tissue Culture Laboratory, Orange Hill, ST. VINCENT

Shelving inside lab
PERSEVERANCE, ST. VINCENT

HARDENING FACILITIES

WORKERS' CHANGE ROOM FACILITY

Propagation facilities
Graeme Hall, BARBADOS
Rehabilitation/Expansion of Tissue Culture Laboratory of Christiana Potato Growers Cooperative Association

Christiana, JAMAICA

Construction of Propagation Sheds of Christiana Potato Growers Cooperative Association

Christiana, JAMAICA
Cunupia, TRINIDAD & TOBAGO

Cassava Propagation Shed
Rio Claro, TRINIDAD & TOBAGO