Food and Agriculture Organization of the United Nations

CLAYUCA Corporation

IICA

A look at the potential of the crop to promote agricultural development and economic growth

# Cassava in the Caribbean region

ISBN 978-92-5-109348-1 (FAO)

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Published by
the Food and Agriculture Organization of the United Nations
and
Clayuca Corporation
and
Inter American Institute for Cooperation on Agriculture

Bridgetown, 2016

# Cassava in the Caribbean region:
## A look at the potential of the crop to promote agricultural development and economic growth

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# FOREWORD

One of the best strategies for promoting sustainable development of the agricultural sector in a country is to implement approaches that integrate genetic resources, eco-efficient field and crop management, and postharvest value-adding technologies. This integrated systems approach offers many advantages to all the actors of a crop value chain, including policy makers, producers, processors and users. For example, farmers can have facilitated access to improved varieties, with high yielding potential and good adaptation to the specific agro-climatic conditions of the region. Also, using eco-efficient technologies to manage the soil and the crop, farmers can increase their yields using those inputs that are necessary and affordable and that can make a real contribution to increase the competitiveness and enhance and maintain the sustainability of their farming systems.

Furthermore, using improved, value-adding technologies for processing, farmer groups can have increased access to and consumption of food products that will have a direct impact in their nutritional and food security status. In turn, this will provide rural populations with access to additional employment and income generation opportunities.

This document is an attempt to present an overview of the technological options that are currently available to promote increased productivity and competitiveness of the cassava crop. These options could become an excellent strategy for the difficult task faced by the countries in the region that need to reduce poverty, hunger and the increased dependency on imported foods to attend the nutritional needs of their populations.

# WHY THIS DOCUMENT?

Most countries in the Caribbean are currently facing a challenge related to the need of reducing the large and increasing amount of imported food products to meet the rising demands of the population and of the industrial sectors. To meet this challenge, the countries in the region have begun to design and implement policies aimed at promoting local production of crops and food products that are widely consumed, and that can be produced locally. “Let us grow what we eat and let us eat what we grow” is one of the popular titles assigned to such initiatives.

In this context, cassava can play an important role. It ranks high among the major crops produced in the region. It is a source of cheap energy and also has a good content of vitamins and minerals. Cassava can contribute to improve food security and nutrition in rural and urban households. In addition, cassava can be used in many industries including food, textiles, pharmaceuticals, paper and adhesives, animal feeding and as feeedstock for ethanol processing.

However, cassava has historically received little attention and support from governments, donors, and national agricultural research and technology transfer systems. This makes the task of Governments of the Caribbean region even more difficult as they address the urgent need to design and implement coherent agricultural policies and strategies to promote sustainable development of the cassava crop.

Therefore, FAO, CLAYUCA, and IICA considered it strategic to prepare this document as a contribution to the countries of the Caribbean Community (CARICOM) that are in the process of formulating approaches that promote sustainable intensification of cassava production, processing and utilization, as an alternative to the increasing dependency on imported foods.

This document is divided into three parts. The first part summarizes relevant background information on the current status of cassava globally and in the context of the Caribbean region. Part two is a compilation of the information collected via a survey administered with the collaboration of key resource persons in most countries of the region. Data obtained was complemented with updated information collected and compiled with the support of the Statistics Department, FAO Rome; and with data provided by the cassava practicioners (research and extension agents), from 12 countries, who attended an International Training event organized by CLAYUCA, with financial support from the Colombian Government. The third part includes some concrete examples of potential opportunities that could be implemented in the region, using a three-pillar approach that CLAYUCA has been proposing, that includes: a) improved genetic resources; b) eco-efficient crop and soil management technologies; and c) value-added processing and utilization technologies. Some conclusions and recommendatios are also included.

# ACKNOWLEDGEMENTS

This document is the result of the efforts of a group of research scientists, technicians and farmers, from selected countries in the Caribbean region, who participated actively in a survey coordinated and conducted by CLAYUCA Corporation on the current status of the cassava crop in various countries. This also included collaborators from Nicaragua, Paraguay and Ecuador. Their contribution is gratefully acknowledged.

The Presidential Agency for International Cooperation of the Government of Colombia (APC-Colombia) greatly contributed to the preparation of this document by providing financial and logistical support to CLAYUCA to organize a training event on cassava technologies, specifically aimed at participants from the Caribbean countries included in the document. It was an excellent opportunity for direct interaction with a selected group of persons who provided very useful, updated information on the status of the cassava sector in their respective countries

FAO provided technical and financial support to the preparation of this document. Feedback from Dr Heiko Bammann, Trade and Markets Officer and editorial assistance by Ms. Waynelle Collymore-Taylor and Ms Vermaran Extavour (all of FAO-SLC, Barbados) are gratefully acknowledged.

# PART 1 BACKGROUND INFORMATION ON CASSAVA

## INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is the fourth most important source of energy in the tropics, after maize, sugarcane and rice, and for many millions of people represents a basic component in their diets (FAO, 2000). The crop is grown in more than 100 tropical and subtropical countries, usually by small-scale farmers. Cassava is one of the most popular crops in small-scale, subsistence farming systems because it is a crop that very seldom fails to produce, even in marginal areas with poor soil conditions and unreliable rainfall.

In the tropical and subtropical regions of Asia, Africa and Latin America, cassava is a major crop for food security and industrial uses. The crop is used mainly for human consumption in most parts of Africa and Latin America. In Asia and some parts of Latin America, it is used for the production of commercial animal feed, processing into starch and starch-based products and on-farm animal feeding. These multiple uses and market options give cassava importance and value as a crop that is appropriate for resource-poor farmers that can use it as vehicle to help feed their families, obtain income and employment and escape poverty.

Cassava has some unique characteristics that make it suitable to produce reasonable yields, even in areas with poor soil and climatic conditions. The crop efficiently uses available water and soil nutrients, has good tolerance to drought and to some pests and diseases. Compared to the main staples globally, cassava is seen as least suited for promoting intensification, using the Green Revolution approach based on the use of uniform crop varieties, intensive tillage, irrigation, fertilizer and pesticides (FAO, 2013). However, in the last decade, the worldwide importance of cassava has changed dramatically. From being a crop considered as "poor man's food", cassava has now become a multipurpose crop for the Third Millennium. Its importance for the potential for value-addition is well-documented and acknowledged. The crop is considered as an important strategy that can help developing countries meet their needs and priorities with regard to rural development, food security, energy security and other wider macroeconomic goals.

## WORLD CASSAVA FIGURES

### Production

Worldwide, most cassava production occurs on small farm holdings and in marginal agricultural areas, and therefore production statistics at country, region and global levels are often inadequately recorded and compiled into reliable statistics figures. The best statistics available are those produced by FAO.

Tables 1 and 2 show data on world cassava production in the last four decades, on each continent, presented as the annual average of ten-year periods. During 2000-2009, Africa produced 53.5% of the total production of cassava globally, which represented an increase of 27.4% compared to 1980-1989, when Africa was responsible for the production of 42% of the total global production of cassava.

In Asia, cassava production during the period 2000-2009 represented 30.2% of the world production. This represented a decrease of 15.4% in the share of the total world production compared to 1980-1989, wherein Asia was responsible for 35.6% of the total production.

Available data for Latin America (South and Central America), indicate that during the decade 2000-2009, the average annual production of cassava was only 15.6% of the total production at the global level. This represented a decrease in production equivalent to 28.4%, compared to the decade of 1980-1989 during which the cassava production in Latin America represented 21.8% of the global production.

In CARICOM (comprising 15 Member States)[1], available data for 2000-2009 indicate that cassava production decreased by 8.6% when compared to the decade 1980-1989. Total production of cassava in CARICOM countries continues to be very small, only 0.21%, in comparison with global production figures (Table 2).

Table 1. Changes in cassava production in three continents, ten-year average.

| REGION | PERIOD | | | |
|---|---|---|---|---|
| | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
| | (million MT) | | | |
| Africa | 44.1 | 56.5 | 83.5 | 103.9 |
| Asia | 32.1 | 47.9 | 48.5 | 58.7 |
| Latin America | 32.0 | 29.4 | 28.8 | 30.2 |
| CARICOM | 0.26 | 0.31 | 0.38 | 0.41 |
| Total | 109.1 | 134.7 | 161.9 | 194.2 |

Source: FAO. http://faostat.fao.org/

Table 2. Changes in cassava production in three continents, ten-year average (as a percentage of total production worldwide).

| REGION | PERIOD | | | |
|---|---|---|---|---|
| | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
| Africa | 40.4 | 42.0 | 51.6 | 53.5 |
| Asia | 29.6 | 35.6 | 30.0 | 30.2 |
| Latin America | 29.3 | 21.8 | 17.8 | 15.6 |
| CARICOM | 0.25 | 0.23 | 0.23 | 0.21 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |

Source: FAO. http://faostat.fao.org/

[1] The countries included as CARICOM member States are: Antigua and Bermuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, Saint Lucia, St. Kitts and Nevis, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago.

## Main facts

- The African continent has maintained its importance as the largest cassava producer in the world, a fact that has been maintained steady over the last four decades. During the last decade (2000-2009), Africa accounted for 53% of the total world cassava production.

- Asia continues to occupy its importance as the second largest cassava producing region in the world. During the last decade, average cassava production increased by 21% in comparison with two decades ago. Globally, the total production of cassava has remained almost the same, with cassava in Asia accounting for almost one third of the total production.

- Cassava production in Latin America has shown a slight increase during the last decade. Average production in the region was 4.8% higher. In terms of the total world production, cassava's importance in Latin America was reduced, accounting for only 15.6% of the total world production from 2000-2009. Two decades ago, the region's share was 17.8 % of the total cassava produced worldwide.

- CARICOM continues to show increase in the volumes of cassava produced. During the last decade, these have been nearly 8% higher than those produced two decades ago. However, in comparison with the total world production, the region accounted for only 0.21% during the last decade, whereas the proportion was 0.23% two decades ago.

## Area planted

Tables 3 and 4 provide data on the evolution of the areas planted to cassava globally, in the last four decades on three continents, presented as the annual average of ten-year periods. During 2000-2009, Africa planted 65.8% of the total area cultivated with cassava worldwide. This represented a constant, increasing trend, considering that during 1980-1989 the area planted with cassava in Africa represented 54.2 % of the area planted with cassava worldwide and during the decade 1990-1999, Africa's share was 62%.

Table 3. Changes in area planted with cassava on three continents, ten-year average (in millions of ha).

| REGION | PERIOD | | | |
|---|---|---|---|---|
| | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
| Africa | 6.87 | 7.65 | 10.13 | 10.05 |
| Asia | 3.03 | 3.80 | 3.68 | 2.99 |
| Latin America | 2.59 | 2.49 | 2.34 | 2.05 |
| CARICOM | 0.06 | 0.07 | 0.08 | 0.08 |
| Total | 12.66 | 14.10 | 16.36 | 15..27 |

Source: FAO. http://faostat.fao.org/

Table 4. Changes in areas planted with cassava on three continents, ten-year average (as a percentage of total area planted with cassava worldwide).

| REGION | PERIOD | | | |
|---|---|---|---|---|
| | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
| Africa | 54.2 | 54.2 | 61.9 | 65.8 |
| Asia | 23.9 | 26.9 | 22.49 | 19.58 |
| Latin America | 20.45 | 17.65 | 14.3 | 13.42 |
| CARICOM | 0.47 | 0.49 | 0.48 | 0. 52 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |

Source: FAO. http://faostat.fao.org/

In contrast, areas planted with cassava in Asia have been declining over the past 30 years. During 2000-2009, the total area in the region planted represented 19.6% of the total area planted with cassava globally, whereas one and two decades ago, the areas planted with cassava in Asia represented a share of 22.5% and 27%respectively.

A review of the available data from South and Central America shows that during the decade 2000-2009, the average area planted with cassava annually represented only 13.4% of the total area planted worldwide. One and two decades ago, the region's share was 14.3% and 17.7%, respectively.

In CARICOM, available data for 2000-2009 indicates that area planted with cassava remained the same over the two previous decades. Total area planted accounts for a very small share, representing only 0.52% of the total area planted with cassava globally over the last decade.

## Main facts

- Areas planted with cassava in Africa have remained constant over the last two decades but represent a large increase of almost 31.3% in comparison with the area planted in the region two decades ago (1980-89).

- In Asia, areas planted with cassava have been showing a negative growth trend over the past three decades. During 2000-2010, average areas planted with cassava in the region were 18.7% lower than a decade ago, and 21.3% lower than two decades ago.

- The average area planted with cassava in South and Central America, during the last decade (2000-2009), were reduced by 31.8%, compared to the area planted two decades ago (1980-1989). The difference in average area planted during the last two decades have maintained a negative trend but the reduction in the average areas planted between the two decades has been only 5.9%.

- The average cassava area planted in the CARICOM during the last two decades has remained constant but in comparison with two decades ago, there is a modest but positive increase. This positive difference of near 14.3 % in the areas planted currently indicates to some extent the renewed importance that the cassava is gaining in the CARICOM region.

## Cassava yields

Data on the evolution of global cassava yields as 10-year averages on the three continents are presented in Tables 5 and 6, and Figure 1.

Table 5. Changes in cassava yield on three continents, ten-year average (MT per ha).

| REGION | PERIOD | | | |
|---|---|---|---|---|
| | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
| Africa | 6.42 | 7.40 | 8.25 | 10.34 |
| Asia | 10.32 | 13.81 | 18.43 | 26.69 |
| Latin America | 12.36 | 11.79 | 12.28 | 14.77 |
| CARICOM | 4.56 | 4.35 | 4.45 | 5.13 |
| World Total | 8.62 | 9.55 | 9.89 | 12.71 |

Source: FAO. http://faostat.fao.org/

Table 6. Changes in cassava yield, by continent, average of ten-year periods (as a percentage of world cassava average yield).

| REGION | PERIOD | | | |
|---|---|---|---|---|
| | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
| Africa | -25.6 | -22.6. | -16.6 | -18.6 |
| Asia | 19.0 | 44.0 | 86.3 | 110 |
| Latin America | 43.0 | 23.0 | 24.1 | 16.2 |
| CARICOM | -47.1 | -54.6 | -55.0 | -59.6 |
| World Total | 100.0 | 100.0 | 100.0 | 100.0 |

Source: FAO. http://faostat.fao.org/

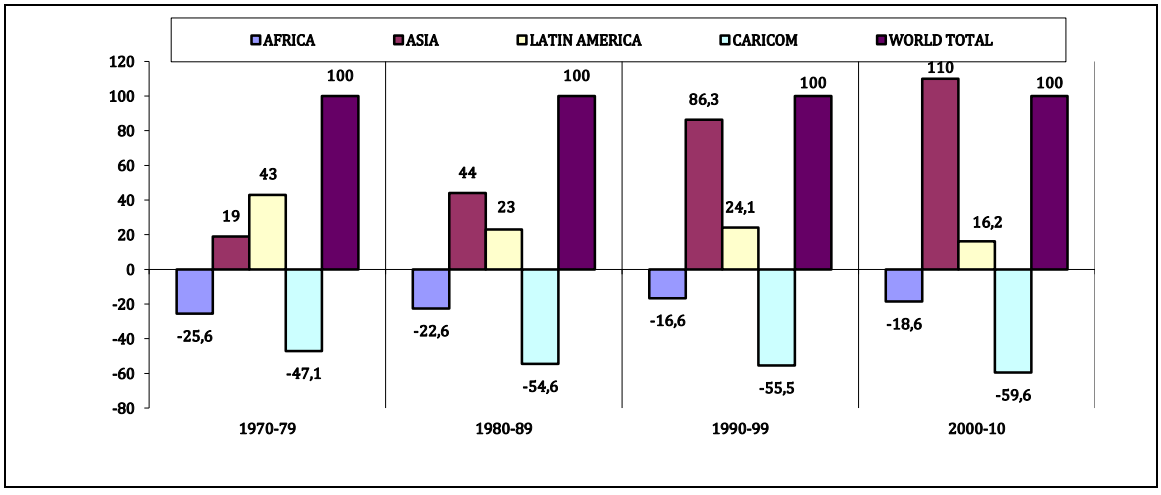


Figure 1. Changes in average cassava yields in four regions, 10-year averages expressed as a percentage of world cassava average yields for each decade.
Source: FAO. http://faostat.fao.org/

During the period 2000-2009, average cassava yield in Africa were estimated in 10.3 MT/ha, the second lowest cassava yield in the world, only higher than the average yield obtained in CARICOM, estimated at 5.13 MT/ha. However, considering the evolution of cassava yield in Africa, there is a positive trend during the last three decades. Average cassava yield in Africa during the last decade were 25.3% higher than those obtained a decade earlier, and 39.7% higher than those obtained two decades ago.

The average cassava yield obtained in Asia during 2000-2009 were the highest worldwide, estimated in 26.7 MT/ha, 44.8% higher than those obtained a decade earlier, and 93% higher than the decade of 1980-89.

An analysis of the cassava yield obtained in the South and Central America during the last three decades, indicates that average yield during 2000-2009 were 20.2% higher than those obtained during 1990-1999 and 25.2% higher than those two decades earlier, suggesting a positive trend in the increase in cassava productivity.

For CARICOM countries, available data for the period 2000-2009 indicate the average cassava yields have experienced a modest but positive increase, improving by 15.3% during the decade 2000-2009, in comparison with one decade earlier, and by 17.9% in comparison with the average cassava yield obtained two decades earlier.

## Main facts

- A comparison of cassava yield obtained in the African region with the cassava yield obtained worldwide indicates that the difference is narrowing. During 2000-2009, average cassava yield in Africa were 18.6% lower than average yields worldwide, whereas twenty years ago, this difference was 22.6%.

- A comparison of the average cassava yield obtained in Asia indicates that during 2000-2009, yields were 110% higher than those obtained worldwide. During 1990-1999, yield in Asia were 86.3% higher and two decades earlier (1980-89), they were also higher but only by 44%. This data clearly indicates the impressive growth in cassava productivity that has been achieved in the Asian region over the last three decades.

- Average cassava yield from Latin America over the past three decades, compared to those obtained worldwide, indicates that during 2000-2009, yields were 16.2% higher than those obtained worldwide. During 1990-1999, average cassava yield were 24.1% higher suggesting that the increase in cassava productivity in the Latin American region during the current decade has been a slightly lower than the increase occurring worldwide.

- The average cassava yields obtained in CARICOM during 2000-2009 were 59.6 % lower than the global average. This difference was also negative in the previous decade but by 55.5%. This is a clear indication of the very poor gains made in cassava productivity in this region compared to the other regions of the world. Indeed, there is a tremendous gap in cassava productivity in CARICOM in comparison with the cassava production systems in the other two continents.

## IMPORTANCE OF CASSAVA IN FOOD SECURITY

Table 7 provides food consumption data in energy equivalents at the regional and global levels as the contribution made by different commodities to the total supply of energy. Three crops - wheat, rice and maize - are responsible for nearly half of the caloric intake of the world population, especially in regions with the largest populations of undernourished people with food and nutrition insecurity. Considering the total contribution of agricultural crops to food consumption, in energy equivalent at the global level, these three crops are responsible for 80.4% of the total energy supplied by agricultural crops. The contribution of cassava to the total worldwide energy supply, coming from the rest of the agricultural crops, excluding wheat, rice and maize, is equivalent to 12.4 %.

In Africa, 65.6% of the total supply of calories comes from the agricultural sector. The three main crops -wheat, maize and rice - contribute to 57.2% of the total energy supply. Cassava is a very important crop for food security in Africa with a contribution equivalent to 21.4 % of the total energy supplied by the rest of the agricultural crops, excluding wheat, rice and maize.

In Asia, the contribution of cassava to the total energy consumption of the population is very low. Whereas the three main crops (rice, wheat and maize) contribute with 86.3% of the total energy consumption, cassava makes a very modest contribution of only 7.7% of the energy equivalent supplied from the other agricultural crops, excluding wheat, maize and rice.

Table 7. Food consumption data in energy equivalents by region, 2007-2009.

| CROP | KILOCALORIES (%) COMMODITY SUPPLY KCAL/TOTAL SUPPLY KCAL | | | | |
|---|---|---|---|---|---|
| | CARICOM | LAC | Africa | Asia | Total |
| Cassava | 0.52 | 1.42 | 6.03 | 0.63 | 1.30 |
| Bananas | 0.91 | 1.01 | 0.66 | 0.71 | 0.68 |
| Plantains | 0.68 | 0.62 | 1.71 | 0.04 | 0.32 |
| Potatoes | 1.03 | 1.39 | 1.17 | 1.82 | 2.15 |
| Sweet potatoes | 0.41 | 0.11 | 1.38 | 1.04 | 0.81 |
| Yams | 0.75 | 0.06 | 2.72 | 0.00 | 0.37 |
| **Roots and tubers total** | **4.31** | **4.62** | **13.70** | **4.23** | **5.62** |
| Wheat | 18.11 | 11.19 | 15.27 | 19.48 | 18.78 |
| Rice | 10.27 | 6.90 | 8.15 | 28.98 | 18.99 |
| Maize | 2.63 | 19.32 | 14.15 | 2.69 | 4.95 |
| Beans | 0.81 | 3.16 | 1.24 | 0.50 | 0.79 |
| Others | 0.85 | 0.50 | 7.18 | 1.35 | 1.86 |
| **Total kilocalories (%)** | **37.62** | **46.25** | **65.59** | **59.25** | **53.1** |
| **Contribution of wheat, maize, rice (%)** | **82.4** | **80.89** | **57.28** | **86.33** | **80.41** |
| **Contribution of cassava in relation to total energy supply (%)** | **1.39** | **3.07** | **9.20** | **1.07** | **2.45** |
| **Contribution of cassava excluding wheat, rice and maize (%)** | **10.28** | **16.06** | **21.44** | **7.7** | **12.48** |

Source: FAO. http://faostat.fao.org/

In Latin America, the contribution of the three main crops (rice, wheat and maize) to the total energy consumption is equivalent to 80.8%. In comparison with the other agricultural crops that contribute to the total energy supply in the region, cassava makes an important contribution equivalent to 16%.

In the CARICOM region, as in the rest of the world, rice, maize and wheat are the most important sources of energy, with a total contribution of 82.4%. Cassava contributes 10.2% of the energy supply from the rest of agricultural commodities, excluding wheat, maize and rice.

The importance of cassava is changing very rapidly around the world. Recent FAO estimates indicate that global harvest in 2012 was around 280 million metric tons, representing an increase of almost 60% in comparison to the volumes produced in 2000. These positive trends are likely to continue as the potential of the cassava crop as a strategic provider of food, feed, fuel and other industrial uses is being increasingly recognized and exploited.

The strategic and growing importance of cassava is demonstrated by the data available from two important regions, the Least Developed Countries (LDC, as defined by FAO) and CARICOM. The LDC is a group of 50 low-income countries and the CARICOM region is a group of 15 countries.

Table 8 presents a comparison of production, area planted and yield, for the cassava crop, in the LDC and in the CARICOM region, over a period of 50 years. The CARICOM region is well behind in terms of yield improvements, increasing only by 2.8 % from 1961 to 2009. During the same period, the growth in cassava productivity in LDCs was 69%.

In relation to area of cassava harvested, CARICOM showed significant growth during the last 50 years, equivalent to 158% whereas the LDC countries, the growth in the area of cassava harvested was equivalent to 78%.

The volumes of cassava produced in the CARICOM region increased by 165% over the last 50 years. During the same period, increase in the total volumes in LDCs was 201%.

Table 8. Cassava production data (1961 to 2009).

| **PRODUCTION (tonnes)** | | **AREA HARVESTED (ha)** | | **YIELD (t/ha)** | |
|---|---|---|---|---|---|
| **CARICOM MEMBER STATES** | | | | | |
| **Average (1961-1963)** | **Average (2007-2009)** | **Average (1961-1963)** | **Average (2007-2009)** | **Average (1961-1963)** | **Average (2007-2009)** |
| 183405 | 487159 | 42715 | 110395 | 4.29 | 4.41 |
| **+165%** | | **+158%** | | **+2.8%** | |

| **PRODUCTION (tonnes)** | | **AREA HARVESTED (ha)** | | **YIELD (t/ha)** | |
|---|---|---|---|---|---|
| **Least Developed Countries (LDC)** | | | | | |
| **Average (1961-1963)** | **Average (2007-2009)** | **Average (1961-1963)** | **Average (2007-2009)** | **Average (1961-1963)** | **Average (2007-2009)** |
| 21523935 | 64861771 | 4266236 | 7598480 | 5.05 | 8.54 |
| ***+201%*** | | ***+78.1%*** | | ***+69.1%*** | |

Source: FAO. http://faostat.fao.org/

Over the next few decades, with the challenges faced by the governments (especially in the developing countries) to meet the priorities and demands of the population for food, income and employment opportunities, the importance of cassava is likely to maintain a positive trend. This would be particularly so as the governments and policy makers recognize the potential of cassava as a strategic option to promote rural development, economic growth, and food security. The major drivers of this renewed importance of cassava for rural development and raising rural incomes are high prices of cereals, potential to use cassava flour to replace wheat imports, cassava as bio-ethanol raw material, cassava starch for industrial uses and resilience to climate changes (FAO, 2013).

In CARICOM, with a food import bill that has been estimated in almost US$5 billion, cassava could become an important rural development policy option for the urgent task that governments are facing in order to reduce the huge food imports. Cassava crop could help countries in the region to save foreign exchange, generate employment and create income oportunites, especially in rural areas, and increase the availability of food, especially for the poorest sectors of the population.

# PART 2 CURRENT STATUS OF THE CASSAVA CROP IN SELECTED CARIBBEAN COUNTRIES

## INTRODUCTION

In conducting the analysis of the current status of the cassava value chain in selected countries of Latin American and the Caribbean, CLAYUCA received excellent collaboration and logistical support from the Food and Agriculture Organization of the United Nations (FAO) and the Inter-American Institute for Cooperation on Agriculture (IICA), through their officers and technical personnel in the countries included in the analysis.

The activity was undertaken as a collaborative effort with the main objective of obtaining accurate, updated and meaningful information that could be used later by the three institutions in the design of a regional strategy aimed at promoting sustainable and competitive intensification of production and industrialization in the Caribbean.

To facilitate the implementation of this analysis, an on-line survey was designed to obtain updated information on the current state of the cassava value chain in the selected countries, covering aspects of production, processing, marketing and planning. Key actors of the sector in each country, including technical personnel, farmers, private sector companies and small-scale agroprocessing enterprises, were identified and their collaboration was requested as a valuable source of information on the above-mentioned topics. The survey was divided into various sections and the informants were asked to answer only those questions in which they believed to have adequate information. Table 9 presents the list of countries included in the survey, the number of contacts identified in each country and the number of responses received. Despite the easy methodology adopted (answering questions in an electronic survey that took a few minutes), and the collaboration received from IICA and FAO country officers and technical personnel, only 31% of the informants contacted responded to the survey.

Table 9. List of countries included in the survey on the current status of the cassava value chain.

| COUNTRY | CONTACTS RECEIVING THE SURVEY | ANSWERS RECEIVED |
|---|---|---|
| Barbados | 21 | 5 |
| Belize | 5 | |
| Ecuador | 15 | 2 |
| Guyana | 28 | 4 |
| Jamaica | 31 | 10 |
| Nicaragua | 57 | 16 |
| Paraguay | 38 | 22 |
| Dominican Republic | 20 | 5 |
| St. Lucia | 10 | 3 |
| St. Vincent | 12 | 4 |
| Suriname | 20 | 7 |
| Trinidad & Tobago | 48 | 16 |
| TOTAL | 305 | 94 |

Source: FAO. http://faostat.fao.org/

Nonetheless, the quality of the information obtained is good considering that it could provide a baseline for further surveys and analyses in the future. The information obtained through the survey was complemented with up-to-date statistical information available at FAO (FAOSTAT). CLAYUCA has done a preliminary processing of the information obtained and a draft report is presented in the next section.

Despite the fact that only 36% of the intended participants in the survey answered it, affecting the quality of the statistical data presented and discussed in this document, the information obtained could be considered accurate and useful, because a very important, complementary set of information was obtained through the participants in the International Training event held at Cali, Colombia,

Additionally, the electronic survey form and the statistical analysis platform built to process the information are now available and can be used for similar work in the future.

## RESULTS OF THE SURVEY

### Cassava in the Caribbean Region

Cassava has been identified as an important crop to meet the food and nutrition needs of the population in the Latin American and Caribbean region. It is recognized as one of the crops with higher potential for the development of value added through its processed products (IICA, 2013).

### Cassava production figures

Production and processing of cassava in Caribbean countries are relatively small-scale activities, in comparison to other countries in South America and around the world, and in most cases there is a high predominance of traditional, subsistence production systems. Table 10 shows the production of cassava in various LAC countries including the twelve countries included in the electronic survey conducted by FAO/ IICA/ CLAYUCA.

Data has been compiled as the average production of ten-year periods, covering the last four decades (1970-2009). Data is also presented on the variation of cassava production between the two previous decades.

Cassava production in CARICOM from 2000-2009 increased by 10% in comparison with the average annual production in 1990-1999 (Table 10). Only four countries in the region experienced increases in production, compared to the two previous decades: Trinidad and Tobago, Antigua and Barbuda, Haiti, and St. Vincent and the Grenadines. In The Bahamas, Barbados and Guyana, cassava production was reduced drastically, by approximately 50-60%, over the last two decades. In Jamaica, Belize, Dominica, Grenada and Suriname, the reduction during the same periods was lower, approximately 10%.

Nicaragua increased the production of cassava over the past two decades by 79%; Paraguay also had a positive increase of 22%; Ecuador had reduced production (22%), while there was a smaller reduction of around 3.6% in the Dominican Republic.

The 10% growth in cassava production in the Caribbean region during the last two decades was modest in comparison with regions like Asia with 44.7%, Africa with 24.3% and Latin America (including South and Central America) with 20.2% growth.

Table 10. Production of cassava in selected LAC countries (average of ten-year periods).

| Countries | Production (tonnes) | | | | % of change between 1990-2009 |
|---|---|---|---|---|---|
| | 1970-79 | 1980-89 | 1990-99 | 2000-2009 | |
| Antigua and Barbuda | 73 | 50 | 46 | 65 | 39.9 |
| The Bahamas | 1104 | 1025 | 507 | 209 | -58.8 |
| Barbados | 883 | 971 | 926 | 376 | -59.4 |
| Belize | | 78 | 697 | 659 | -5.5 |
| Dominica | 784 | 884 | 874 | 850 | -2.7 |
| Grenada | 231 | 134 | 164 | 159 | -3.2 |
| Guyana | | 4940 | 30840 | 17091 | -44.5 |
| Haiti | 232476 | 275864 | 317599 | 371309 | 16.9 |
| Jamaica | 21494 | 17399 | 16314 | 14482 | -11.2 |
| St Lucia | 856 | 923 | 970 | 969 | -0.1 |
| St. Vincent and the Grenadines | 2815 | 2060 | 321 | 555 | 72.6 |
| Suriname | 2091 | 2640 | 4351 | 3743 | -13.9 |
| Trinidad and Tobago | 4442 | 1885 | 1014 | 1387 | 36.7 |
| **CARICOM** | 267248 | 308853 | 374626 | 411851 | 9.9 |
| | | | | | |
| Dominican Republic | 161477 | 101421 | 122256 | 117846 | -3.6 |
| Ecuador | 316628 | 179876 | 89966 | 74492 | -17.2 |
| Nicaragua | 21328 | 52666 | 52000 | 93125 | 79.1 |
| Paraguay | 1493221 | 2901332 | 2975141 | 3636796 | 22.2 |
| | | | | | |
| **Latin America Total (South and Central)** | **32017561** | **29460489** | **28820790** | **30278032** | **20.2** |
| **Africa Total** | **44123936** | **56579414** | **83580622** | **103951230** | **24.3** |
| **Asia Total** | **32133478** | **47943121** | **48567395** | **58793448** | **21.0** |

Source: FAO. http://faostat.fao.org/

Additionally, an analysis of the production of cassava in selected LAC countries, based on available data (FAOSTAT) for the period 2006-2010, is provided in Table 11. Analysis of data obtained considering the period 2009-2010 revealed that during this period, only three countries in the LAC region showed negative growth in the rate of cassava production: Trinidad and Tobago, Barbados and St. Vincent and the Grenadines. Further analysis for the period 2006-2010 indicates that with the exception of St. Vincent and the Grenadines, the other countries showed positive growth rates in terms of area planted to cassava.

Table 11. Production of cassava in selected countries of the LAC region (2006-2010).

| Country | Production of cassava (tonnes) | | | | | % change 2009-2010 | % change 2006-2010 |
|---|---|---|---|---|---|---|---|
| | 2006 | 2007 | 2008 | 2009 | 2010 | | |
| | Caribbean Countries | | | | | | |
| Antigua and Barbados | 60 | 78 | 72 | 77 | 99 | + 23.7 | + 23.7 |
| The Bahamas | 170 | 190 | 175 | 188 | 865 | + 56.9 | + 408.8 |
| Barbados | 379 | 448 | 466 | 691 | 400 | - 42.1 | + 5.5 |
| Belize | 239 | 327 | 304 | 328 | 331 | +0.01 | + 38.5 |
| Dominica | 836 | 819 | 752 | 809 | 1037 | +28.1 | + 24.0 |
| Grenada | 164 | 172 | 170 | 159 | 204 | + 28.3 | + 24.4 |
| Guyana | 23145 | 20184 | 4127 | 7100 | 10092 | + 42.1 | - 0.5 |
| Haiti | 400000 | 450000 | 435000 | 467822 | 599575 | + 28.1 | + 48.0 |
| Jamaica | 17711 | 18519 | 14991 | 13995 | 18490 | + 32.1 | + 4.4 |
| Saint Lucia | 1021 | 1030 | 1100 | 898 | 1151 | + 28.1 | + 12.7 |
| Saint Vincent and the Grenadines | 602 | 770 | 707 | 780 | 527 | -32.4 | - 12.4 |
| Suriname | 4120 | 3948 | 2894 | 3931 | 4243 | + 7.9 | + 3.0 |
| Trinidad and Tobago | 1100 | 2190 | 2788 | 2479 | 2311 | - 6.77 | + 110.1 |
| Dominican Republic | 128369 | 128340 | 106291 | 165688 | 211105 | + 27.4 | + 64.4 |
| Latin American Countries | | | | | | | |
| Ecuador | 69397 | 74241 | 102277 | 66299 | 53857 | - 18.7 | - 22.3 |
| Nicaragua | 105000 | 115000 | 128124 | 101908 | 73789 | - 27.6 | - 29.7 |
| Paraguay | 4800000 | 4800000 | 2218530 | 2610000 | 2624084 | + 0.5 | - 45.3 |

Source: FAO. http://faostat.fao.org/

## Importance of cassava in selected Caribbean countries

An analysis of the importance of cassava in the Caribbean countries, compared to other crops, is presented in Table 12. The parameter used for this analysis has been the amount of food supply available for consumption, from the different commodities available in each country, expressed as the Kilocalories / per capita / per day, and expressed as the average of the period 2007 to 2009.

Table 13 presents the same analysis but excluding the three main crops consumed in the region: wheat, rice and maize. This provides evidence of the important role which crops such as potatoes, yam, groundnut (peanut), bananas, plantains and cassava play meeting the caloric needs of the population on the Caribbean region.

Table 12. Ranking of the most important crops in selected Latin American and Caribbean countries.

| Country | CROPS PRODUCTION (2007-2009, average of a three-years period) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat | Paddy Rice | Maize | Sweet potatoes | Potatoes | Yams | Cassava | Bananas | Plantains | Groundnuts | Sorghum |
| Barbados | 1 | 2 | 3 | 8 | 4 | 9 | 10 | 6 | 7 | 5 | |
| Belize | 1 | 2 | 3 | 8 | 6 | 10 | 9 | | 5 | 7 | 4 |
| Guyana | 2 | 1 | 4 | 9 | 6 | | 3 | 7 | 8 | 4 | |
| Jamaica | 1 | 2 | 4 | 6 | | 3 | 9 | 5 | 8 | 7 | |
| St. Lucia | 1 | 2 | 4 | 9 | 5 | 8 | 6 | 3 | 7 | | |
| Dominica | 1 | 3 | 6 | 8 | 7 | 2 | 9 | 5 | 4 | | |
| Grenada | 1 | 2 | 3 | | 4 | 6 | 8 | 5 | 9 | 7 | |
| St. Vincent and the Grenadines | 1 | 2 | 3 | 8 | 6 | 7 | | 5 | 4 | | |
| Suriname | 2 | 3 | 4 | 5 | | | 1 | | | | |
| St. Kitts and Nevis | 1 | 2 | 6 | 5 | 4 | 9 | 8 | 7 | | 3 | |
| Trinidad and Tobago | 1 | 2 | 3 | 8 | 4 | | 9 | 6 | 7 | 5 | |
| Antigua and Barbuda | 1 | 2 | 4 | 6 | 3 | 8 | 9 | 5 | 7 | | |
| Bahamas | 1 | 2 | 3 | 8 | 4 | | 9 | 5 | 7 | 6 | |
| Haiti | 2 | 1 | 3 | 5 | | 6 | 4 | 7 | 9 | | 8 |
| **CARICOM** | **1** | **2** | **3** | **10** | **4** | **6** | **9** | **5** | **7** | **8** | **11** |
| | | | | | | | | | | | |
| Dominican Republic | 3 | 1 | **4** | 5 | 7 | 8 | 2 | | | | |
| Ecuador | 1 | 3 | **6** | 9 | 5 | | 2 | | | | |
| Nicaragua* | 3 | 5 | **4** | | 6 | | 2 | | | | |
| Paraguay | 5 | | **1** | 6 | | | 7 | | | | |

***** Maize was the first ranked crop.
Source: FAO. http://faostat.fao.org/

Table 13. Ranking of the most important crops in selected Latin American and Caribbean countries, excluding wheat, rice and maize.

| Country | CROPS PRODUCTION (2007-2009, average of a three-years period) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sweet potatoes | Potatoes | Yams | Cassava | Bananas | Plantains | Groundnuts | Sorghum |
| Barbados | 7 | 1 | 5 | 6 | 3 | 4 | 2 | |
| Belize | 5 | 3 | 7 | 6 | | 2 | 4 | 1 |
| Guyana | 7 | 4 | | 1 | 5 | 6 | 2 | |
| Jamaica | 4 | | 1 | 7 | 3 | 6 | 5 | |
| St. Lucia | 5 | 2 | 7 | 3 | 1 | 5 | | |
| Dominica | 8 | 7 | 1 | 9 | 3 | 2 | | |
| Grenada | | 1 | 3 | 5 | 2 | 6 | 4 | |
| St. Vincent and the Grenadines | 5 | 3 | 4 | | 2 | 1 | | |
| Suriname | 3 | | | 1 | | | | |
| St. Kitts and Nevis | 3 | 2 | 7 | 6 | 5 | | 1 | |
| Trinidad and Tobago | 5 | 1 | | 6 | 3 | 4 | 2 | |
| Antigua and Barbuda | 4 | 1 | 6 | 7 | 3 | 5 | | |
| Bahamas | 5 | 1 | | 6 | 2 | 4 | 3 | |
| Haiti | 2 | | 3 | 1 | 4 | 6 | | 5 |
| **CARICOM** | **7** | **1** | **3** | **6** | **2** | **4** | **5** | **8** |
| Dominican Republic | 3 | 4 | 5 | 1 | | | | |
| Ecuador | 4 | 2 | | 1 | | | | |
| Nicaragua* | | 3 | | 1 | | | | |
| Paraguay | 1 | | | 2 | | | | |

Bananas were ranked first in seven of the fifteen Caribbean countries and in Ecuador. Yams were a very important crop, ranked number one in three countries and as the second most important crop in two other counties. Rice was the most important crop in Suriname, Guyana and Trinidad and Tobago. In terms of the high volumes produced, rice emerged as the top-ranked crop in the entire Caribbean region, with cassava being ranked as the number one crop only in Haiti. In Paraguay, cassava was also the first ranked crop. With the exception of Grenada, cassava was ranked among the top five important crops in all the other Caribbean countries. In Nicaragua and Dominican Republic, cassava was also among the top five important crops.

**Cassava productivity in selected Caribbean countries**

Table 14 presents data on the productivity of cassava in selected LAC countries, as the average of 10-year periods, over the last forty years. An analysis was also made of the changes in growth rates for the cassava productivity in each country. During the last decade (2000-2009), seven CARICOM countries obtained cassava yields higher than those obtained at the global level.

Table 14. Cassava yield in selected LAC countries (average ten-year periods, 1970-2009).

| COUNTRIES | CASSAVA YIELDS (t/ha) | | | | % OF CHANGE 1990 – 2010 |
|---|---|---|---|---|---|
| | 1970–79 | 1980-89 | 1990–99 | 2000–2009 | |
| Antigua and Barbuda | 3.44 | 5.09 | 4.73 | 4.86 | 2.5 |
| The Bahamas | 12.34 | 10.73 | 9.15 | 13.42 | 46.7 |
| Barbados | 25.59 | 23.01 | 17.65 | 22.60 | 28.0 |
| Belize | | 14.72 | 9.38 | 18.86 | 101 |
| Dominica | 10.11 | 10.56 | 9.93 | 9.67 | -2.65 |
| Grenada | 8.64 | 7.01 | 6.12 | 7.28 | 18.9 |
| Guyana | | 11.49 | 12.45 | 12.83 | 3.02 |
| Haiti | 4.24 | 4.07 | 4.00 | 4.82 | 20.6 |
| Jamaica | 9.03 | 11.45 | 17.44 | 20.48 | 17,5 |
| St. Lucia | 3.80 | 3.33 | 3.01 | 3.19 | 5.79 |
| St. Vincent and the Grenadines | 12.24 | 8.29 | 6.20 | 6.31 | 1.6 |
| Suriname | 6.58 | 6.73 | 14.29 | 25.32 | 77.2 |
| Trinidad and Tobago | 11.50 | 11.74 | 3.49 | 3.45 | -1.2 |
| **CARICOM** | **4.56** | **4.35** | **4.45** | **5.13** | **15.3** |
| Dominican Republic | 4.54 | 5.56 | 6.58 | 8.28 | 25.8 |
| Ecuador | 9.38 | 8.08 | 4.52 | 4.43 | -1.8 |
| Nicaragua | 4.45 | 11.25 | 11.18 | 9.91 | -11.4 |
| Paraguay | 14.55 | 15.17 | 14.44 | 17.65 | 22.1 |
| **Latin America Total (South and Central)** | **12.36** | **11.79** | **12.28** | **14.77** | **20.2** |
| **Africa Total** | **6.42** | **7.40** | **8.25** | **10.34** | **25.3** |
| **Asia Total** | **10.32** | **13.81** | **18.43** | **26.69** | **44.7** |
| **World Total** | **8.62** | **9.55** | **9.89** | **12.71** | **28.5** |

Source: FAO. http://faostat.fao.org/

During the same period, yield in seven other countries were lower than the global average yield, while three countries, Barbados, Jamaica and Suriname reported outstanding yield, closer to those obtained in Asia, the region with the highest productivity globally. In the countries of Latin America included in this analysis, only Paraguay obtained cassava yield above the world average, with the other three countries, Nicaragua, Ecuador and Dominican Republic obtaining yields below the average global yield. Considering the changes in average yield obtained during the last two decades, for each country, only in two countries, Dominica and Trinidad and Tobago, cassava yield obtained during the last decade, were lower than those obtained two decades ago. The rest of the countries showed positive growth rates in cassava productivity similar to the Dominican Republic and Paraguay in Latin America; Ecuador maintained productivity at almost the same level and Nicaragua presented a negative trend in the growth of cassava yield.

An analysis of the data reveals that Asia obtained impressive gains in cassava productivity, increasing by 44% in the last decade, in comparison with two decades ago. Africa and Latin America also showed positive, although smaller, growth rates in productivity, increasing by 25.3% and 20.2%, respectively, during the last decade, compared to two decades ago. CARICOM registered a positive growth of 15.3% in productivity during the last decade, in comparison with yield obtained two decades ago. A further analysis of the more recent changes (2006-2010) that have occurred in cassava productivy in the LAC region is presented in Table 15.

In 2010, only four countries in the Caribbean (The Bahamas, Barbados, Suriname and Jamaica), obtained cassava yield higher than the average global yiels, while Belize and Guyana were almost at the same level as the global average and the other seven countries had lower yield than the rest of the world (including the entire African region).

In terms of the trends in changes of cassava yield for the five years period (2006-2010), it was observed that only four countries had maintained a positive trend in yield growth (Antigua and Barbuda, The Bahamas, Grenada and Guyana). In three countries - Belize, Jamaica, and St. Vincent and the Grenadines - a constant negative trend was noted during the same period.

Some countrties like Barbados and Suriname showed positive growth in the first part of the period analyzed but in the last year (2009-2010), the situation was reversed and the cassava yields dropped significantly. On the other hand, countries like Haiti, St. Lucia, Dominica and Trinidad and Tobago that reported negative growth at the beginning of the period showed positive growth in the average yields obtained during the period 2009-2010.

The data presented for the Latin American countries indicated that during 2010 yields obtained in the Dominican Republic, Ecuador and Nicaragua were not only below the global average yields but were also lower than those obtained in Africa. Only Paraguay had cassava yields higher than those obtained on average in Africa and Latin America. For the period 2009-2010, CARICOM showed a positive growth rate similar to that obtained in Africa. During the same period, the Asian region reported a negative growth rate in cassava yield.

Table 16 depicts information on the average annual growth rate of cassava yield in selected countries of the LAC region for 10-year periods. During 2000-2009, five CARICOM countries (Dominica, Guyana, Jamaica, St. Lucia and St. Vincent and the Grenadines) showed negative growth for average annual cassava yield. The other eight countries grew positively albeit with modest increases in comparison with other cassava growing areas worldwide. Guyana was the country with the largest negative growth rate for average annual cassava yield during this period.

Table 15. Cassava yield in selected LAC countries (period 2006-2010).

| COUNTRY | PRODUCTION OF CASSAVA (tonnes) | | | | | % CHANGE 2009-2010 | % CHANGE 2006-2010 |
|---|---|---|---|---|---|---|---|
| | 2006 | 2007 | 2008 | 2009 | 2010 | | |
| | Caribbean Countries | | | | | | |
| Antigua and Barbados | 4.0 | 5.20 | 5.54 | 4,81 | 5.21 | 8.3 | 30.2 |
| The Bahamas | 10.63 | 10.56 | 10.94 | 9.89 | 22.18 | 124.2 | 108.6 |
| Barbados | 18.75 | 17.92 | 21.18 | 25.59 | 20 | -21.8 | 6.6 |
| Belize | 14.06 | 17.21 | 13.22 | 13.12 | 12.73 | -2.9 | -9.4 |
| Dominica | 9.61 | 8.19 | 8.36 | 7.42 | 7.86 | 5.9 | -18.2 |
| Grenada | 6.56 | 9.05 | 10.0 | 7.57 | 8.16 | 7.79 | 24.4 |
| Guyana | 11.02 | 10.91 | 10.32 | 10.92 | 11.21 | 2.65 | 1.72 |
| Haiti | 6.25 | 4.41 | 4.39 | 3.90 | 4.13 | 5.89 | -33.9 |
| Jamaica | 18.62 | 18.67 | 18.60 | 18.64 | 18.53 | -0.5 | -0.4 |
| St Lucia | 3.80 | 3.03 | 3.06 | 2.05 | 2.18 | 6.3 | -42.6 |
| St Vincent and the Grenadines | 7.72 | 6.42 | 6.61 | 6 | 3.36 | -44 | -56.4 |
| Suriname | 20.0 | 25.47 | 25.17 | 27.68 | 25.26 | -8.7 | 26.3 |
| Trinidad and Tobago | 3.49 | 3.03 | 5.10 | 2.76 | 3.04 | 10.1 | -12.9 |
| Dominican Republic | 7.22 | 7.56 | 7.56 | 7.72 | 8.51 | 10.2 | 17.9 |
| Latin American Countries | | | | | | | |
| Ecuador | 3.43 | 4.51 | 5.12 | 3.12 | 3.20 | 2.5 | -6.7 |
| Nicaragua | 9.55 | 9.58 | 8.07 | 8.71 | 8.85 | 1.6 | -7.3 |
| Paraguay | 16.0 | 16.0 | 13.0 | 14.50 | 14.79 | 2 | -7.5 |
| | | | | | | | |
| **CARICOM Region** | 6.60 | 4.69 | 4.57 | 4.05 | 4.30 | 6.1 | -34.8 |
| **Latin America Total. (South and Central)** | 13.66 | 13.68 | 13.47 | 13.32 | 13.42 | 0.75 | -1.75 |
| **Africa Total** | 9.68 | 9.50 | 9.80 | 9.67 | 10.30 | 6.5 | 6.4 |
| **Asia Total** | 18.38 | 19.20 | 19.31 | 20.21 | 19.33 | -4.3 | 5.1 |
| **World Total** | 11.91 | 11.97 | 12.20 | 12.27 | 12.41 | 1.14 | 4.19 |

Source: FAO. http://faostat.fao.org/

During this decade, the CARICOM region as a whole reported a drastic reduction in the average growth rate of cassava yield, while a decade ago, the growth rates for the region were positive. It was the only cassava growing region worldwide that showed negative growth rates for average yield.

The Latin American region had the highest growth rate for average annual cassava yield during 2000-2009, with three countries (Ecuador, Nicaragaua and Paraguay) showing negative growth rates for cassava yield and only the Dominican Republic reporting positive growth rates.

On a global basis, Latin America showed very high growth in cassava productivity during the last decade. Africa also grew positively but Asia's positive growth rate was reduced considerably,

compared to the previous decade. Worldwide, the growth rates for average annual cassava yield were high but lower than the growth rates from a decade ago (Table 16).

Table 16. Average yield annual growth rate (%) for cassava in selected LAC countries (1970 – 2009).

| COUNTRIES | AVERAGE YIELD ANNUAL GROWTH RATE (%) | | | | |
|---|---|---|---|---|---|
| | 1970-79 | 1980-89 | 1990-99 | 2000-2009 | 1963-2012 |
| Antigua and Barbuda | -0.01 | 0.03 | 0.01 | 0.04 | 0.46 |
| The Bahamas | 0.15 | -0.24 | -0.10 | 0.02 | 0.05 |
| Barbados | -0.11 | -0.04 | -0.01 | 0.01 | -0.11 |
| Belize | | | | 0.02 | |
| Dominica | 0.40 | -0.34 | 0.04 | -0.10 | -0.43 |
| Grenada | -0.04 | -0.13 | 0.10 | 0.05 | -0.26 |
| Guyana | | | 0.01 | -0.22 | |
| Haiti | 0.34 | 0.52 | 0.04 | 0.01 | 0.53 |
| Jamaica | 0.11 | 0.12 | 0.04 | -0.01 | 0.14 |
| St Lucia | -0.53 | -1.62 | -0.11 | -0.18 | -1.07 |
| St. Vincent and the Grenadines | -0.44 | -0.06 | 0.10 | -0.03 | -0.21 |
| Suriname | -0.04 | 0.03 | 0.02 | 0.04 | 0.10 |
| Trinidad and Tobago | 0.08 | -0.16 | 1.60 | 0.02 | -0.14 |
| **CARICOM** | **0.46** | **1.19** | **0.18** | **-0.03** | **0.59** |
| | | | | | |
| Dominican Republic | -0.01 | 0.05 | -0.08 | 0.23 | |
| Ecuador | -0.07 | -0.06 | 0.01 | -0.04 | |
| Nicaragua | 0.08 | -0.17 | -0.01 | -0.08 | |
| Paraguay | 0.08 | 0.07 | -0.17 | -0.05 | |
| | | | | | |
| **LATIN AMERICA TOTAL (South and Central)** | **-0.15** | **0.21** | **0.09** | **0.27** | **0.12** |
| **Africa Total** | **0.22** | **-0.25** | **-0.16** | **0.15** | **0.51** |
| **Asia Total** | **0.16** | **0.18** | **0.29** | **0.07** | **0.21** |
| **World Total** | **0.36** | **0.48** | **0.35** | **0.21** | **0.51** |

Source: FAO. http://faostat.fao.org/

## Main facts

- A comparison of cassava yield obtained in the African region with yield obtained worldwide indicates that the difference is narrowing. During the decade 2000-2009, average cassava yield in Africa were 18.6% lower than average yield worldwide, whereas twenty years ago, this difference was 22.6%.
- A comparison of the average cassava yield obtained in Asia with average yield obtained globally, indicates that during 2000-2009, cassava yield in Asia were 110% higher than those obtained worldwide. During 1990-1999, yield in Asia were 86.3% higher and two decades earlier (1980-89), they were also higher but only by 44%. This data clearly indicates the impressive growth in cassava productivity that has been achieved in the Asian region over the last three decades.

## Cassava technical and technological profile in selected Caribbean countries

An electronic survey was implemented during the second half of 2014, as part of the FAO/ IICA / CLAYUCA initiative, aimed at improving the knowledge and information about the current status of the cassava sector in the Caribbean (CARICOM region and the Dominican Republic). The survey included sections with specific questions about the technical and technological profile of cassava systems in the selected countries. Some of the findings are presented below.

About 51% of the persons that responded considered themselves as cassava producers. In the region, cassava producers can be classified in three main groups:

- **Category 1**: planting small-scale areas, using traditional cassava production technologies, and generally obtaining low yields.
- **Category 2:** planting medium-scale cassava areas, using some type of modern production technologies, and generally obtaining medium yields.
- **Category 3**: planting large-scale areas, generally using modern technologies, and obtaining high yields.

Table 17 shows the classification of cassava farmers based on the yield obtained, in some Caribbean countries. The data clearly indicates the very low yield obtained by small-scale farmers, using traditional technologies, which in most countries do not exceed 10 t/ha. Suriname farmers reported the lowest yield between 1.5 and 5.5 t/ha, followed by Jamaica (central Jamaica) with the yield between 4 to 8 t/ha, Dominican Republic with the yield between 6 to 10 t/ha and St Vincent and the Grenadines, Trinidad and Tobago and Guyana with minimum yield of 8 t/ha. Barbados (22 t/ha), St. Lucia (12-15 t/ha) and some exceptional producers of Trinidad and Tobago reported yield between 15 to 25 t/ha, representing the highest yield among the small-scale producers that responded to the survey.

Table 17. Classification of cassava farmers in countries of Caribbean based on farm size and yields.

| COUNTRY | CASSAVA YIELDS OBTAINED, BY TYPE OF FARMERS (t/ha) | | |
|---|---|---|---|
| | Category 1 (small-scale) | Category 2 (medium-scale) | Category 3 (large-scale) |
| Barbados | 22 | 32-40 | |
| Guyana | 8-10 | 10-20 | |
| Jamaica (central part) | 4-8 | 15-20 | 20-30 |
| St. Lucia | 12-15 | 20-30 | 30-40 |
| St. Vincent and the Grenadines | 8 | 15-25 | |
| Suriname | 1.5-5.5 | 15-25 | |
| Trinidad and Tobago | 8-15 | 11-25 | 23 |
| Dominican Republic | 6-10 | 14-17 | 20-25 |

Source: FAO/IICA/CLAYUCA Survey

Category 2 farmers cultivated medium size areas and used some level of improved technology for cassava production, reported the yield between 10 and 25 t/ha, with the exception of Barbados that reported cassava yield between 32 to 40 t/ha. St. Lucia, Jamaica, St Vincent and the Grenadines, Trinidad and Tobago, Dominican Republic and Suriname reported cassava yield between between 15 and 25 t/ha and Guyana between 10 and 20 t/ha.

Farmers producing cassava on large scale farms and using modern technologies were not very common in CARICOM countries. Commercial-scale cassava farmers were reported in Jamaica, with yield of 20 to 30 t/ha; St. Lucia with yield of 30 to 40 t/ha; Trinidad and Tobago with yield of 30 to 40 t/ha; and the Dominican Republic with yield of 20 to 25 t/ha.

Most producers included in the survey had small cassava plots: 46% indicated having less than 1 ha planted to cassava, while 25% indicated having cassava areas between1 to 3 ha (Figure 2).

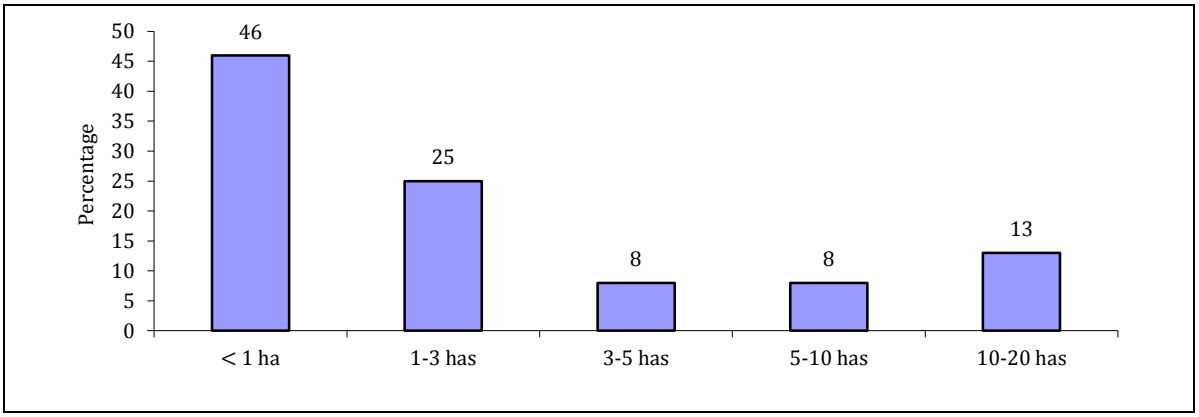


Figure 2. Average size of cassava areas in selected countries of the Caribbean region.
Source: FAO/IICA/CLAYUCA Survey.

## Cassava varieties grown in selected Caribbean countries

One of the most important cassava varieties grown in the region is MCol-22, mentioned by 13% of the survey participants from Jamaica, St Lucia, and Trinidad and Tobago. The popularity of this variety among cassava growers in the region was attributed to some specific traits: high yields, high resistance to pests and diseases, early maturing, as well as good market acceptance and good cooking quality. Other important cassava varieties mentioned by farmers were: M Mex 59 (Guyana, Trinidad and Tobago), CM 516 (Jamaica) and CIAT Hybrid (Jamaica). Farmers' preference for these varieties was principally related to high yielding characteristics.

Table 18 presents the main cassava varieties that are currently grown in each of the countries included in the survey and the main attributes identified by the farmers. Table 19 presents additional information about the most common varieties found in selected countries of the Caribbean region.

## Experience of cassava farmers in selected Caribbean countries

17% of the survey respondents indicated that they have been planting cassava for more than 20 years. 20% of the farmers have been planting the crop for 10 to 20 years. Near two thirds of the farmers included in the survey (64%) indicated that their experience as cassava growers were

less than 10 years and near one fourth of the farmers stated that their experience as cassava growers were less than 5 years (Figure 3).

Table 18. Main cassava varieties grown in selected Caribbean countries and farmers' reasons for the preference.

| COUNTRY | MOST POPULAR CASSAVA VARIETY | FARMERS OPINIONS FOR THEIR PREFERENCE OF THE MAIN CASSAVA VARIETIES | | | | | |
|---|---|---|---|---|---|---|---|
| | | Good yields | Good cooking quality | Good market acceptance | Pest and disease resistance | Early maturing | Good yields in drought periods |
| Barbados | White stick | X | | | | | |
| Guyana | Uncle mack | X | | | X | X | X |
| | Yankee red stem | X | X | X | | X | |
| | Brown stem | X | X | X | X | | X |
| Jamaica | MCol22 | X | X | X | X | X | X |
| | CM516 | X | | | | | |
| St Lucia | MCol22 | X | X | | | | X |
| Suriname | Valencia | | | X | | | |
| | Botro cassava (gele cassave) | X | X | X | X | X | X |
| Trinidad and Tobago | MMex 59 | X | X | X | X | X | X |
| | CIAT Hybrid | X | X | | X | | |
| Dom. Rep. | Valencia | X | X | X | X | | X |

Source: FAO/IICA/CLAYUCA Survey.

Table 19. Principal cassava varieties planted in selected countries of the Caribbean region.

| COUNTRY | CASSAVA VARIETIES | | | |
|---|---|---|---|---|
| **Barbados** | - White stick<br>- Butterstick (Brown stick) | | - M. Mex 23<br>- M. Mex 55 | Tacana<br>Local 1 |
| **Guyana** | - Uncle Mack<br>- Bad woman<br>- MMex 59 | - MMex 52<br>- Butter stick<br>- Mexican | - Brown stem<br>- Kairuni Cassava<br>- White stick | - Smokey Prolific<br>- Santa Rosa Magenta<br>- Yankee |
| **Jamaica** | - Blue Bud<br>- Cuba Sweet<br>- Prison Farm<br>- Real Sweet | - Rockwood<br>- Manson<br>- Sweet cassava<br>- Bitter cassava | - CM516<br>- CM849<br>- CM3306-4<br>- CM3299<br>- CM6119-5<br>- CM523-7 | - CM2772-3<br>- CM2776-5<br>- MCOL 22<br>- MCOL 1505<br>- BRA383<br>- PER183 |
| **Belize** | - Panamá<br>- Sweet Cassava | - Blue Bird<br>- Rasta | - Bitter cassava | |
| **Dominica** | - Bitter | Butter Stick | - White Stick | 100 pounds |
| **Grenada** | -MCOL 1468 | Señorita Blanca | - CMC-40 | - Valencia |

| COUNTRY | CASSAVA VARIETIES | | | |
|---|---|---|---|---|
| **Montserrat** | - Red Stem<br>- Mingo Sweet | - Fountain Bitter<br>- Green Stem | - Fountain Sweet-<br>- Elmont Pink | - Guyana Sweet<br>- Belmont Green |
| **St. Lucia** | -Bitter variety | - Sweet variety | - MCOL 22 | Whyme |
| **St. Kitts and Nevis** | -Coconut<br>-St. Lucia Sweet | - Mingo Sweet<br>- Sugar | - Negro | - Salt |
| **St Vincent and The Grenadines** | - Punt stick-<br>- Butter stick<br>- White stick | - M Bra 383<br>- CM 3306-4<br>- CM 7514-8 | - CM 7514-7<br>- CM 4919-1<br>- SM 1565-15 | |
| **Suriname** | - Local yellow<br>- Valencia | - Sweet cassava<br>- Bitter cassava | - Reditikie<br>- Botro cassava (gele cassave) | |
| **Trinidad and Toabgo** | - Blue bud<br>- Butter stick<br>- CIAT hybrid<br>- Maracas black stick<br>- White stick | - Pickney mumma<br>- Sweet cassava<br>- Bitter cassava<br>- MMex 59<br>- MMex 60<br>- MMex 61 | - CM3306-4<br>- CM3299<br>- CM6119-5<br>- CM523-7<br>- BRA383<br>- M PER183 | - CM2772-3<br>- CM2766-5<br>- MCOL 2215<br>- MCOL 1505<br>- CG 1450-4 |

Source: FAO/IICA/CLAYUCA Survey.

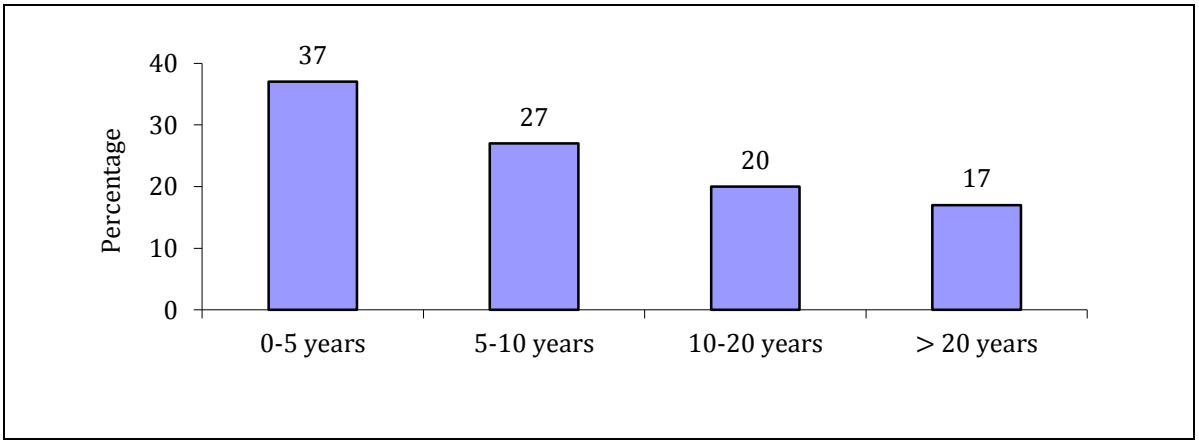


Figure 3. Experience of cassava farmers included in the survey.
Source: FAO/IICA/CLAYUCA Survey.

## Origin of the cassava planting material

The majority of the farmers interviewed (83%) obtained planting material from their own cassava fields. 13% of the farmers interviewed indicated that they used both, their own planting material and also material purchased from other farms. A small group of farmers (7%) indicated that they only used planting material purchased from other farms. Finally, around 10% of the farmers indicated that they used only planting material obtained through research and technology transfer agents and through their participation in cassava technology research and development activities (Figure 4). Cassava gene banks were considered the best source for

farmers to have access to improved cassava varieties. In the LAC region, the germplasm bank of the International Centre for Tropical Agriculture – CIAT, Cali, Colombia, is the largest cassava genebank, and it is also the main source from which cassava farmers could have facilitated access to improved cassava varieties and good quality planting material.

### Introduction of improved cassava germplasm in the Caribbean countries

This could be one of the best strategies for promoting improvements in the productivity of the crop. One of the sections included in the survey aimed to obtain specific, updated information on the existence of cassava gene banks in the Caribbean countries. 65% of the respondents indicated that there is a cassava gene bank in their countries that could be used as a source for obtaining new, improved cassava varieties; however, 36% of the respondents indicated that they had not used any new variety for the past 10 years, despite the fact that they knew that during this period, there were introductions of improved cassava varieties in their countries.

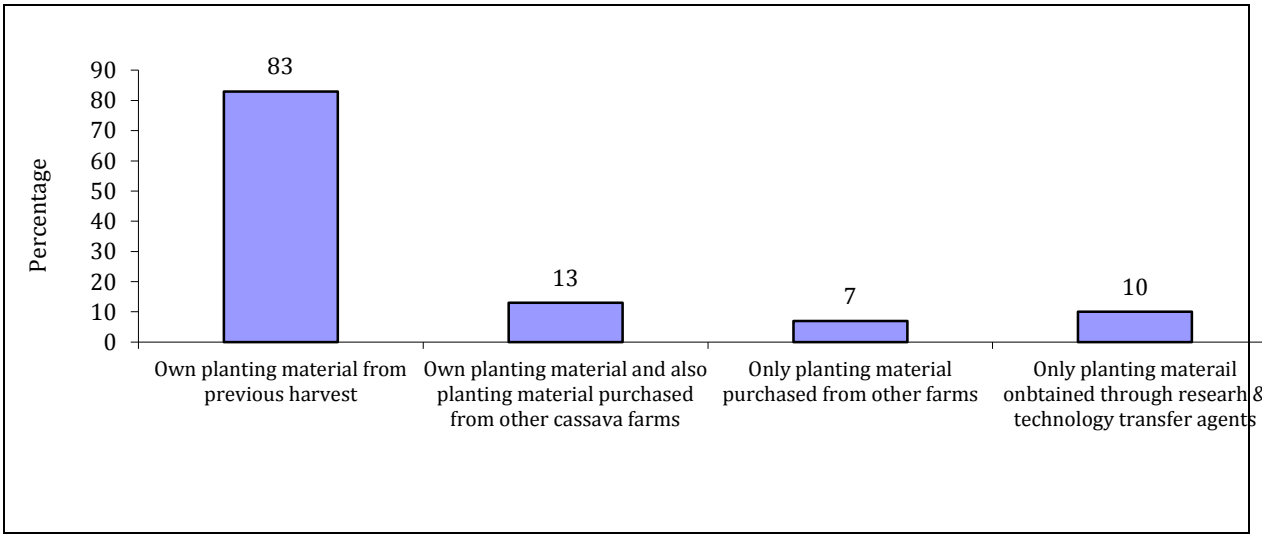


Figure 4. Origin of the cassava planting material used by cassava farmers included in the survey. Source: FAO/IICA/CLAYUCA Survey.

A recurrent, very common problem in countries of CARICOM is the lack of tracking / traceability of the varieties after release. In many instances, improved cassava varieties have been introduced, and some years later, it has been difficult to keep track of these varieties. In some cases, they have been completely lost. Very seldom, these introduced varieties become cassava genetic resource pools that can be used widely by the farmers, especially the small-scale farmers. Interestingly, 93% of the respondents expressed that they would be interested in paying to acquire planting material of a new cassava variety, if they could be convinced that this new variety would yield better than the varieties they were currently growing.

This is a good indicator that the cassava farmers in the region are open to innovations and are willing to invest in acquiring them. Table 20 presents a list of the principal cassava varieties that have been introduced to the CARICOM countries, as indicated by the respondents to the survey.

Table 20. Cassava varieties introduced in the Latin America and Caribbean region.

| COUNTRY | CASSAVA VARIETIES INTRODUCED | | | YEAR AND ORIGIN |
|---|---|---|---|---|
| Jamaica | CM 6119-5 | CM 3306-4 | CM 523-7 | 2012 CIAT Cassava Germplasm Bank |
| | CM 2772-3 | MCOL 2215 | BRA 383 | |
| | Per183 | CM 2766-5 | MCOL 1505 | |
| | CM 3299 | CM 516 | CM 849 | |
| | CM 1450-4 | CM 523-7 | CM 2766-5 | 2011 CIAT Cassava Germplasm Bank |
| | CM 2772-3 | CM 3306-4 | CM 6119-5 | |
| | BRA 383 | MCOL 1505 | MCOL 2215 | |
| | HMC 7 | PER 183 | | |
| Trinidad and Tobago | MCOL 2215 | MMex 59 | CM 3306-4 | 2005 CIAT Cassava Germplasm Bank |
| | CM 523-7 | BRA 383 | CG 1450-4 | |
| | CM 2766-5 | CM 6119-5 | MCOL 2215 | |
| | MCOL 1505 | | | |
| | CM 5306-8 | MCOL 1522 | CR 30 | 2013 CIAT Cassava Germplasm Bank |
| | CR 63 | CR 64 | CR 67 | |
| | PER 183 | | | |
| Suriname | CM 507-37 | CM 523-7 | CM 3306-4 | 2002 CIAT Cassava Germplasm Bank 2014 CIAT Cassava Germplasm Bank |
| | CM 4574-7 | CM 4843-1 | CM 5306-8 | |
| | CM 6119-5 | CM 6740-7 | CM 6754-8 | |
| | CM 6921-3 | | | |
| | CM 5306-8 | MCOL 1522 | CR 30 | |
| | CR 63 | CR 64 | CR 67 | |
| | PER 183 | CM 7073-7 | CM 7514-7 | |
| | CM 7514-8 | CM 7951-5 | CM 8027-3 | |
| | SM 805-15 | SM 909-25 | SM 1411-5 | |
| | | | | |
| | SM 1565-15 | BRA383 | PER 183 | |
| | M TAI 8 | CM 2166-6 | CM 2563-5 | |
| | | | | |
| | CM 2766-3 | CM 3110-8 | CM 5253-1 | |
| | CM 7086-13 | CM 7596-5 | SM 667-1 | |
| Barbados | M Mex 23 | M Mex 55 | MCol 673 | 1979 |
| | M Col 22 | To 172 | Tacana | |
| | CM 323 375 | CM 308 197 | CM 305 122 | |
| | M Col 1684 | Butterstick | Local 1 | |
| | Local 2 | | | |
| | CG 1450-4 | CM 2766-5 | CM 6119-5 | 2014 CIAT Cassava Germplasm Bank |
| | MCOL 1823 | PER 183 | CM 2600-2 | |
| | CM 6438-14 | CUB 75 | CUB 74 | |
| | CM 6740-7 | SM 1219-9 | | |
| Dominican Republic | CM 507-37 | CM 523-7 | CM 2772-3 | 2003 CIAT Cassava Germplasm Bank |
| | CM 3306-4 | CM 4574-7 | CM 4843-1 | |
| | CM 4919-1 | CM 5306-8 | CM 6119-5 | |
| | CM 6438-14 | CM 6740-7 | CM 7033-3 | |
| | CM 6921-3 | CM 7073-7 | CM 7514-8 | |
| | CM 7951-5 | CM 8027-3 | SM 805-15 | |

| COUNTRY | CASSAVA VARIETIES INTRODUCED | | | YEAR AND ORIGIN |
|---|---|---|---|---|
| | SM 909-25 | SM 1433-4 | SM 1460-1 | |
| | SM 1565-15 | SM 1821-7 | MCOL 2063 | |
| | BRA383 | PER 183 | M TAI 8 | |
| | Valencia | CM 6921 (Lima-21) | CM 6740 (Lima-40) | 2008 |
| | TAI-8 (Tai Lima) | | | Costa Rica |
| **Ecuador** | CG 165-7 | CM 3380-7 | CM 3456-3 | 2012 CIAT Cassava Germplasm Bank |
| | CM 4733-2 | CM 4574-7 | CM 4772-4 | |
| | CM 4793-1 | CM 5253-1 | CM 5898-2 | |
| | CM 6070-1 | CM 6082-1 | SG 104-64 | |
| | CM 6850-2 | CM 7052-3 | CM 7395-5 | |
| | CM 7825-1 | CM 8370-1 | CM 7392-5 | |
| | MCOL 2199 | MCOL 2436 | MPER 297 | |
| | CM 4484-2 | CM 4777-2 | SG 107-35 | |
| | CM 6758-1 | CM 7463-2 | MBRA 253 | |
| **Nicaragua** | CG 1141-1 | CM 523-7 | CM 2772-3 | 2012 CIAT Cassava Germplasm Bank |
| | CM 3306-4 | CM 4574-7 | CM 4843-1 | |
| | CM 4919-1 | CM 5306-8 | CM 6119-5 | |
| | CM 6438-14 | CM 6740-7 | CM 7033-3 | |
| | CM 6921-3 | CM 7073-7 | CM 7514-8 | |
| | M BRA383 | SM 1433-4 | SM 805-15 | |
| | PER 183 | SM 1460-1 | MCOL 2215 | |

Source: FAO/IICA/CLAYUCA Survey.

## Technical aspects of cassava cultivation in the Caribbean region

### *Soil preparation*

Soil preparation for planting cassava is done mechanically, in the majority of the cases, principally during the months of January to May and also October to November.

### *Planting*

80% of the respondents indicated that they plant cassava manually, all year round, using planting distances of between 50 to 100 centimeters between plants and 60 to 150 centimeters between rows.

### *Weed control*

The principal weeds affecting the cassava crop in the region were:

- *Cyperus rotundus* (Nut grass)
- *Digitaria insularis* (Cebadilla)
- *Euphorbiaceas*
- *Gramínea* spp.
- *Panicum maximum*
- *Portulaca* spp.*s*
- *Pueraria phaseolides* (Kudzu)
- *Amaranthus hybridus*

- *Ipomoea tiliacea*

Cassava producers in the region use a combination of manual and chemical methods (herbicides) for the control of weeds in cassava plots.

***Fertilization***

About 87% of the respondents indicated that they used fertilizers to increase yields and complement soil nutrient requirements and the application was done initially after planting, and later, several times during the crop cycle.

53% of the farmers used soil analysis to determine the need, type and amount of fertilizer required. 13% of the respondents do not use fertilizers due to high costs and their belief that the soil does not require nutritional improvements.

***Diseases***

The principal diseases affecting the cassava crop in the Caribbean region were:

- *Xanthomonas campestris* (Cassava bacterial blight)
- *Super elongation*
- *Cercospora henningsii* (Brown Leaf spot)
- *Phytophthora* (Fungus in the roots)

Farmers try to control these diseases through integrated methods, including chemicals. Biological and manual controls were the least used (Figure 5).

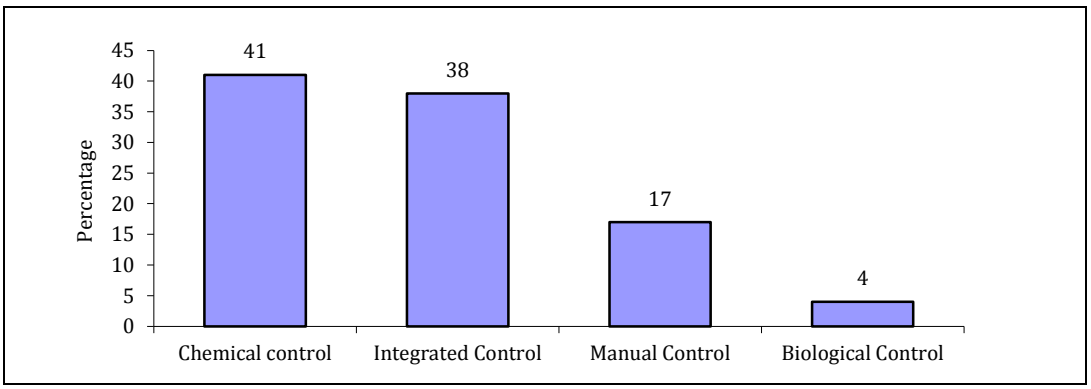


Figure 5. Methods used in the Caribbean region to control cassava diseases.
Source: FAO/IICA/CLAYUCA Survey.

***Pests***

The main pests and insects attacking the cassava crop in the Caribbean region were:

- *Corynothrips stenopterus* Thrips
- *Mononychellus tanajoa* Mites
- *Bemisia tuberculata* Whiteflies
- *Erinnyis ello* L Marandova, cassava hornworm
- Worms and bugs
- Spiders and Ants
- Rats

67% of the respondents indicated that they used chemical methods to deal with pests and diseases affecting the cassava crop. 23% indicated that they prefer an integrated approach. Manual and biological control methods were least used for controlling cassava pests and insects (Figure 6).

The intensive use of chemical control for dealing with cassava pests and diseases in the Caribbean indicates that alternative methods for cassava production, based on organic farming systems, are not widely used. In fact, 71% of respondents indicated that cassava production systems based on organic farming methods are non existent.

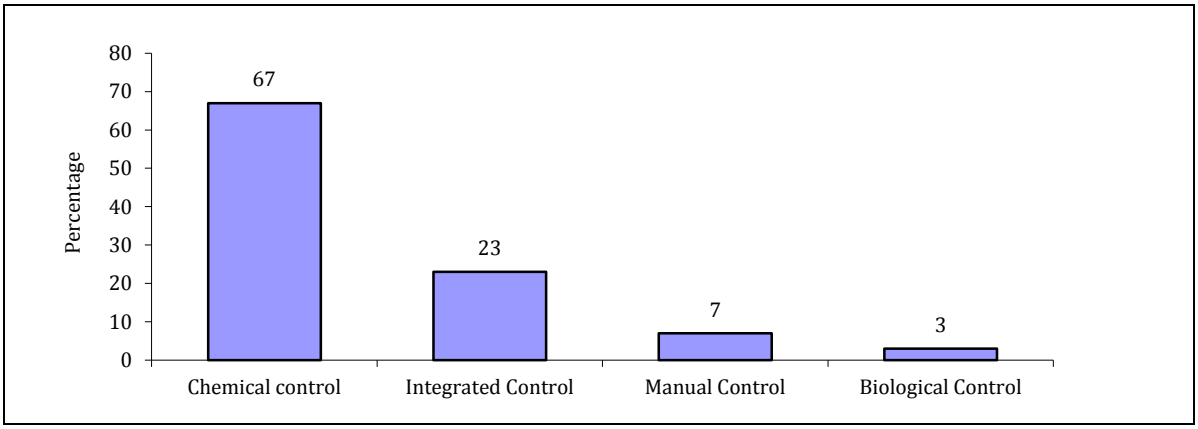


Figure 6. Methods used in the Caribbean region to control cassava pests and insects.
Source: FAO/IICA/CLAYUCA Survey.

***Harvest and use***

Cassava harvest is done principally using manual methods. The main destination for the produce varies between commercial sales, own consumption, and agro-processing (for both own consumption and sales). Figure 7 presents the information obtained in the survey. Although the main target of cassava producers are commercial sales, a significant number of farmers that responded to the survey (29%) are engaged in agricultural research, and more specifically in activities related to the management of cassava germplasm banks and the establishment of validation trials for cassava varieties.

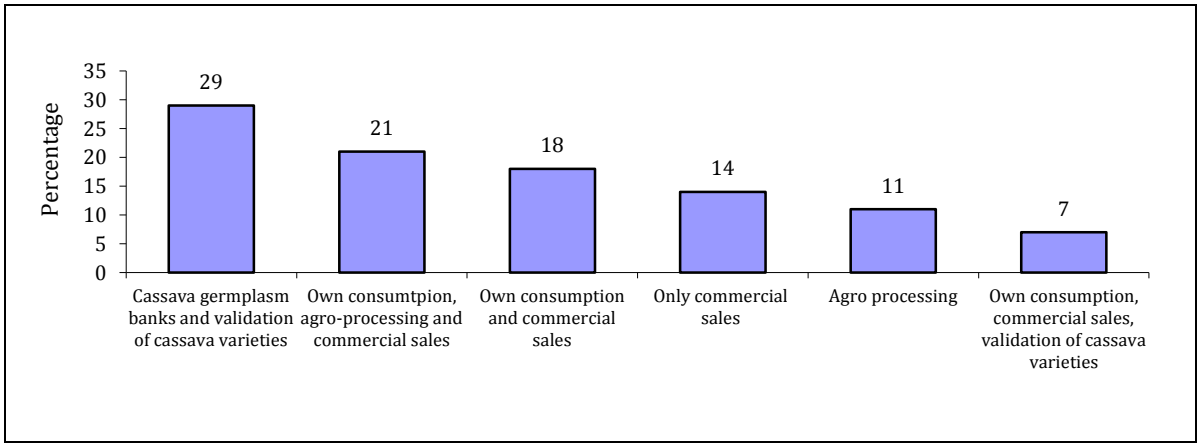


Figure 7. Main markets for cassava production in selected Caribbean countries.

Source: FAO/IICA/CLAYUCA Survey.

21% of the respondents used the cassava produced for self-consumption, as raw material for their own agro-processing activities, and also for selling to other markets as fresh cassava roots and for agro-processing. 18% of the respondents used the cassava for their own consumption and for sale as fresh cassava roots. Only 14% of the respondents indicated that they sold all the cassava produced and another 11% used it solely for agro-processing. Finally, 7% of the respondents indicated that they used the cassava produced for their own consumption, for commercial sales and they also participated in validation trials of cassava varieties, because they are also researchers or technology transfer agents that have their own cassava plantings.

### Institutions working with cassava in the Caribbean region

In the Caribbean region, the main institutes working to promote improvements in cassava production and productivity are the Caribbean Agricultural Research and Development Institute (CARDI), the Inter-American Institute for Cooperation on Agriculture (IICA), FAO and the respective Ministries of Agriculture in each country. In some countries, Universities are also involved in research and development activities with cassava. Table 21 presents the list of the institutions that work on cassava in each country. The existence of these institutions has enabled cassava producers and processors in the region, to have greater and facilitated access to new knowledge on improved production and processing technologies for cassava. 75 % of respondents to the survey indicated that cassava producers in the country are receiving technical assistance from national institutions related to cassava production technology through courses for farmers, field manuals with recommendations and periodic visits of the technology transfer agents.

Table 21. Main Institutions working on cassava in the Caribbean region.

| COUNTRY | INSTITUTION | ACTIVITES |
|---|---|---|
| **Barbados** | Ministry of Agriculture | ▪ Production of high quality cassava varieties through *in-vitro* and vegetative propagation methods. |
| | CARDI | ▪ Establishment and operation of virus-free, tissue culture laboratories.<br>▪ Evaluation of the quality of the *in-vitro* cassava materials.<br>▪ Vegetative propagation of cassava materials for production of high quality cassava varieties.<br>▪ Establishment and upgrading of greenhouses. |
| | BADMC | ▪ Cassava varietal evaluation trials.<br>▪ Development of food products with added value.<br>▪ Building processing infrastructures and connecting cassava processors with other actors of the cassava chain.<br>▪ Research and formulation of packaging materials.<br>▪ Replacement of wheat flour by cassava flour.<br>▪ Development of food products (bread, pastries, cookies, snacks, extruded products). |
| | UWI | ▪ Production of high quality cassava varieties through in-vitro and vegetative propagation methods.<br>▪ Research on super-elongation disease of cassava (in collaboration with the Ministry of Agriculture, BADMC and farmers) |
| **Belize** | CARDI<br>Ministry of Agriculture | ▪ Evaluation of high yield cassava varieties.<br>▪ Evaluation of disease-resistant cassava varieties. |
| **Jamaica** | Ministry of Agriculture - Research & Development | ▪ Field demonstration activities: land preparation, use of planting material, fertilization, integrated pest and disease management. |
| | UWI | ▪ Cassava processing activities; development of food products. |
| | CARDI | ▪ Conservation and commercial production of seedlings.<br>▪ Field demonstration activities: land preparation, use of planting material, fertilization, integrated pest and disease management.<br>▪ Evaluation of cassava varieties with high yield potential and tolerance to pests and diseases.<br>▪ Upgrading of equipment and tools.<br>▪ Training in safe handling of food and machinery. Association of producers and processors.<br>▪ Technical assistance for the development of action plans to increase cassava industry and improve cassava competitiveness. |
| | RADA-Rural Agricultural Development Agency (Extension arm of the Ministry of Agriculture) | ▪ Promotion of proper Post Harvest Managements practices.<br>▪ In some countries, Universities are also involved in research and development activities with the cassava crop. Technology delivery link to rural farmers.<br>▪ Providing continuous training opportunities for farmers. |
| | Red Stripe Beer Company | ▪ Promotion of the use of cassava in beer making.<br>▪ Commercial scale cassava plantings with higher productivity. |
| | Scientific Research Council (SRC) | ▪ Greenhouse propagation of high quality cassava varieties.<br>▪ Conservation and commercial production of seedlings.<br>▪ Research for development of packaging materials.<br>▪ Replacement of wheat flour by cassava flour.<br>▪ Development of products such as bread, cakes, biscuits and snacks (extruded). |

| COUNTRY | INSTITUTION | ACTIVITES |
|---|---|---|
| | Bodles Research Station | ▪ Field evaluation of improved cassava varieties.<br>▪ Demonstration of cassava crop management practices. |
| | FAO | ▪ Agricultural policy related activities; promoting the development of the cassava industry in the Caribbean |
| | University of Techology (UTECH) | ▪ Promotion of the use of cassava in food products. |
| **Guyana** | Ministry of Agriculture | ▪ Production of high quality cassava varieties through in-vitro and vegetative propagation methods.<br>▪ Field demonstration of technological packages: land preparation, use of planting material, fertilization, integrated pest and disease management, post-harvest technologies and yield improvement. |
| | CARDI | ▪ In-situ establishment and maintenance of cassava Germplasm Banks.<br>▪ Field demonstration of technological packages: land preparation, use of planting material, fertilization, integrated pest and disease management, post-harvest technologies and yield improvement. |
| | NAREI | ▪ Post-harvest practices.<br>▪ Yield improvement technologies.<br>▪ Actualization of equipment and machinery.<br>▪ Promotion of the production, processing and commercialization of high quality bread, flour, tapioca and cassarep. |
| | UWI | ▪ Production of high quality cassava varieties through in-vitro and vegetative propagation methods. |
| **Trinidad and Tobago** | Ministry of Food Production | ▪ Field demonstration activities: land preparation, use of planting material, fertilization, integrated pest and disease management.<br>▪ In-vitro collection of cassava varieties.<br>▪ Greenhouse propagation of high quality cassava varieties.<br>▪ Training and technology transfer activities.<br>▪ Public awareness activities (cassava week, cassava store). |
| | CARDI | ▪ Multi-actors platforms for the development of agro-productive value chains.<br>▪ Training activities on improved production and post-harvest technologies.<br>▪ In-situ collection of cassava varieties bank.<br>▪ Construction and maintenance of greenhouses.<br>▪ Greenhouse propagation of high quality cassava varieties.<br>▪ Improvement of the infrastructure for processing of cassava bread and cassava flour (5 agro-enterprises).<br>▪ Training activities for safe handling of food products.<br>▪ Technical assistance for the development of action plans to increase cassava industry and improve cassava competitiveness. |
| | UWI<br>St. Augustine Campus | ▪ In-situ collection of cassava varieties bank.<br>▪ In-vitro collection of cassava varieties.<br>▪ Training activities for safe handling of food products and machinery. |
| | IICA | ▪ Public policies for agricultural sector.<br>▪ Innovation for agribusiness sector.<br>▪ Institutional framework for agriculture.<br>▪ Technological innovations. |
| | TTABA | ▪ Research for development of packing materials.<br>▪ Substitution of wheat flour by cassava flour.<br>▪ Development of food products (bread, cookies, pastries, snacks).<br>▪ Development and strengthening of agro-productive value chains.<br>▪ Commercial development of food products.<br>▪ Expansion of the cassava agribusiness sector. |

| COUNTRY | INSTITUTION | ACTIVITES |
|---|---|---|
| | NAMDEVCO | ▪ Marketing systems: data base (costs, prices, production, imports, exports) for fresh and processed cassava.<br>▪ Public awareness activities (cassava week, cassava store). |
| | CARIRI | ▪ Research for development of packing materials.<br>▪ Substitution of wheat flour by cassava flour.<br>▪ Development of food products (bread, cookies, pastries, snacks)<br>▪ Development of processing equipment. |
| **St Lucia** | Ministry of Agriculture | ▪ Field demonstration activities: land preparation, use of planting material, fertilization, integrated pest and disease management. |
| | CARDI | ▪ Evaluation of cassava varieties with high yield potential and tolerance to pests and diseases. |
| | IICA | ▪ Public policies for agricultural sector.<br>▪ Innovation for agribusiness sector.<br>▪ Institutional framework for agriculture.<br>▪ Technological innovations. |
| **St. Vincent and the Grenadines** | Ministry of Agriculture | ▪ *In-situ* collection of cassava varieties bank.<br>▪ Greenhouse propagation of high quality cassava varieties. |
| | CARDI | ▪ *In-situ* collection of cassava varieties bank.<br>▪ Construction and maintenance of greenhouses.<br>▪ Greenhouse propagation of high quality cassava varieties.<br>▪ Improvement of the infrastructure for processing of cassava bread and cassava flour (5 agro-enterprises).<br>▪ Training activities for safe handling of food products.<br>▪ Technical assistance for the development of action plans to increase cassava industry and improve cassava competitiveness. |
| | IICA | ▪ Public policies for agricultural sector.<br>▪ Innovation for agribusiness sector.<br>▪ Institutional framework for agriculture.<br>▪ Technological innovations. |
| | UWI | ▪ In-situ collection of cassava varieties bank.<br>▪ Training activities for safe handling of food products. |
| | Tissue culture laboratory | ▪ In-vitro collection of cassava varieties.<br>▪ Conservation of in-situ collection of cassava varieties.<br>▪ Commercial production of cassava planting material. |
| **Suriname** | Ministry of Agriculture, Animal Husbandry and Fisheries | ▪ Training activities for farmers on post-harvest technologies. |
| | CELOS | ▪ Experimental trials with cassava varieties (local and imported from CIAT).<br>▪ Economic analysis of the costs and profits resulting from field research activities.<br>▪ Studies on the impact of mechanization for cassava production. |
| | STOCPA | ▪ Support development with the focus on entrepreneurial activities. |
| **Dominican Republic** | Ministry of Agriculture | ▪ Technical assistance activities; Prevention and control of pests and diseases. |
| | IDIAF | ▪ Research and technology adaptation and transfer activities. |
| | CONIAF | ▪ Support to research and technology transfer activities. |
| | FAO | ▪ Agricultural policy related activities. |
| | Agricultural Bank | ▪ Credit services for agricultural sector. |

Source: FAO/IICA/CLAYUCA Survey.

## Constraints to cassava production and processing in the Caribbean region

The main constraints to cassava production and processing activities in selected countries of the Caribbean region, according to the information collected from the survey, were as follows:

### Institutional support and assistance

- Lack of credit.
- Lack of technological innovation options for cassava.
- Subsistence, small-scale economies of cassava processors.
- Lack of government programs and policies to support cassava production and agro-processing activities.
- Lack of secure, reliable contracts for farmers to maintain continuous production to supply processing enterprises.

### Production

- Poor performance in production (low yield).
- Lack of options for using cassava improved varieties (in terms of knowledge and availability).
- Traditional production technologies and cultural and traditional methods (low inputs, low yield).
- Low quality of cassava roots for sales and processing.

### Markets

- Lack of organization of cassava producers and processors to enable them to meet different markets.
- Lack of guaranteed markets.
- High cost of labor and low market prices for agricultural products.
- Limited domestic markets with few products available.

### Women's participation in cassava production and processing activities in the Caribbean region

Over the past 10 years, the participation of women in cassava production and processing activities in countries of the Caribbean region has been increasing. Figure 8 shows the participation of women in different activities related to cassava production and processing. This reveals that the participation of women has been higher in activities such as marketing, processing, training, and the selling of the products. Some activities more related with the production of the crop had less participation of women: planting, weed control, fertilization, harvesting and procurement of planting material. The activities with minimum involvement of women were land preparation, pest and disease control, wage generation in other farms, and land renting arrangements.

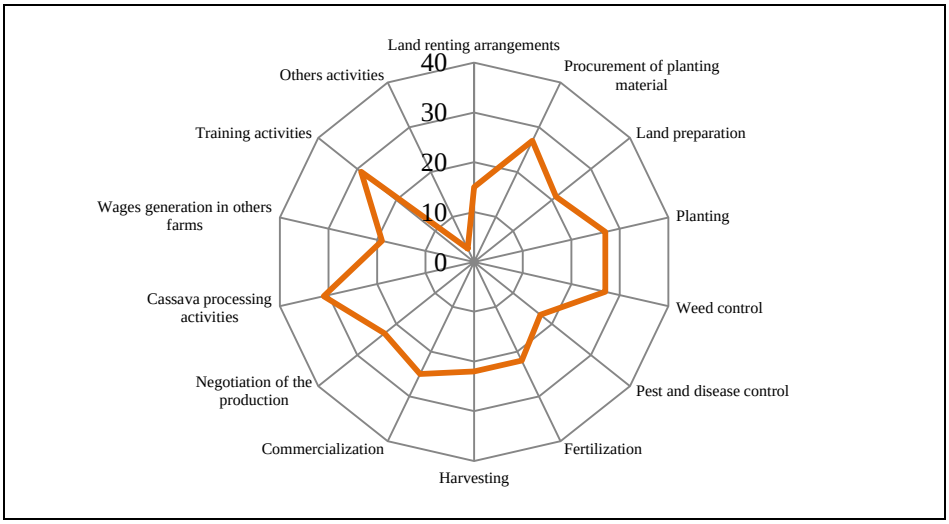


Figure 8. Participation of women in cassava production and processing activities in selected Caribbean countries.
Source: FAO/IICA/CLAYUCA Survey.

## Cassava processing activities in selected countries of the Latin American and Caribbean (LAC) Region (including Dominican Republic, Paraguay, Nicaragua and Ecuador)

Based on the answers from the respondents to the survey, the profile of the cassava processing systems prevailing in selected countries of the LAC region is presented in the next section (30% of the respondents indicated that they participate actively in cassava processing activities).

### *Main characteristics*

Over 90% of cassava production is targeted for the fresh market and less than 5% is used for product development with some added value. Most cassava processors operated small-scale enterprises with traditional technology and inadequate infrastructure. In most cases, cassava processing activities are conducted at the household level, usually based on two or three local varieties and the market options are limited to small shops and local stores and supermarkets.

### *Type of business*

57% of the survey respondents were persons that produced cassava in the region. About 30% of these producers are also engaged in cassava processing related activities. About one third of the farmers that participated in processing activities were working for a private sector processing company (Figure 9). These private companies were mostly micro-enterprises, with no more than 10 employees. Labor hiring was temporary and depended on the production levels.

The second most important category of cassava processing enterprises corresponded to family-owned type, with about 30% of the processors. These family-owned enterprises made use of mainly family labor, although, in times of high production, they may hire between 1 to 5 workers.

About 20% of the processing companies are state-owned enterprises that process cassava for research and technology development purposes. These research groups are comprised of 2 to 6 employees.

Finally, farmers' cooperatives account for 14% of the enterprises that conducted cassava processing activities in the region; cooperatives had on average between 6 and 10 employees (farmers).

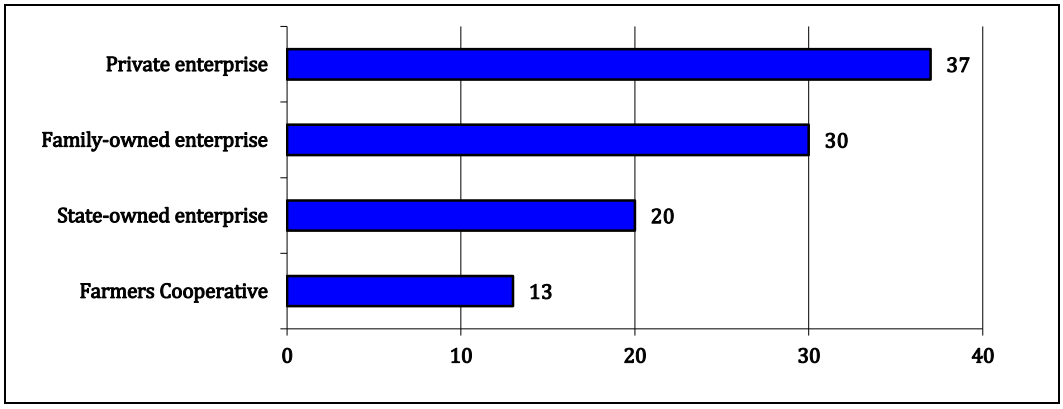


Figure 9. Different types of cassava processing enterprises existing in selected Caribbean countries.
Source: FAO/IICA/CLAYUCA Survey.

## Origin of cassava for processing activities and prices

The main sources of raw material (cassava roots) for the processing enterprises are from growers in the surrounding areas. 45% of cassava processors who answered the survey indicated that they rely exclusively on local farmers for cassava roots. About 36% of the cassava processors had their own cassava plantings and the other 19% operated with both their own plantings and cassava roots purchased from growers in the vicinity of their processing enterprises (Figure 10).

Having their own cassava plantings allowed processors to have a constant supply of roots. 70% of the respondents indicated that in 2013, the cassava roots purchased were enough to supply the needs and the installed capacity of their enterprises.

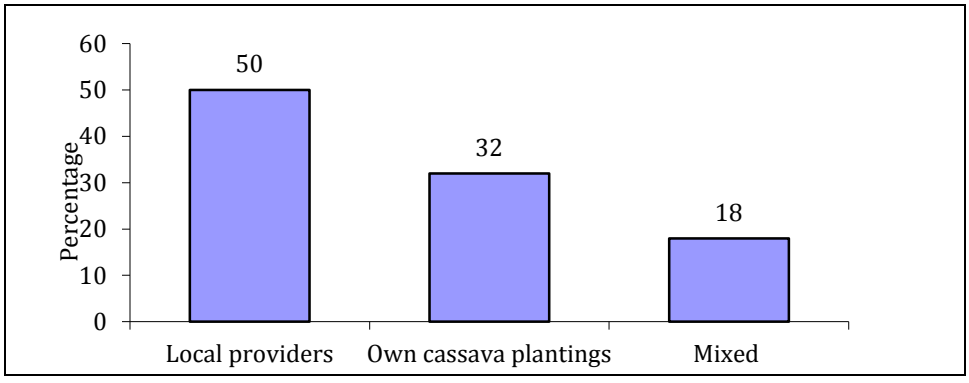


Figure 10. Different sources of raw material (cassava roots) for cassava processing enterprises in selected Caribbean countries.
Source: FAO/IICA/CLAYUCA Survey.

### Prices of cassava roots

The prices at which the processors buy fresh cassava roots were rather similar in some countries of the CARICOM region, with prices ranging from US$ 100 to US$ 180 per metric ton. Processors in Trinidad and Tobago and St. Vincent and the Grenadines reported the highest prices, ranging from US$ 230 to US$ 470 per metric ton. Table 22 shows the prices at which cassava roots were purchased by cassava processing enterprises, in selected countries of the Caribbean region, based on the survey.

Table 22. Prices paid for cassava roots by processing enterprises in selected countries.

| COUNTRY | PRICE (USD$/MT) |
|---|---|
| Barbados | 140 |
| Jamaica | 160 – 180 |
| San Vincent & the Grenadines | 190 – 260 |
| Surinam | 100 |
| Trinidad and Tobago | 230 – 470 |
| Nicaragua | Cassava Grade A: 135<br>Cassava roots Grade B: 88 - 90<br>Cassava roots Grade C: 30 – 50 |
| Paraguay | 80 – 160 |

Source: FAO/IICA/CLAYUCA Survey

Although cassava roots were purchased at rather high prices, processors reported that their production cycle generated returns, albeit these were medium to low. They were able to cover part of the demand and remain in the market as producers and processors. The demand for processed products was increasing, a situation that encouraged them to continue with cassava activities, undertaking technological improvements and trying to build trusting relationships with farmers and traders to lower production costs and generate better profits.

### Cassava processing technology

Figures 11 and 12 indicate the different types of processing activities that are conducted in the cassava processing enterprises, and the percentage of these operations that are done manually or mechanically. Some of the activities are performed manually, especially those steps in the processing line that could be done easily by workers. This is an important aspect of cassava processing activities in the region, as an activity that helps to generate employment at the rural level (Figure 11).

There are other processing activities that require some degree of care and quality (slicing, pressing, and cooking), in which the use of mechanical processing is more intensive (Figure 12).

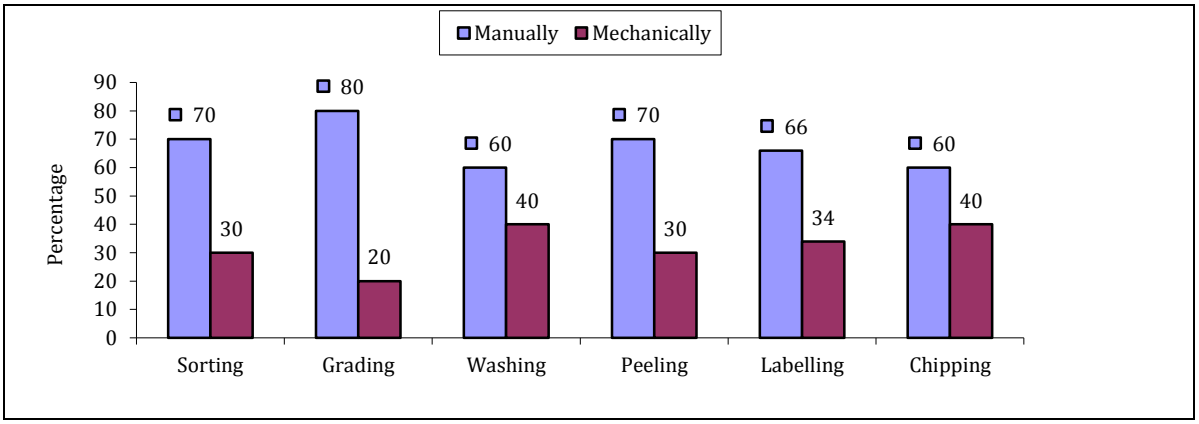


Figure 11. Cassava processing activities conducted manually and mechanically in selected Caribbean countries (as a percentage of the total number of processing enterprises interviewed). Source: FAO/IICA/CLAYUCA Survey

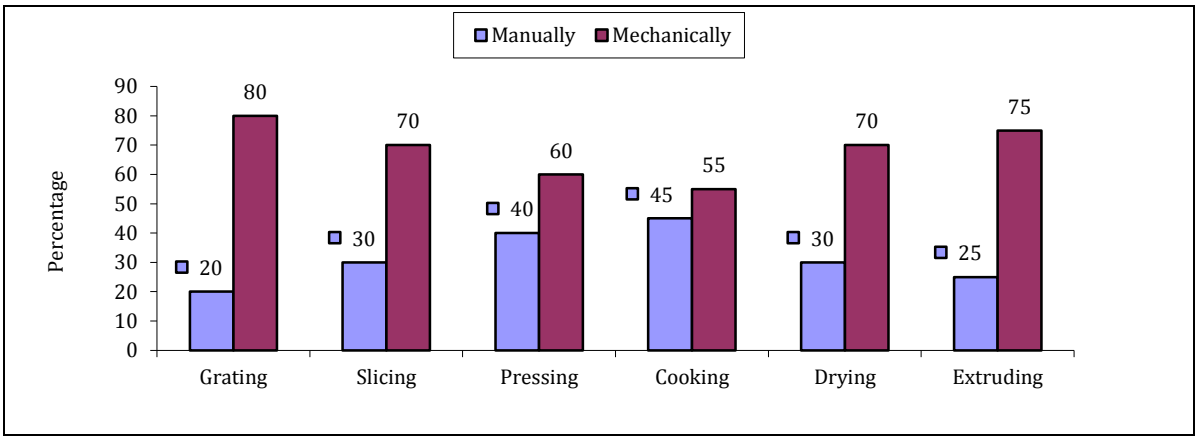


Figure 12. Cassava processing activities conducted manually and mechanically in selected Caribbean countries (as a percentage of the total number of processing enterprises interviewed). Source: FAO/IICA/CLAYUCA Survey

## Cassava varieties used in processing activities

In the CARICOM countries, surveyed, a large number of cassava varieties are being used in processing activities, both native and those introduced in recent years. Table 23 indicates the main varieties that are currently in use for cassava processing activities in these countries, the main use for each variety and the reasons of the preference by the farmers for these varieties

MMEX is the only commercial variety in Trinidad and Tobago. Farmers and processors did not yet have reliable access to other sources of varieties with higher yields and better processing quality. In some countries like Paraguay, due to lack of raw materials, processors accept all available cassava varieties, but prefer those with a concentration of dry matter exceeding 25%, such as Cano Pyta and the White starch. The main forms in which cassava is processed in the Caribbean region are:

- Cassava flour
- Cassava starch
- Paraffin-coated cassava
- Dry cassava chips for animal feed
- Peeled, frozen fresh cassava logs

Table 23. Main cassava varieties used in cassava processing activities in selected countries of the Caribbean region.

| COUNTRY | VARIETY | USE | REASONS FOR PREFERENCE |
|---|---|---|---|
| **Barbados** | Butter stick<br>Bobby Hassan<br>Prison farm<br>Rockwood<br>Smoking | Flour | Small roots, thin peel |
| **Belize** | Panama<br>Sweet cassava<br>Blu bie<br>Red<br>Rasta<br>Bitter cassava | Fresh consumption<br>Starch<br>Processing<br>Animal feed | High dry matter<br>Good yields<br>Good market acceptance |
| **Dominica** | Butter<br>Sweet<br>100 pounds | Flour<br>Cassava bread | Good yields<br>Good acceptance<br>High dry matter |
| **Grenada** | Sweet<br>Butter<br>Señorita Blanca<br>MCol 1468<br>CMC-40<br>Valencia | Farine<br>Flour<br>Cassava bread<br>Peeled frozen cassava | Good yields<br>Good acceptance<br>High dry matter |
| **Guyana** | Four months<br>Butterstick<br>Uncle Mack<br>Bad Woman<br>7U | Fresh consumption<br>Flour<br>Bammy<br>Starch<br>Chips<br>Biscuits<br>Cookies | Good yields<br>Good acceptance<br>High dry matter |
| **Jamaica** | Mcol 22 (Colombia)<br>CM516<br>Cuban sweet<br>CM849<br>Blue Bud<br>Real Sweet | Flour; starch | High starch content; good supply<br>Flour |
| **Nicaragua** | Valencia<br>CM 6740-3 (Reyna)<br>Colombia<br>Criolla<br>Peru 183 (2008) Perú<br>Ceiba<br>Pococha or Cubana | Paraffin-coated (export market)<br>Flour; starch | High productivity; good market acceptance; disease resistant; good shape; high cooking quality<br>High productivity<br>High dry matter content<br>Attractive for the consumer<br>Presence of peduncle that makes it suitable for paraffin coating. |
| **Montserrat** | Red Stem<br>Mango Sweet | Cassava bread | |

| COUNTRY | VARIETY | USE | REASONS FOR PREFERENCE |
|---|---|---|---|
| | Belmont Pint<br>Fountain Bitter<br>Green Stem<br>Belmont Green<br>Fountain Sweet<br>Guyana sweet | | |
| **Paraguay** | Cano Pyta<br>Fécula Blanca<br>Pomberí<br>Mesaí<br>Toledo | Flour, starch, Bammy | High dry matter content<br>Good yields |
| **St. Vincent and the Grenadines** | Butter stick (white variety)<br>Point Stick | Flour<br>Farine<br>Starch<br>Chips Cassava bread | Soft and good flavor |
| **St: Kitts** | Coconut<br>Mango Sweet<br>Negro<br>Salt<br>St. Lucia Sweet<br>Sugar | Pellets<br>Flour | |
| **Suriname** | Bitter<br>Sweet<br>White stick | Pellets<br>Flour | |
| **Trinidad and Tobago** | MMex<br>CIAT Hybrid<br>MCol 2215<br>Maracas Black Stick<br>Butter Stick | Peeled, frozen cassava roots.<br>Soups; flour; animal feed;Cassava damplings; mix flours<br>Grated cassava mash | Easy peeling, good cooking quality, long duration |
| **Dominican Republic** | Valencia | | |
| | CM 6921-3 (Lima-21) | Flour | High dry matter content, good flour quality |
| | CM 6740 (Lima-40) | | |
| | TAI-8 (Tai Lima) | Flour | High dry matter content; colour of flour; early maturing variety |

Source: FAO/IICA/CLAYUCA Survey

### Markets for cassava processing enterprises in the Caribbean region

There are basically three main markets to which the cassava processing enterprises in the Caribbean region are currently linked:

- Domestic consumer markets, in places such as supermarkets, bakeries, restaurants and groceries.
- Animal feed (livestock, poultry and aquaculture sectors)
- Export markets in countries of America, Europe and Africa.

### Product development

57% of the respondents indicated that they have received requests for the development of new downstream products, especially modified starch for human food products, grated cassava, cassava bread, cassava chips, cassava flour and frozen cassava logs.

### Cassava processors preferences for cassava roots (physical, physico-chemical, and cooking characteristics)

The physical, physico-chemical and cooking characteristics that the cassava processing enterprises in some countries of the Caribbean would like to have in the cassava roots that they purchase for their processing activities are summarized in Table 24.

Table 24. Summary of physical, physico-chemical, and cooking characteristics demanded by cassava processing enterprises in selected Caribbean countries.

| COUNTRY | PHYSICAL CHARACTERISTICS REQUIRED | PHYSICO-CHEMICAL CHARACTERISTICS REQUIRED | COOKING CHARCATERISTICS |
|---|---|---|---|
| **Barbados** | Uniformity in cassava roots size, easy of peeling, thin peel, and uniformity in colour of the pulp. | High dry matter content, low cyanide content. | Good cooking quality. |
| **Guyana** | Uniformity in cassava roots size, easy of peeling, uniformity in colour of the pulp. | | |
| **Jamaica** | Uniformity in cassava roots size, easy of peeling, thin peel, and uniformity in colour of the pulp. | | |
| **Ecuador** | Thin peel. | High starch content, low cyanide content. | Good cooking quality. |
| **Paraguay** | Thin peel, easy of peeling. | High starch content, high dry matter content, low cyanide content. | |
| **Dominican Republic** | Easy of peeling. | High starch content, high dry matter content, low cyanide content. | |
| **St. Vincent and the Grenadines** | Uniformity in cassava roots size, easy of peeling, uniformity in colour of the pulp. | Low cyanide content. | Good cooking quality. |
| **Suriname** | | High starch content. | |
| **Trinidad and Tobago** | Uniformity in cassava roots size, easy of peeling, uniformity in colour of the pulp. | | Good cooking quality. |

Source: FAO/IICA/CLAYUCA Survey

The physical characteristics required are mostly related to:

- Uniform size of the cassava roots.
- Roots with thin skin to facilitate peeling.
- Uniform colour.
- Soft texture of the cassava pulp.

The physico-chemical characteristics required are:

- Higher dry matter content.
- High starch content.
- Lower cyanide content.

### Financial support

The main sources of funding, as mentioned by the cassava processing enterprises interviewed were:

- Own funding obtained from the reinvestment of the profits obtained through the sales of their cassava processed products.
- National institutions supporting the development of small-scale businesses.
- Government institutions through credits and subsidies.
- Foreign institutions providers of technical and financial support.

Cassava processors indicated that the lack of financing opportunities is one of the main constraints for the development of the cassava processed products sector.

### Constraints

70% of the processors interviewed in the selected countries of the Caribbean region stated that they were able to have enough raw material (cassava roots) to meet the needs and capacities of their processing plants during the year 2013; about 50% of the respondents indicated that current yields and efficiencies obtained in their cassava processing activities were not optimal, and nearly 40% complained about the low economic returns from the cassava processing enterprises.

These low yields and efficiencies, and poor economic returns were linked to the following reasons:

- Lack of equipment.
- Limited access to financial resources.
- Lack of technical assistance.
- High costs of input and labor.
- Lack of training opportunities.
- Lack of steady supply of cassava roots.
- Lack of knowledge about the possibility of replacing local varieties.
- Lack of support on agribusiness and marketing.
- Lack of government policies that support the activities of small-scale cassava processing activities.

## Innovation and perspectives

The majority of the cassava processors interviewed (90%), planned to expand their scale of production of processed cassava products over the next 3-5 years, based on their opinion that the demand for cassava processed products was increasing. These processors were interested in innovations and improvement in their processing activities through mechanization or the acquisition of machinery with better technological conditions (electric peelers, fryers and semi-automatic packaging machines).

The processors indicated that through the mechanization of their processing activities, combined with the introduction and use of new, improved cassava varieties, with high dry matter, high starch content, and market intelligence studies, they will be able to identify new market niches and diversify the portfolio of products offered by their cassava processing enterprises. Other innovations proposed by these enterprises include an increase in training activities in technical aspects, formulation and implementation of productive projects, and research and development activities for the cassava processing sector.

The survey respondents engaged in subsistence processing activities indicated that they did not have any plans, short or medium term, to increase the scale of their operation and engage in technical innovations, as they only process cassava for self-consumption and for sporadic sales to local markets, as a strategy to supplement their incomes.

Table 25 indicates the principal activities and areas of work that could be addressed to increase the efficiency and competitiveness of the cassava processing activities, in some of the Caribbean countries surveyed.

Table 25. Activities and areas of work for interventions to increase efficiency and competitiveness in cassava processing enterprises in some Caribbean countries.

| COUNTRY | ACTIVITIES / AREAS OF WORK |
|---|---|
| **Barbados** | Better equipment and technology, better quality roots, adequate technical support, reduce input costs, more research and training activities, adequate financial support. |
| **Ecuador** | Better equipment and technology, better quality roots, better supply of labor, more research and product development activities, greater technical support, better infrastructure, more training activities and more government support policies. |
| **Paraguay** | Adequate financial support, more research and product development activities, better supply system for cassava roots, more technical support and more training activities. |
| **Dominican Republic** | Better equipment and technology, adequate financial support, more research and product development activities, lower input costs, more training activities and more political support to agribusiness and marketing strategies. |

Source: FAO/IICA/CLAYUCASurvey

# STATISTICAL INFORMATION ABOUT CASSAVA AND OTHER IMPORTANT CROPS IN SELECTED COUNTRIES OF THE LATIN AMERICAN AND CARIBBEAN REGION

In this section, updated information has been compiled on the changes in the main crops over the past 40 years, in each of the LAC countries included in the survey. This information has been complemented with recent information reported by FAO (FAOSTAT, 2015), on the current status of the cassava crop in each country.

## BARBADOS

Production of principal crops (MT) Annual average of 10-years periods

| Crop | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Yams | 8573 | 3474 | 1709 | 686 |
| Sweet potatoes | 4584 | 3044 | 3519 | 1560 |
| Maize | 1907 | 2100 | 1256 | 235 |
| Cassava | 883 | 971 | 926 | 376 |
| Bananas | 786 | 774 | 565 | 603 |

Area of principal crops harvested (ha) Average of 10-years periods

| Crop | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Yams | 737 | 283 | 182 | 49 |
| Sweet potatoes | 463 | 296 | 367 | 87 |
| Maize | 737 | 820 | 476 | 81 |
| Cassava | 35 | 42 | 53 | 17 |
| Bananas | 98 | 90 | 93 | 101 |

Yields of principal crops (MT/ha) Average of 10-years periods

| Crop | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Yams | 12.1 | 12.3 | 9.4 | 13.9 |
| Sweet potatoes | 9.9 | 10.3 | 9.6 | 17.9 |
| Maize | 2.6 | 2.6 | 2.6 | 2.9 |
| Cassava | 25.6 | 23.0 | 17.6 | 22.6 |
| Bananas | 8.0 | 8.6 | 6.1 | 6 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in Barbados

Cassava is an important crop in Barbados, introduced from the Guyanas and cultivated by the Arawaks and Caribs before the advent of the Europeans. Production and consumption of cassava in the country fluctuates, depending on the availability of other sources of carbohydrates such as yams, sweet potato and corn. During World War II, the Government introduced the Vegetable Production (Defense) Control Order (1942), which made it mandatory for sugar states to plant up to 35% of all arable land in food crops.

In 1943, the Government built a cassava flour processing plant to produce flour for human consumption and meal for livestock. The capacity of the plant was approximately 12 MT of flour per day. It was used for a short period and is no longer in existence. The Government in Barbados is currently pursuing an agenda to incorporate more cassava into the local diet, as well as promote the use of cassava in animal feed. The Ministry of Agriculture, in collaboration with FAO and CARDI, is in the process of validating cost of production at the field level and at the factory level.

Current cassava production is around 1316 MT, with a planted area of around 107 ha and productivity of 12 MT per ha. Most preferred varieties are white butter and white skinned. The main processed products currently available are: cassava biscuits and cookies, fine cassava flour, frozen wedges, frozen grated cassava and whole logs (peeled and frozen). Planting material of preferred varieties is readily available. Most of the cassava processing enterprises are small-scale, and have a registered brand. They rely on word-of-mouth to promote their products. Principal market outlets are supermarkets and local fresh market (IICA, 2013).

## Recent developments

During the last 3-5 years, there has been a renewed interest on promoting the development of cassava by Government agencies and some private sector companies in Barbados. Some recent developments, directly related to the cassava sector are:

- Establishment of a Roots and Tubers Committee.
- Establishment of a working partnership with FAO, IICA, CARDI and UWI to help resolve some of the issues with cassava production.
- Introduction of 11 improved cassava varieties from CIAT-CLAYUCA.
- Establishment of food zones with private sector involvement and full government support.
- On-going work aimed at developing various cassava flour mixes and various dishes and other cassava products.

## Constraints

Some of the constraints already identified by the different public and private sector institutions participating in the root and tuber crop committee are:

- Predominance of low-yielding varieties (10-12 MT per ha).
- Although cassava varieties have been imported in the past, they are basically lost and it is very difficult to track their existence and performance.
- Agro-processing activities with added value for the cassava crop are very limited.
- Need for higher yielding, improved cassava varieties.
- Mechanization of some activities in cassava production is very limited.

## Strategies proposed to move forward

Some of the strategies proposed for solving the current constraints and promote sustainable and competitive development of the cassava sector in Barbados are:

- Create a program for the promotion, education, public awareness and training, in all the components of cassava production, processing and marketing.
- Establish a mechanism that creates an environment that stimulates and encourage major stakeholders to buy-in.
- Introduce higher-yielding cassava varieties, with shorter maturity period, that are acceptable for food and feed agro-processing enterprises.
- Establish working and collaborative agreements with cassava research and technology development agencies and institutions within the CARICOM region and in South America.
- Introduce competitions that would challenge schools and general public to be innovative in developing cassava recipes.
- Introduce full mechanization of the cassava crop.

# BELIZE

Production of principal crops (MT) Average of 10-year periods

| Crop | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Maize | 15717 | 19813 | 30808 | 34164 |
| Bananas | 7070 | 20474 | 44793 | 63593 |
| Rice Paddy | 6230 | 6435 | 9347 | 13527 |
| Cassava | | 78 | 697 | 659 |

Area of principal crops harvested (ha) Average of 10-year periods

| Crop | 1970-79 | 1980-89 | 1990-99 | 2000-2090 |
|---|---|---|---|---|
| Maize | 11066 | 12216 | 13461 | 12446 |
| Bananas | 470 | 1244 | 1906 | 2020 |
| Rice Paddy | 3315 | 2742 | 5256 | 3190 |
| Cassava | | 5 | 74 | 35 |

Yields of principal crops (MT/ha) Average of 10-year periods

| Crop | 1970-79 | 1980-89 | 1990-99 | 2000-2090 |
|---|---|---|---|---|
| Maize | 1.42 | 1.62 | 2.29 | 2.75 |
| Bananas | 15.0 | 16.4 | 23.5 | 31.5 |
| Rice Paddy | 1.88 | 2.35 | 1.78 | 4.24 |
| Cassava | | 14,7 | 9,4 | 18.9 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in Belize

Cassava is mainly produced in the southern and central part of the country. The Garinagu people (commonly called Garifuna people) consume cassava in fresh and processed forms (chips and baked products). Presently, the bulk of the production (340 MT, equivalent to ≈60% of the national production) comes from the southern part of the country.

## Production and processing statistics

For the past 12 years, cassava production has been on a decline, from more than 1362 MT produced annually to less than 450 MT. Over a ten-year period, the production was reduced from 5760 MT in 2002 to a mere 421 MT reported for the entire country in 2012 (Figure 13). Preliminary statistics on production areas in 2013-2014 indicate an area planted of around 37 ha. The cassava yields obtained in the country have not presented large variations during the last 12 years, with an average yield for cassava reported as 13.4 MT per ha (Figure 14).

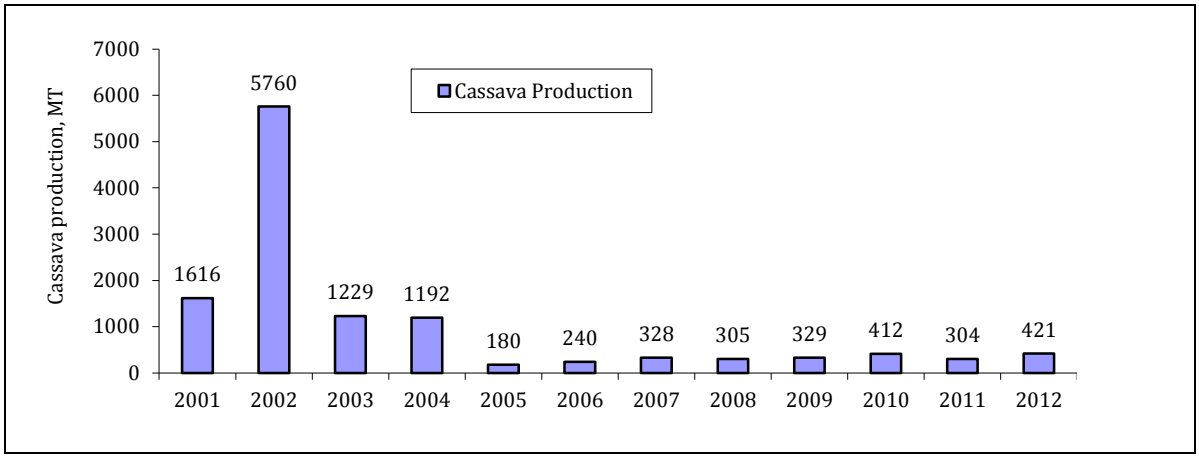


Figure 13. Cassava production in Belize, 2001-2012.
Source: Production statistics, 2012. Ministry of Natural Resources and Agriculture, Belize

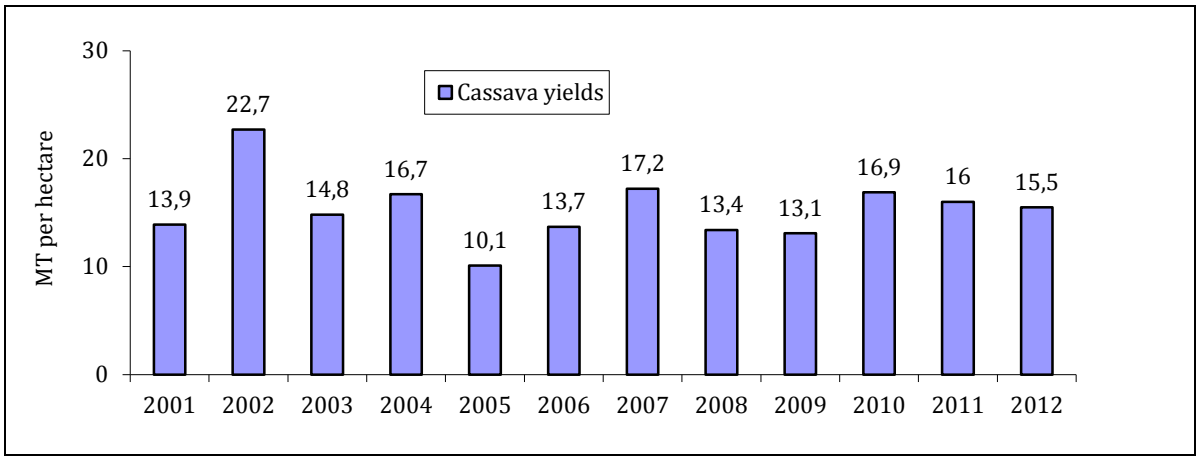


Figure 14. Cassava yields in Belize, 2001-2012.
Source: Production statistics, 2012. Ministry of Natural Resources and Agriculture, Belize

The main cassava varieties used in the country are:

| VARIETY | USES |
|---|---|
| Panama | fresh consumption |
| Sweet cassava | starch and fresh consumption |
| Blue Bird | processing |
| Rasta | fresh consumption |
| Bitter cassava | processing, animal feed |

The cassava production system in Belize is based on manual planting, although there are some production enterprises have started using semi-mechanized planting. In general, the production technology commonly used is rudimentary, with limited use of fertilizer, irrigation and other inputs.

## Constraints

Some of the constraints already identified that are affecting sustainable development of the cassava sector in Belize are:

- The Germplasm Bank only has five varieties. Their origin is not known and they are used mainly for fresh consumption. Industrial types of cassava varieties are required for expanded production.
- No technical profile is available for the current germplasm (variety characterization).
- Development of value-added food products based on cassava is limited (flour, starch, animal feed).
- Technological packages are not available for farmers (crop nutrition, integrated pest management, mechanized production, irrigation, production costs, etc).
- Cassava is not listed as a priority crop under the portfolio of the Ministry of Natural Resources and Agriculture (MNRA).

## Opportunities

- Belize has good potential to grow cassava, vast land areas are available and the climate is excellent for cassava production.
- Farmers are willing to learn new technology packages for cassava production.
- The population is increasing as well as the food import bill. Cassava can be used as an import substitution commodity.
- The MNRA has an annual budget of 2 million dollars for crop research and demonstration activities.

## The way forward

In order to promote development of a vibrant cassava industry in Belize, the following aspects should be addressed:

- The feasibility study of cassava production in Belize needs to be updated, to determine economic viability and potential social impact.
- The MNRA should include cassava in the research and demonstration activities, as a strategy to promote crop diversification and reduction of food import bill.
- The MNRA should request technical experiences from national/regional partners in areas related to post-harvest technologies, soil and crop management, marketing and value-added.
- The MNRA, in collaboration with relevant agencies, should develop various technology packages for cassava: fresh consumption, industrial types (processing) and feed use.
- Government support is necessary – this could be in the form of incentives and programs for interested producers and processors.
- The MNRA should lead the process by providing technical guidance to farmers in selection of adequate varieties, source appropriate processing equipment and seek and consolidate alternative, more profitable markets.

# DOMINICA

Production of principal crops (MT) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 37 120 | 47 324 | 50 258 | 18 294 |
| Cassava | 784 | 884 | 874 | 850 |
| Plantains | 1 012 | 2 523 | 5 982 | 4 911 |
| Sweet potatoes | 716 | 1 669 | 1 698 | 2 106 |
| Yams | 2 998 | 5 552 | 6 676 | 8 615 |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 4 920 | 4 031 | 3 709 | 1 625 |
| Cassava | 78 | 84 | 88 | 88 |
| Plantains | 145 | 299 | 737 | 636 |
| Sweet potatoes | 143 | 337 | 416 | 433 |
| Yams | 293 | 400 | 453 | 712 |

Yields of principal crops (MT/ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 7.54 | 11.74 | 13.55 | 11.26 |
| Cassava | 10.11 | 10.56 | 9.93 | 9.67 |
| Plantains | 6.98 | 8.44 | 8.12 | 7.72 |
| Sweet potatoes | 5.01 | 4.95 | 4.08 | 4.86 |
| Yams | 10.25 | 13.88 | 14.75 | 12.09 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in Dominica

In Dominica, the cassava industry is underdeveloped. The cassava value chain has only come into focus since 2010, through the intervention of the Root and Tuber Crop Project of CARDI. The crop is mainly produced in the southern and central part of the country. Cassava is consumed in the form of farine, cassava bread and farine balls (traditional delicacy). Very few people consume cassava directly (boiled, fried). Some restaurants in the Eastern part of the Island are now making dishes based on cassava farine.

## Production and processing statistics

Overall cassava production in Dominica has been estimated at around 870 MT, with an average productivity of 8.2 MT per ha. The preferred cassava varieties in the country are Bitter, Sweet and 100 pounds, all three of indigenous origin. Currently, all varieties are used for the production of farine and cassava bread. Planting material is readily available locally. Production is based on small plots (0.2 to 0.5 acres) and due to the topography of the land, mechanization cannot be used. Cassava can be planted all year round and farmers use minimal inputs in the production system. Farmers growing bitter cassava for production of cassava bread are currently being encouraged to grow the sweet variety.

There are fourteen cassava processing facilities on the island; most are the cottage-industry type. Two facilities have been upgraded recently, with technical support from CARDI and the Dominican Republic. Processing is done in privately-owned facilities, operated as communal facilities. Farmers make a small payment for electricity and the facility owner gets paid with a portion of the processed farine. There are two main bakeries in the country and one of them was completely upgraded by CARDI in 2011. The cassava bread and farine processors both have good niche markets among the local population. Farine is a product that can be stored for a long period and some portion of the farine produced is exported to regional markets. Cassava bread is consumed mainly by the local population and to a lesser extent by the tourist population.

## Constraints

Some of the constraints affecting cassava development in Dominica are:

- Rudimentary infrastructure.
- Lack of improved varieties.
- Insufficient research and investigation.
- Lack of knowledge and updated information on the appropriate equipment and machinery for processing.
- Cassava farmers use a mix of local varieties.
- Lack of support from the Government.

## Opportunities

Some of the opportunities that may contribute to the formulation of a strategy to promote sustainable and competitive development of the cassava crop in Dominica are:

- Good local market.
- Request for cassava flour / farine by neighboring French-speaking countries.
- Other forms of value-added products based on cassava could be produced and have good market potential (e.g. sliced bread using composite flour incorporating grated cassava or cassava flour).
- New, improved varieties could be introduced.
- The Caribbean community development project, funded by the Caribbean Development Bank (CDB), is considering the construction of a cassava factory.
- It is important that the strategy selected as the way forward to promote sustainable and competitive development of the cassava value chain, is based on an integrated approach with simultaneous actions on production, processing and commercialization and market development aspects.

# GRENADA

Production of principal crops (MT) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 18912 | 13721 | 7600 | 2779 |
| Cassava | 231 | 134 | 164 | 159 |
| Maize | 501 | 352 | 321 | 322 |
| Sweet potatoes | 390 | 261 | 256 | 110 |
| Yams | 480 | 390 | 339 | 417 |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 5 803 | 4 865 | 2 270 | 706 |
| Cassava | 27 | 19 | 27 | 22 |
| Maize | 570 | 366 | 307 | 253 |
| Plantains | | 37 | 87 | 30 |
| Sweet potatoes | 77 | 100 | 92 | 34 |

Yields of principal crops (MT/ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 3.26 | 2.82 | 3.35 | 3.94 |
| Cassava | 8.64 | 7.01 | 6.12 | 7.28 |
| Maize | 0.88 | 0.96 | 1.05 | 1.27 |
| Plantains | | 13.72 | 7.90 | 9.64 |
| Sweet potatoes | 5.08 | 2.60 | 2.78 | 3.21 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in Grenada

The economy in Grenada is dependent on tourism and on revenue from export crops. About one-third of the land (13,000 ha) is classified as agricultural lands. Cassava is one of the root crops grown, along with yams, sweet potato, and dasheen.

## Production and processing statistics

Cassava is produced by small farmers, usually on areas less than one acre. Land preparation is done manually and using mechanical traction. The two main types of cassava varieties are used are sweet and bitter. The main varieties used in the country are: MCOL-1468; Señorita Blanca, CMC-40 and Valencia. Major pest threats for cassava are shoot fly and rats. Cassava fields are mainly rain-fed and most plots are prepared and planted manually on ridges. Current estimated

yields for cassava in Grenada are 8 MT per ha. Planting material is only available when the crop is harvested and where the farmers' demands for planting materials cannot be met.

Cassava is used mostly for the production of farine which is sold in local supermarkets. Small-scale agro-processors are currently using cassava to process products such as chips, flour, cassava flat bread and peeled and frozen cassava. These products are being sold in local supermarkets. A large proportion of cassava is converted into farine. The bitter variety is used only for processing into farine. In the past, some people mistakenly ate bitter varieties in fresh form and four people died. Today the myth stands that cassava will kill if eaten fresh. As a result, very few persons consume cassava in fresh form.

### Constraints

Some of the constraints and challenges for increasing cassava production and productivity in Grenada are:

- Poor harvesting techniques that result in unmarketable tubers.
- High postharvest losses due to damage to tubers during harvest.
- Production is seasonal.
- A popular belief that cassava is toxic.
- Farmers unable to properly identify the cassava varieties available locally.
- Unsuitable cassava varieties used in agro-processing activities.
- Inadequate local research activities in crop management and varietal adaptation and selection.
- No formal market intelligence infrastructure for root and tuber crops.
- Lack of adequate farm machinery for cassava cultivation.

### Opportunities

Some of the opportunities that could be used as the basis for promoting cassava development in Grenada are:

- Existence of Government policy to increase the production of cassava as a staple crop under the Food Security Programme of the Ministry of Agriculture, the Grenada Food and Nutrition Council (GFNC) and the Grenada Network of Rural Woman Producers (GRENROP).
- Cassava farmers have been trained on the importance of using clean planting material and in rapid propagation techniques using the two-node method, after a Study Tour on root crops, conducted in the Dominican Republic in 2011, organized by FAO, IDIAF and CARDI.
- A Zero Hunger Program has been launched by the Government, focussing on cassava.
- The Ministry of Agriculture has established cassava germplasm fields where farmers can source planting material free of charge. This could be an important strategy to promote quick adoption and dissemination of improved varieties by the farmers.

# GUYANA

Production of principal crops (MT) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 5 625 | 10 418 | 13 080 | 10 475 |
| Cassava | | 4 940 | 30 840 | 17 091 |
| Maize | 2 864 | 1 595 | 3 720 | 3 859 |
| Plantains | 18 708 | 19 140 | 13 870 | 7 647 |
| Rice Paddy | 236 841 | 264 289 | 414 374 | 450 041 |

* Data corresponds to average of 2 years.

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 866 | 1 440 | 1 860 | 1 198 |
| Cassava | | 430 | 2 477 | 1 332 |
| Maize | 1 873 | 1 453 | 2 633 | 2 654 |
| Plantains | 5 849 | 5 530 | 4 456 | 1 842 |
| Rice Paddy | 107 356 | 83 292 | 109 817 | 94 845 |

Yields of principal crops (MT/ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 6.50 | 7.23 | 7.03 | 8.74 |
| Cassava | | 11.49 | 12.45 | 12.83 |
| Maize | 1.53 | 1.10 | 1.41 | 1.45 |
| Plantains | 3.20 | 3.46 | 3.11 | 4.15 |
| Rice Paddy | 2.21 | 3.17 | 3.77 | 4.74 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in Guyana

Cassava is the main root crop grown throughout Guyana especially in areas with soils rich in organic matter. For the Amerindians, the predominant ethnic group in the country, cassava is a staple food. Cassava is produced mainly as monoculture. In some cases, it is intercropped with pineapples.

## Production and processing statistics

In Guyana, approximately 2000 ha of land is planted with sweet cassava and 3000 ha with bitter cassava. The crop is grown mainly in small-size plots, between 0.5 and 2.0 ha. Land preparation is done manually and partially mechanized. Yields vary depending on the region, the varieties used and the soil and crop management practices. Average yields have been estimated in 19 MT

per ha. More than 70 local varieties are used in the country, the most popular being Four Months, Butterstick, Uncle Mack, 7U and Bad Woman.

The crop is seldom treated with chemicals, and for this reason cassava production in Guyana can be considered "organic". Ants are the main pest problem experienced.

Cassava is produced mainly for local consumption. Boiling is the principal form in which the root is used, and in the interior regions, grated cassava is also consumed extensively. Processing technology, especially for grated cassava, is very traditional with the grating being done mostly by women and taking up a considerable amount of time. Exports are very limited and mainly in the form of cassareep, a traditional local product. Other processed products based on cassava that are now available are: bammy (flatbread), starch; chips; biscuits and cookies; and fine flour.

### Constraints

Some of the constraints and challenges that will need to be addressed to promote a more sustainable and competitive cassava sector in Guyana are:

- Cassava processing technologies used are mainly traditional.
- High postharvest losses due to damage to tuber during harvest, followed by deterioration and spoilage during storage.
- High cost and low availability of mechanical equipment for land preparation in the savannas area.
- Limited technical support and training opportunities for farmers.
- Market outlets and options are usually limited to the local areas.

### Opportunities

Some of the opportunities that exist for supporting cassava development and intensification of production and agro-industrialization in Guyana are:

- The Government of Guyana, through the Ministry of Agriculture has established policies specifically aimed at supporting research and development activities for cassava.
- Cassava is one of the crops of focus in the Agriculture 2020 vision strategy, with defined targets to increase production and processing by 100%.
- The Government of Guyana, through the United Nations Development Programme (UNDP) is providing funding for the Amerindian communities.
- Farmers groups have been formed in cassava producing areas, which are already implementing successful long-term relationships with agro-processors and entrepreneurs.
- The Priority Agricultural Development Programme in Guyana is aimed at supporting and strengthening integration along the entire value chain of cassava.
- CARDI, in collaboration with NAREI are presently implementing the project "Integrated Development of Cassava in the Caribbean", funded by FAO.
- Communities in the hinterlands are starting to diversify from traditional to more appropriate cassava processing technologies.

The Ministry of Health and Ministry of Agriculture are working closely to nationally promote the health benefits of roots and tubers crops.

# JAMAICA

Production of principal crops (MT) Average of 10-year periods

| CROP | *1970-79* | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 162 900 | 146 500 | 126 366 | 78 423 |
| Cassava | 21 494 | 17 399 | 16 314 | 14 482 |
| Plantains | 21 265 | 27 438 | 29 886 | 18 172 |
| Sweet potatoes | 20 241 | 24 678 | 25 749 | 23 674 |
| Yams | 127 585 | 147 114 | 211 819 | 118 284 |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | *1970-79* | 1980-89 | *1990-99* | 2000-2009 |
|---|---|---|---|---|
| Bananas | 20 000 | 18 800 | 15 750 | 8 591 |
| Cassava | 2 379 | 1 519 | 936 | 707 |
| Plantains | 2 250 | 2 220 | 1 865 | 909 |
| Sweet potatoes | 2 517 | 2 379 | 1 773 | 1 293 |
| Yams | 11 189 | 11 631 | 13 572 | 6 432 |

Yields of principal crops (MT/ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 8.15 | 7.79 | 8.02 | 9.13 |
| Cassava | 9.03 | 11.45 | 17.44 | 20.48 |
| Plantains | 9.45 | 12.36 | 16.03 | 19.98 |
| Sweet potatoes | 8.04 | 10.37 | 14.52 | 18.31 |
| Yams | 11.40 | 12.65 | 15.61 | 18.39 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in Jamaica

Cassava is the third most important root and tuber crop in Jamaica, after yams and sweet potato. Most cassava producers are small farmers, with no more than 1 ha planted, and with high use of labor due to the lack of mechanization in most of the production activities. In general, small-scale cassava farmers do not use any modern agricultural inputs such as fertilization, weed control, irrigation, and pest and disease control.

## Production and processing statistics

In Jamaica, approximately 925 ha are planted with cassava. The average cassava yields in the country have been estimated to 17 MT per ha. Cassava farmers plant both, bitter and sweet varieties. There is a higher demand by the processing markets for the bitter varieties because of the high starch content and white colour. To reduce the bitter flavor, cassava processors mix bitter and sweet varieties.

Sweet varieties are used mainly for processing cassava chips. In Jamaica, cassava is rarely consumed fresh. Some of the most popular sweet cassava varieties are: Blue Bud, Real sweet, Cuban sweet, Prison farm, and MCol 22. Some of the most common bitter cassava varieties are: Smalling, Bobby Hassan, and Rockwood.

Cassava is produced mainly for local consumption in the form of a processed product known as Bammy, which accounts for approximately 90% of the cassava production in the country. Bammy is a very popular type of bread with a high consumption rate across all segments of the population. Bammies are usually produced by housewives at home, and at some small-scale processing factories, for sale in supermarkets, small shops and on the streets. There are some export markets mainly to USA, Canada and other CARICOM countries. The other 10% of the cassava production in Jamaica is used to produce cassava chips, fine flour and starch. The wastes of processing operation (peels, residues), are used in animal feeding, mainly for pigs.

### Constraints

Some of the constraints and challenges that will need to be addressed to promote a more sustainable and competitive cassava sector in Jamaica are:

- The predominance of low yield, late maturing cassava varieties.
- Cassava supply does not meet current demand causing high prices for cassava roots and for cassava processed products.
- Low availability and high costs of labor.
- Lack of knowledge on modern cassava production technologies.
- Low productivity.
- High reliance on manual labor at all stages of production.
- Cassava processing technologies used are mainly traditional.
- Small-scale of cassava processing enterprises.
- Limited technical support and training opportunities for farmers.

### Opportunities

Some of the opportunities that exist for supporting cassava development and intensification of production and agro-industrialization in Jamaica are:

- Jamaica´s Food Import Bill has been growing steadily during the past 10 years. In 2013, it has a value of US$ 930 million. This represents an opportunity to promote cassava as an import substitution crop.
- Promoting 10% substitution of wheat flour by cassava flour will help to reduce the import bill by US$ 6 milion per year.
- To meet these goals, local production of cassava will have to be increased approximately 6 fold, from current 14,000 MT to 85,000 MT.
- Cassava production and productivity at the farm level could be easily improved through mechanization and improved agronomic practices.
- Increased production of cassava through arrangements based on rural communities linked to processing enterprises could stimulate rural economic development and growth.
- Food science technology is available. UWI is willing to participate in research and technology transfer activities to incorporate cassava flour into widely accepted food products (bread, cereals, snack foods, biscuits, cookies, etc.).

- Adoption of newer, improved processing technologies will allow for improved processing efficiency and higher economic returns for small and medium scale processing entrepreneurs.
- Use of maltose made from cassava to substitute corn maltose in the production of beer by the largest local brewery
- Increased awareness of policy makers about the importance of the cassava as a rural development option to promote economic development and growth.

# MONTSERRAT

Production of principal crops (MT) Average of 10-year periods

| CROP | *1970-79* | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 134 | 142 | 150 | 162 |
| Cassava | | | | |
| Maize | 10 | 19 | 43 | 87 |
| Potatoes | 114 | 133 | 128 | 154 |
| Sweet potatoes | 38 | 17 | 18 | 27 |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 31 | 32 | 35 | 34 |
| Cassava | | | | |
| Maize | 10 | 12 | 18 | 15 |
| Potatoes | 46 | 45 | 39 | 33 |
| Sweet potatoes | 16 | 8 | 9 | 7 |

Yields of principal crops (MT/ha) Average of 10-years periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 4.31 | 4.48 | 4.33 | 4.78 |
| Cassava | | | | |
| Maize | 1.00 | 1.57 | 2.37 | 5.78 |
| Potatoes | 2.46 | 2.95 | 3.32 | 4.71 |
| Sweet potatoes | 2.42 | 2.27 | 2.08 | 3.77 |

Source: FAO. http://faostat.fao.org/

**Overview of cassava in Montserrat**

Monserrat, also known as the Emerald Isle is a very tiny country with a landmass of only 102 square km. Farmers are located in the most northern part of the Island. Since the volcanic eruption in 1997, two thirds of the Island area have been deemed hazardous and as such are uninhabited. Cassava is a traditional crop for farmers, used primarily in a processed form to make cassava bread and other food products for human consumption. Cassava is grown as a subsistence crop with little or no inputs. It is cultivated on sloping lands using manual labor and in flat areas using some mechanization. Land is prepared in a ridge and furrow system and water logging is not a problem due to the topography.

## Production and processing statistics

The area cultivated with cassava in Montserrat is between 3 and 5 ha. Due to shortage of land, long growth period and low farm gate price, farmers do not plant areas larger than 0.3 ha. Cassava farmers plant both bitter and sweet varieties. However, the bitter varieties are more commonly grown since traditionally, it is better suited for making cassava bread. With the integration of other CARICOM citizens in Montserrat, there is a growing demand for cassava as a staple food. Some of the most common cassava cultivars used in Montserrat are: Red Stem; Mingo Sweet; Belmont Pint; Fountain Bitter; Green Stem; Belmont Green; Fountain Sweet; Guyana Sweet. The crop is affected mainly by the cassava shoot fly and thrips. Harvesting is done manually over an extended period to facilitate marketing of the crop with the bread makers and processors.

Processing is carried out at a processing unit built by the Department of Agriculture in collaboration with CARDI. This improved facility is helping to alleviate the laborious traditional processing methods commonly practiced by farmers, and it is also encouraging younger persons to engage in cassava processing activities. The improved processing technology unit includes; electric cassava grating mills, hydraulic compressors, drying trays, and a baking stove that operates on gas instead of the traditional wood or coal. With this improved cassava processing technology, the entire process from harvest to baking can be done in one day.

## Constraints

Some of the constraints and challenges that require an action plan in Montserrat are:

- The predominance of low yield and traditionally, late maturing cassava varieties.
- Very small cassava plots.
- Rudimentary agronomic practices.
- Lack of post-harvest management practices.
- Lack of knowledge on modern cassava production technologies.
- Low productivity of cassava production systems.
- High reliance on manual labor at all stages of cassava production.
- Limited technical support and training opportunities for farmers.

## Opportunities

Some of the opportunities that exist for supporting cassava development and intensification of production and agro-industrialization in Montserrat are:

- The banana industry is in decline and cassava can be promoted as a complementary commodity that could contribute to improve food security.
- Increased awareness of local policy makers on the potential of the cassava crop to be used as a strategic crop to promote sustainable growth and development of the agricultural sector.

# ST. LUCIA

Production of principal crops (MT) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 57 937 | 99 147 | 125 600 | 38 000 |
| Cassava | 856 | 923 | 970 | 969 |
| Maize | 32 | | | |
| Sweet potatoes | 1 118 | 1 461 | 834 | 451 |
| Yams | 3 539 | 3 770 | 3 941 | 478 |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 5 576 | 8 051 | 12 250 | 2 909 |
| Cassava | 226 | 277 | 322 | 304 |
| Maize | 45 | | | |
| Sweet potatoes | 289 | 214 | 88 | 44 |
| Yams | 784 | 962 | 1 028 | 127 |

Yields of principal crops (MT/ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 10.39 | 12.31 | 10.25 | 13.06 |
| Cassava | 3.80 | 3.33 | 3.01 | 3.19 |
| Maize | 0.71 | | | |
| Sweet potatoes | 3.87 | 6.83 | 9.44 | 10.34 |
| Yams | 4.51 | 3.92 | 3.83 | 3.76 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in St. Lucia

Cassava in St. Lucia is viewed as a subsistence crop. Both bitter and sweet varieties are planted. Production is done mainly using manual labour. Cassava is generally grown on marginal land and is intercropped with other short-term crops. In general, farmers in St. Lucia do not use any modern inputs such us fertilizers or agro-chemicals. Cassava is planted on mounds, raised beds, flat and in single or double row. Due to the topography of the land and the high costs of mechanized services, farmers rely on traditional, manual land preparation methods, and pay little or no attention to the crop after planting. The crop is harvested in 9 to 18 months. There is no cassava germplasm bank in the country.

## Production and processing statistics

In St. Lucia the size of the land for planting cassava in 2014 was approximately 40 ha with 51 farmers planting small plots. Cassava is primarily used in a processed form and consumption in the boiled form is not common. Consumers typically purchase small quantities rather than in bulk. Most processors grow part of their raw material i.e. cassava roots. Processing operations are partially mechanized. The main market for cassava is the local market, in the form of farine and cassava bread. Cassava in fresh form and as processed product is absent in the majority of the tourist resorts.

## Constraints

Some of the constraints and challenges that will need to be considered to promote development of the cassava sector in St. Lucia are:

- Low level of irrigated production.
- Reliance on manual production methods.
- Lack of improved cassava varieties.
- Lack of a germplasm bank with local varieties.
- Low level of organization in farmer groups.
- Lack of large commercial farms.
- Low level of research and technology transfer activities.
- Insufficient supply of cassava roots to processing enterprises.
- Inability of cassava processors to maintain and strengthen export markets.
- Inadequate marketing support services.
- Inadequate data and record keeping to track productivity and profitability.
- Low level of promotion of health benefits by increased consumption of cassava products.
- Absence of formal supply contracts between farmers and processors
- Inadequate market information.
- Absence of an industry-wide training program for cassava processors.
- Natural disasters, including storms, floods, hurricanes and frequent droughts.
- Resistance of farmers to change current production practices.
- Introduction to St. Lucia of cassava products imported from other countries.

## Opportunities

Some of the opportunities that exist upon which a strategy to promote cassava development in St. Lucia could be designed are:

- Positive response by consumers in the local markets to processed cassava.
- Significant demand for processed cassava locally and in the St. Lucian diaspora.
- Easy transport links to outlets in the local market.
- Willingness of Government agencies to support cassava marketing activities.
- Strong tradition of cassava processing in St. Lucia.
- Existence of local agricultural marketing organizations whose institutional knowledge can be tapped.
- Land available to expand cassava production.
- Willingness of local farmers to grow cassava.
- Input supplies available locally.
- Markets available and increasing demand, locally, regionally and internationally.
- Processing capacity can be easily increased with greater mechanization.

- Potential to move into a niche market based on highly differentiated cassava processed products for local and export markets.
- Potential to encourage the formation of farmers groups, producers and processors, willing to receive and apply sound technical assistance and training.

# ST. KITTS AND NEVIS

Production of principal crops (MT) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Potatoes | 154 | 256 | 204 | 138 |
| Sweet potatoes | 172 | 146 | 184 | 168 |
| Yams | 410 | 418 | 168 | 11 |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Potatoes | 17 | 27 | 20 | 8 |
| Sweet potatoes | 62 | 17 | 28 | 29 |
| Yams | 82 | 82 | 35 | 2 |

Yields of principal crops (MT/ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Potatoes | 8.92 | 9.46 | 10.20 | 16.32 |
| Sweet potatoes | 2.79 | 8.64 | 6.53 | 5.81 |
| Yams | 5.03 | 5.13 | 4.82 | 6.56 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in St. Kitts and Nevis

Cassava has been identified as one of the staple crops that can be successfully grown and processed in the country. It could greatly assist and support policies towards attaining food security and increased levels of self-sufficiency. However, there are no national large-scale ventures for cassava cultivation, although former sugar cane fields can be utilized across the country to successfully expand cassava production.

## Production and processing statistics

Cassava plantations are currently limited to 3 ha in St. Kitts and 1 ha in Nevis. There is no officially reported cassava production in the country. As a result, cassava processors rely on imports for their needs. The main cassava varieties grown in the country are: Coconut, Mingo Sweet, Negro, Salt, St. Lucia Sweet and Sugar. The Nevis Agriculture Department and individual farmers are credited with growing cassava for producing flour, bread and chips for local use. Feasibility studies have shown that cassava can be grown easily and integrated fully into the national diets. Elderly people are quite familiar with eating boiled or steamed cassava and cassava bread, as staple foods. Integrated into soups and stews, such as the national dish goat water, the potential of cassava could be unlimited. There is an Agro Processing Unit established by the Taiwanese Technical Mission. Cassava production is supported by the local Government

and CARDI. Support for production is through provision of duty free concessions, reduced water rates and training and education by technical staff.

### Constraints

Some of the constraints affecting cassava development in St Kitts and Nevis are:

- Reliance on manual production methods.
- Lack of improved cassava varieties.
- Lack of a germplasm bank with local varieties.
- Low level of organization in farmer groups.
- Lack of large commercial farms.
- Low level of research and technology transfer activities.
- Low level of promotion of health benefits by increased consumption of cassava products.
- Absence of an industry-wide training program for cassava processors.

### Opportunities

Some of the opportunities that exist upon which a strategy to promote cassava development in St. Kitts and Nevis could be designed are:

- Positive response by consumers in the local markets to processed cassava products.
- Significant demand for processed cassava locally.
- Willingness of Government agencies to support cassava processing and marketing activities.
- Strong tradition of cassava processing in St. Kitts and Nevis.
- Existence of local agricultural marketing organizations whose institutional knowledge can be tapped.
- Land available to expand cassava production.
- Willingness of local farmers to grow cassava.

# ST. VINCENT AND THE GRENADINES

Production of principal crops (MT) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 28 573 | 41 358 | 56 926 | 45 636 |
| Cassava | 2 815 | 2 060 | 321 | 555 |
| Plantains | 315 | 2 759 | 1 589 | 2 343 |
| Sweet potatoes | 2 444 | 4 514 | 2 536 | 1 758 |
| Yams | 2 622 | 3 739 | 1 413 | 1 994 |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 3 654 | 4 070 | 5 280 | 4 136 |
| Cassava | 230 | 249 | 52 | 88 |
| Plantains | 41 | 321 | 164 | 176 |
| Sweet potatoes | 1 039 | 2 366 | 1 528 | 1 223 |
| Yams | 257 | 370 | 127 | 201 |

Yields of principal crops (MT/ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 7.82 | 10.16 | 10.78 | 11.03 |
| Cassava | 12.24 | 8.29 | 6.20 | 6.31 |
| Plantains | 7.78 | 8.61 | 9.71 | 13.30 |
| Sweet potatoes | 2.35 | 1.91 | 1.66 | 1.44 |
| Yams | 10.22 | 10.10 | 11.15 | 9.91 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in St. Vincent and the Grenadines

Cassava can be grown throughout St Vincent and the Grenadines. However, production is concentrated in areas that are closer to the cassava processing plants. Cassava has been included as a staple in the Food and Dietary Guidelines developed by FAO/CFNI, in collaboration with the Ministries of Health and Agriculture.

## Production and processing statistics

The cultivated land area with cassava in St. Vincent and the Grenadines has been estimated at around 120 ha, with yields of 6.6 MT per ha. The main cassava varieties grown are: Punt stick, Butter stick and White Stick. White Stick is considered the best variety for processing farine. The processed products available in the country are: farine, cassava bread, cassava bitty, cassava starch and cassava chips. In 2002, CARDI introduced 29 cassava varieties from CIAT, Colombia: 12 sweet, 12 bitter and 5 intermediate. These varieties are housed at the Government-operated tissue culture laboratory. CARDI has implemented evaluation trials with these varieties,

including subsequent testing done at a government-run cassava processing factory. Some of the cassava introduced varieties that have shown good results are: CM 7514-8; CM 4919-1; and CM 3306-4. No formal grower and processor cooperatives exist in the country. However, loose cooperation arrangements exist among processors for use of the central processing plants. There is mechanization for land preparation where applicable. Shoot tip borer and rodents are the main pest threats but are not economically important.

### Constraints

Some of the constraints and challenges that will need to be considered to promote the development of the cassava sector in St. Vincent and the Grenadines are:

- Reliance on manual production methods.
- Low level of organization in farmer groups.
- Lack of large commercial farms.
- Low level of research and technology transfer activities.
- Insufficient supply of cassava roots to processing enterprises.
- Low level of promotion of health benefits by increased consumption of cassava products.
- Absence of formal supply contracts between farmers and processors.
- Inadequate market information.
- Absence of an industry-wide training program for cassava processors.

### Opportunities

Some of the opportunities that exist to promote cassava development in St. Vincent and the Grenadines are:

- Positive response to processed products by consumers in the local markets.
- Existence of improved design for farine processing plant.
- Significant demand for processed products locally and in the Vincentian Diaspora.
- Willingness of Government agencies to support cassava marketing activities.
- Land available to expand cassava production.
- Willingness of local farmers to grow cassava.
- Input supplies available locally.

# SURINAME

Production of principal crops (MT) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 39 817 | 43 291 | 47 400 | 49 683 |
| Cassava | 2 091 | 2 640 | 4 351 | 3 743 |
| Maize | 247 | 256 | 201 | 44 |
| Plantains | 2 078 | 5 206 | 14 364 | 9 797 |
| Rice Paddy | 174 107 | 280 629 | 217 365 | 171 019 |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 1 765 | 1 766 | 2 139 | 1 375 |
| Cassava | 318 | 392 | 305 | 148 |
| Maize | 131 | 159 | 100 | 16 |
| Plantains | 235 | 359 | 655 | 315 |
| Rice Paddy | 46 569 | 71 702 | 56 833 | 38 643 |

Yields of principal crops (MT/ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 22.56 | 24.51 | 22.16 | 36.14 |
| Cassava | 6.58 | 6.73 | 14.29 | 25.32 |
| Maize | 1.89 | 1.61 | 2.02 | 2.68 |
| Plantains | 8.84 | 14.49 | 21.92 | 31.10 |
| Rice Paddy | 3.74 | 3.91 | 3.82 | 4.43 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in Suriname

Suriname is a country with an estimated area of 13.7 million ha, of which more than 80% is covered with tropical rain forest. Only 1.6 million ha are considered suitable for agriculture. In 2013, the total cultivated land area was estimated at 62.367 ha of which near 92% comprised annual crops. Rice is the dominant crop, with 95% of the total annual crops production. Cassava is the fourth most important staple food after rice, wheat, and plantain and the most planted crop among roots and tubers. It is also the main food security crop for the ethnic groups Amerindians and Maroons, especially in remote areas of the country. There is a basic cassava value chain that includes producers, buyers, processors, retailers and consumers, with cassava being an important source of income for many small-scale farmers and micro-processors.

## Production and processing statistics

In 2013, the land area planted with cassava was estimated to be 254 ha, with a production of 6549 MT, at an average yield of 25 MT per ha. Cassava producers in the interior of the country apply the slash and burn system or shifting cultivation. Producers are mostly women, not trained as farmers and for the most part illiterate, with production practices being traditionally passed from mother to daughter. Cassava production is mostly for local consumption. Cassava is cultivated in all soil types, although loamy soils are preferred. A limited number of locally processed products is available. To date, 106 cassava accessions have been collected and described, based on descriptors related to yield, cyanide content and dry matter content. Leaf cutting ants are the major challenge identified for cassava production.

## Constraints

Some of the constraints and challenges that are currently affecting the development of the cassava sector in Suriname are:

- Absence of commercially identified cassava varieties.
- Shortage of labor.
- Most cassava producers and processors are unorganized.
- Frequent seasonal attacks by leaf cutting ants in some regions.
- Introduction of invasive species by weak quarantine measures.
- Limited capital investment in the cassava chain.
- Underutilization of all parts of the cassava plant (roots and leaves).
- High post-harvest losses.
- Price fluctuations.
- Lack of large commercial farms.
- Low level of research and technology transfer activities.
- Inadequate market information.
- Absence of an industry-wide training program for cassava processors.

## Opportunities

Some of the opportunities that exist to promote sustainable and competitive development of the cassava sector in Suriname are:

- Good government support for food security policy and objectives.
- Excellent agro-ecological climate conditions and good agriculture land.
- Traditional experience with production, consumption and marketing of cassava, resulting in high consumption in all ethnic groups.
- Full mechanized systems for large scale production of cassava can be implemented in the country.
- Existence of public-private initiatives that are utilizing the latest technologies to process cassava starch, with agreed upon contracts with farmers.
- Great potential for full-time employment generation in rural areas.
- Great potential for expanding production, processing and linkages to export markets.
- Great potential to promote cassava flour as a partial substitute to wheat, maize and potato flour.

# TRINIDAD AND TOBAGO

Production of principal crops (MT) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 5 464 | 5 420 | 7 668 | 5 485 |
| Cassava | 4 442 | 1 885 | 1 014 | 1 387 |
| Maize | 3 542 | 3 025 | 5 418 | 2 777 |
| Plantains | 3 109 | 3 494 | 4 031 | 4 153 |
| Rice Paddy | 15 751 | 5 766 | 13 027 | 2 163 |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 1 126 | 1 084 | 1 296 | 1 168 |
| Cassava | 386 | 161 | 291 | 402 |
| Maize | 917 | 1 067 | 1 311 | 1 050 |
| Plantains | 491 | 983 | 1 163 | 1 093 |
| Rice Paddy | 5 609 | 2 172 | 4 081 | 1 716 |

Yields of principal crops (MT/ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 4.85 | 5.00 | 5.92 | 4.70 |
| Cassava | 11.50 | 11.74 | 3.49 | 3.45 |
| Maize | 3.86 | 2.83 | 4.13 | 2.64 |
| Plantains | 6.33 | 3.55 | 3.46 | 3.80 |
| Rice Paddy | 2.81 | 2.65 | 3.19 | 1.26 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in Trinidad and Tobago

Cassava is grown throughout the Island. Farm sizes range from 0.5 to 50 ha. In Trinidad and Tobago, as with most of the other CARICOM countries, cassava trade is relatively small in comparison with other countries in Latin America. Locally, cassava is consumed directly, primarily boiled and fried, and a small group of cassava farmers process frozen cassava logs. In Tobago, there is limited cassava flour processing. Cassava is produced year round but peak-planting is May-June. Some farmers plant year-round in order to obtain a regular supply for local markets. Cassava is one of the six main root crops grown in Trinidad and Tobago, which include sweet potatoes, yams, dasheen, tannia and eddoes.

## Production and processing statistics

The total cassava production in 2012 was estimated to be 1,888 MT from 600 ha and an average yield of only 3.1 MT per ha (FAOSTAT). Cassava is usually grown in pure stand and the size of the areas planted ranges from 0.1 ha to as much as 12 ha. The most commonly grown cassava variety is the MMEX, which accounts for near 95% of the local production. Other varieties grown by farmers are CIAT Hybrid, Maracas Black Stick, and Butter Stick. Improved cassava varieties have been imported from CIAT-Colombia and are currently being evaluated. Land preparation for cassava production is usually done mechanically using tractors but planting and other agronomic practices are done manually. Currently a small group (six farmers) uses mechanized planting and semi-mechanized harvesting. Farmers propagate cassava from stem cuttings, usually obtained from their own cassava fields. Most cassava farmers utilize a combination of manual and chemical weed control. Cassava bacterial blight is a common stem-borne disease that affects plantings. Farmers use a bactericide to control it. Fresh cassava is consumed by farmers and is also sold to processors to make flour, farine and cassava bread. Some of the most common, cassava processed products available in the country are: mix flour for bakery and roti; frozen cassava logs; grated cassava; and cassava dumpling.

## Constraints

Some of the constraints and challenges that will need to be addressed to support the development of the cassava crop in Trinidad and Tobago are:

- Current crop yields are very low. Need to be improved by two or three fold.
- Lack of appropriate cassava varieties suited for different markets. Local varieties present significant differences in yield, starch content, bitterness.
- Uncompetitive price of fresh cassava roots. In almost every country of the CARICOM region, the farm gate price of fresh cassava roots is very high.
- Research and technology development capacity in the country is not very strong.
- Low level processing capacity.
- Minimum use of irrigated production systems in the country.
- High production costs.
- Low availability of labor.
- Absence of specialized extension support for farmers.
- Vast majority of soils are heavy clays which are not the most suited for cassava production with high yields.
- Praedial larceny is a big constraint in the country.
- Not enough local awareness of the health benefits of cassava.
- No system in place to provide accurate market intelligence.
- Weak quality control systems in most processing plants.
- Poorly designed processing plants leading to inefficient operations and increased costs.

## Opportunities

Some of the opportunities that exist to promote sustainable and competitive development of the cassava sector in Trinidad and Tobago are:

- Potential to increase cassava yields by investing in best practice systems.
- Availability of high yielding cassava varieties that could be incorporated into the current cassava production systems.

- Existence of local, regional and international organizations with expertise on cassava technologies that could be easily tapped (FAO, IICA, CARDI, University of the West Indies, University of Trinidad and Tobago, CARIRI, CIAT, CLAYUCA, etc).
- Large and growing market for cassava products, at national, regional and international level.
- Positive response by consumers to processed products (frozen cassava logs, cassava fries, cassava bread).
- Current cassava processing enterprises are unable to meet the domestic demand for cassava.
- Interest of the major supermarket chains in marketing fresh and processed cassava products.
- Cassava has been accepted by local government as a crop that contributes to food security policy and objectives.
- Huge potential for full time employment generation in rural areas.
- Enormous potential to promote cassava flour as a partial substitute to wheat, maize and potato flour.

# DOMINICAN REPUBLIC

Production of principal crops (MT) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 288 407 | 347 443 | 400 222 | 478 716 |
| Cassava | 161 477 | 101 421 | 122 256 | 117 846 |
| Maize | 52 189 | 51 025 | 38 107 | 31 566 |
| Plantains | 542 412 | 632 660 | 313 969 | 376 292 |
| Rice Paddy | 268 798 | 460 667 | 478 836 | 650 359 |
| Sweet potatoes | 72 590 | 38 554 | 41 874 | 33 338 |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 20 500 | 25 946 | 13 382 | 15 146 |
| Cassava | 35 590 | 18 227 | 18 588 | 14 236 |
| Maize | 30 506 | 33 522 | 29 110 | 19 449 |
| Plantains | 60 490 | 63 300 | 35 881 | 33 814 |
| Rice Paddy | 88 429 | 107 450 | 100 867 | 127 896 |
| Sweet potatoes | 10 802 | 6 343 | 6 939 | 4 321 |

Yields of principal crops (MT/ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 14.07 | 13.39 | 29.91 | 31.61 |
| Cassava | 4.54 | 5.56 | 6.58 | 8.28 |
| Maize | 1.71 | 1.52 | 1.31 | 1.62 |
| Plantains | 8.97 | 9.99 | 8.75 | 11.13 |
| Rice Paddy | 3.04 | 4.29 | 4.75 | 5.09 |
| Sweet potatoes | 6.72 | 6.08 | 6.03 | 7.72 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in Dominican Republic

Cassava is the fourth most important crop in Dominican Republic after paddy rice, bananas and plantains, in terms of area planted. The technological level is medium to low. The majority of the cassava farmers own farms with an average size of 1 to 3 ha. Most farmers prepare the soil mechanically, use foliar fertilization (micro and macro elements), weed control by hand and irrigation for about 20% of the area planted (between 3,000 and 4,000 ha.).

There is no formal genetic improvement program for cassava in the country although recently, some improved varieties have been imported from CIAT. These are being evaluated under different ecosystems of the country.

## Production and processing statistics

At the end of the first decade of the 21st century, an estimated land area of 18,000 to 19,000 ha was planted with cassava (FAOSTAT). Average national production for this period was estimated at 129,000 MT, with an average productivity of 7-8 MT per ha. In production systems without irrigation, production costs for cassava are between US$960 to 1,200 per ha, (not including the use of the land). Land renting cost varied between US$450 to US$500 per ha per year. In systems with irrigation, the production costs varied between US$1,280 and US$1,640 per ha. Market prices paid to farmers, depending on the availability of the roots, vary between US$264.00 to US$330.00 per MT. More than 90% of the cassava production in the country is destinated for the fresh market, with only 0.5% destinated to export markets. One of the principal processed products is casabe that accounts for about 7% of the total production of cassava roots.

## Constraints

Some of the constraints and challenges that will need to be addressed to support the development of the cassava crop in Dominican Republic are:

- Lack of use of modern technologies.
- Planting material used by farmers is of poor phytosanitary quality.
- Mixture of local and improved varieties used by farmers.
- Lack of programs for production of high quality planting material.
- The cassava areas are not defined according to characteristics of the zones.
- High post-harvest losses that could reach 17 to 20%.
- Very limited transformation of the crop and lack of promotion for using cassava as human food and as animal feed.
- Lack of trust of the consumers on the quality of the products.
- Local varieties are not good for export markets as fresh cassava.
- Local varieties with low dry matter are not suited for industrial processing.

## Opportunities

Some of the opportunities that exist to promote sustainable and competitive development of the cassava sector in Dominican Republic are:

- Existence of local varieties with good yielding potential and good acceptance in local markets.
- High demand for fresh cassava in local markets.
- Great genetic diversity.
- Adequate soils and climates for cassava production.
- Possibility for market expansion through agroindustrial diversification of cassava.
- High demand for cassava in animal production sector.
- Growing ethnic market in USA.
- Availability of high yielding cassava varieties that could be incorporated into the current cassava production systems.

# ECUADOR

Production of principal crops (MT) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 2 515 796 | 2 142 254 | 5 056 195 | 5 890 171 |
| Cassava | 318 628 | 179 876 | 89 966 | 74 492 |
| Maize | 242 502 | 354 486 | 540 740 | 672 585 |
| Plantains | 525 365 | 827 931 | 827 649 | 598 404 |
| Rice Paddy | 271 061 | 548 596 | 1 134 273 | 1 389 637 |
| Sweet potatoes | 8 977 | 5 673 | 1 551 | 2827 |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 132 115 | 87 385 | 198 711 | 178 644 |
| Cassava | 33 983 | 22 252 | 19 919 | 16 798 |
| Maize | 273 268 | 320 623 | 486 788 | 321 190 |
| Plantains | 58 506 | 72 481 | 83 680 | 95 663 |
| Rice Paddy | 97 841 | 184 238 | 339 834 | 311 337 |
| Sweet potatoes | 2 107 | 1 041 | 394 | 1 434 |

Yields of principal crops (MT/ha) Average of 10-years periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 19.04 | 24.52 | 25,45 | 32,97 |
| Cassava | 9.38 | 8.08 | 4.52 | 4.43 |
| Maize | 0.89 | 1.11 | 1.11 | 2.09 |
| Plantains | 8.98 | 11.42 | 9.89 | 6.26 |
| Rice Paddy | 2.77 | 2.98 | 3.34 | 4.46 |
| Sweet potatoes | 4.26 | 5.45 | 3.94 | 1.97 |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in Ecuador

Cassava is a traditional crop grown for many years ago, mainly in the West Coast, the Eastern Amazon region and the Inter-Andean valleys. The majority of the farmers who plant cassava grow it as a subsistence crop on land areas between 0.25 and 0.5 ha, without improved technologies, and in most cases, intercropped with maize. Cassava is consumed basically in fresh form. Processing activities convert the roots in dry cassava chips for animal feed, starch for human food and also for industrial uses. Some cassava is also exported as paraffin-coated roots and as frozen cassava roots.

## Production and processing statistics

From 2000-2009, the average production of cassava in Ecuador was approximately 75 000 MT, on an estimated land area of 18 000 ha, and with an average productivity of 4 to 5 ton per ha (FAOStat). This very low productivity is due principally to the low rainfall in the Coastal areas (Manabi), the region that accounts for more than 70% of the total production.

## Constraints

Some of the constraints and challenges that will need to be addressed to support the development of the cassava crop in Ecuador are:

- Current crop yields are very low. Need to be improved by two or three fold.
- Lack of better knowledge of the market opportunies at local and international levels.
- Low use of modern technologies by cassava farmers.
- Technology transfer systems for cassava need to be upgraded.
- Lack of improved varieties for cassava.
- Lack of a national research and technology transfer system working with the cassava crop.

## Opportunities

Some of the opportunities that exist to promote sustainable and competitive development of the cassava sector in Ecuador are:

- Potential to increase cassava yields by promoting wider use of improved technologies.
- Availability of high yielding cassava varieties that could be incorporated into the current cassava production systems.
- Demand for cassava as fresh food and as processed products is increasing rapidly.

# NICARAGUA

Production of principal crops (MT) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 117 505 | 114 545 | 88 979 | 44 238 |
| Cassava | 21 328 | 52 666 | 52 000 | 93 125 |
| Maize | 200 530 | 213 581 | 277 864 | 445 335 |
| Plantains | 73 333 | 69 500 | 44 300 | 46 615 |
| Rice Paddy | 81 693 | 136 061 | 201 152 | 279 584 |
| Sweet potatoes | | | | |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 1 913 | 2 569 | 1 975 | 711 |
| Cassava | 4 791 | 4 681 | 4 650 | 9 399 |
| Maize | 224 588 | 180 832 | 232 050 | 288 827 |
| Plantains | 6 360 | 6 950 | 4 430 | 4 264 |
| Rice Paddy | 27 131 | 39 608 | 59 821 | 67 619 |
| Sweet potatoes | | | | |

Yields of principal crops (MT/ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 61.42 | 44.59 | 45.06 | 62.20 |
| Cassava | 4.45 | 11.25 | 11.18 | 9.91 |
| Maize | 0.89 | 1.18 | 1.20 | 1.54 |
| Plantains | 11.53 | 10.00 | 10.00 | 10.93 |
| Rice Paddy | 3.01 | 3.44 | 3.36 | 4.13 |
| Sweet potatoes | | | | |

Source: FAO. http://faostat.fao.org/

## Overview of cassava in Nicaragua

Cassava is produced mainly by small- and medium-size farmers with very low yields (around 6.5 to 7.0 ton per ha). Farmers are usually distant from the main national markets and have limited access to modern technologies. Cassava plays a very important role in the farmers' families as a subsistence crop. 70% of the area planted with cassava is in the humid tropics and the other 30% is grown in the dry tropic. Cassava is commercialized in Nicaragua mainly as fresh roots sold to commercial entrepreneurs that transport the roots to the different markets. There are also traders who travel from Costa Rica to purchase cassava roots in the South region.

## Production and processing statistics

In Nicaragua around 10 000 ha of cassava are planted, producing around 93 000 ton, for an average productivity of near 10 ton per ha (FAOStat). There are small-scale agroindustries, principally for starch. Dry cassava chips for animal feed are also a processed product available in Nicaragua. Recently, some industrial scale projects based on cassava have been established in the country to produce starch, paraffin-coated cassava roots and frozen cassava roots.

## Constraints

Some of the constraints and challenges that will need to be addressed to support the development of the cassava crop in Nicaragua are:

- Current crop yields are very low.
- Low quality of the product for export markets.
- High costs of production.
- Commonly used varieties have low productivity.
- Post-harvest handling of the product is inappropriate.
- Defficiencies in commercialization systems for cassava farmers.
- Farmers and other actors of the agro-productive chain do not have access to credit lines.
- Agricultural technology does not have a dynamic development.
- Farmers supply is lower than market demand.

## Opportunities

Some of the opportunities that exist to promote sustainable and competitive development of the cassava sector in Nicaragua are:

- Potential to increase cassava yields by investing in improved soil and crop management practices.
- Availability of high yielding cassava varieties that could be incorporated into the current cassava production systems.
- Existence of local, regional and international organizations with expertise on cassava technologies that could be easily tapped (FAO, IICA, CARDI, INTA, etc).
- Demand for cassava products and by-products is increasing rapidly locally and in the international markets.
- Positive response by consumers to processed products (frozen cassava logs, cassava fries, cassava bread).
- Supply of cassava roots for different markets could be increased rapidly.
- Cassava is a crop that occupies an important role as a rural development policy option for the Government.

# PARAGUAY

Production of princi pal crops (MT) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 240 559 | 125 944 | 76 775 | 50 900 |
| Cassava | 1 493 221 | 2 901 332 | 2 975 141 | 3 636 796 |
| Maize | 293 599 | 304 557 | 638 891 | 1 468 940 |
| Plantains | | | | |
| Rice Paddy | 51 994 | 73 445 | 111 601 | 134 482 |
| Sweet potatoes | 101 610 | 104 794 | 85 161 | 96 670 |

Area of principal crops harvested (ha) Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 9 100 | 5 820 | 3 843 | 8 750 |
| Cassava | 102 660 | 191 273 | 205 965 | 206 066 |
| Maize | 220 010 | 182 900 | 290 756 | 520 800 |
| Plantains | | | | |
| Rice Paddy | 25 984 | 32 594 | 37 353 | 31 743 |
| Sweet potatoes | 12 432 | 12 691 | 10 751 | 11 599 |

Yields of principal crops (MT/ha Average of 10-year periods

| CROP | 1970-79 | 1980-89 | 1990-99 | 2000-2009 |
|---|---|---|---|---|
| Bananas | 26.44 | 21.64 | 19.98 | 5.82 |
| Cassava | 14.55 | 15.17 | 14.44 | 17.65 |
| Maize | 1.33 | 1.67 | 2.20 | 2.82 |
| Plantains | | | | |
| Rice Paddy | 2.00 | 2.25 | 2.99 | 4.24 |
| Sweet potatoes | 8.17 | 8.26 | 7.92 | 8.33 |

*Source: FAO. http://faostat.fao.org/*

## Overview of cassava in Paraguay

Cassava has great social and economic importance in Paraguay, since 91% of the cassava farmers in the country could be classified as family agriculture farms, with average land area of 1 ha or less. Cassava is ranked fourth in area planted and fifth in total production among the key agricultural crops of the country. More than 75% of the cassava production in Paraguay takes place in small-scale farms. The largest cassava planted area is in the East Region, accounting for more than 90% of the national production. This region has also the higher yields in cassava. The principal use for cassava is for human consumption in fresh form and to a lesser scale in small-scale industries for starch and bakery products.

## Production and processing statistics

The area planted with cassava in Paraguay is 171 000 ha, with total production estimated at 2,560, 000 ton for an average productivity of 14 ton per ha. Paraguay has fourteen large-scale cassava starch processing plants, with a total installed capacity that varies from 50 to 200 ton of roots per day. These processing plants could operate 250-280 days per year. Most operate at lower capacity due to a shortage in the supply of cassava roots at certain times of the year. It is estimated that the installed full capacity of the processing plants will require a potential supply of nearly 50 000 ha.

## Constraints

Some of the constraints and challenges that will need to be addressed to support the development of cassava in Paraguay are:

- Low quality of planting material.
- High competence with other crops at farmer level.
- Lack of appropriate cultural practices.
- Farmers do not use modern inputs.
- Lack of technical personnel trained in modern practices.
- Lack of credit lines to promote crop expansion.

## Opportunities

Some of the opportunities that exist to promote sustainable and competitive development of the cassava sector in Paraguay are:

- Cassava is a very traditional crop in the country.
- High diversity of genetic material.
- High potential for expansion.
- Diverse alternatives to promote other products, uses and markets.
- High daily consumption as a fresh product.
- Huge processing capacity installed in the country.
- Land availability.

# PART 3: POTENTIAL TECHNOLOGICAL OPTIONS TO PROMOTE SUSTAINABLE AGRICULTURAL DEVELOPMENT AND ECONOMIC GROWTH

## INTRODUCTION

The greatest challenge currently being faced by countries and governments in the Caribbean region, relates to the high food import bill, resulting from large imports of agricultural products required to meet the food demand of the population. This situation has forced policy makers in the region to develop and implement specific policies to reduce food imports and promote greater production and consumption of crops that can be grown locally.

The cassava crop could become one of the most important options for promoting the expansion of production and consumption of food products. However, the current situation of the cassava production, processing and utilization systems in the Caribbean region is far from optimal. Very important and intensive changes will have to take place in the way cassava is being produced, processed and consumed, if the desired goal of converting the crop into a strategy to promote sustainable development and economic growth in the CARICOM region is to be achieved.

The strategies that need to be formulated and implemented in the region to move cassava production systems from subsistence to commercial level will have to include components related to at least four main pillars:

1. Increased production and productivity at farm level.
2. Improved processing, value-adding technologies.
3. New commercialization (innovation, product development) and market systems.
4. Promotion of consumption.

As a complement, stronger links between all the actors of the value chain will have to be created. In the following section, a review is made of some of the technological options that are currently available for implementation, related to these pillars. The efficiency and impact of the technological options will vary from country to country, depending on the specific agro-ecological conditions and the socio-economic context.

## PILLAR 1. INCREASED PRODUCTION AND PRODUCTIVITY IN CASSAVA

### *a. Soil fertility maintenance and nutrient efficiency*

Successful crop production is heavily dependent on good soil fertility management. Crops like cassava extract a significant amount of nutrients from the soil. If these nutrients are not replenished, the yields obtained will be low and will decline over time. Soils with low fertility profile, in particular low organic matter, are very common in the CARICOM region and this could be perhaps one of the major factors contributing to low cassava productivity in the region. However, this constraint is highly manageable and good cassava yield can be obtained with appropriate management of soil fertility and organic matter content.

### *b. Pest and disease management*

Although no major pests and diseases have been reported for cassava in the Caribbean region, with the intensification of cassava production systems that is expected occur in the near future, it is likely that pest and disease constraints will increase. The most efficient pest and disease management systems that currently exist for cassava are based on three main options: resistant

varieties, crop management and biological control. Important gains have been made and are available in cassava germplasm for several key pests and pathogens such as cassava bacterial blight, superelongation disease, thrips, cassava green mite and whiteflies.

Biological control is one of the most efficient strategies for pest management. Although biological control options are currently available for the most important pest constraints, or are in the process of being developed, biological control strategies never offer a complete solution. They are an important component of any integrated management programme and need to be complemented with other strategies such as monitoring and supplemental methods such as cultural practices as well as manual and chemical control).

### *c. Weed management*

Weed control in cassava production is mostly done manually. This trend is changing as farmers look for ways to reduce labor inputs and produce cassava at the lowest possible price. Weeding could account for nearly 40% of the total labour input for the crop. Chemical weed control is an alternative, especially in commercial plantations. Mechanized weeding is possible in the early stages of the crop, especially when the planting of cassava is designed to facilitate this management practice. Weed control is and will continue to be one of the most important constraints to be solved in order to obtain more efficient and competitive production systems.

### *d. Crop management*

Cassava has a long growing cycle, averaging of 8-12 months before harvest. This makes the crop more vulnerable to potential pest and disease problems. Some crop management practices have been developed to try to minimize the incidence of pests and diseases, common among them being planting dates, plant spacing and intercropping.

Crop management is also important from the point of view of production costs. For example, for manual planting, 12 workers may be required to plant one ha in one day. This is a very high cost and in some cases, will create a heavy demand for labour which is becoming very scarce in the rural areas of many countries. One option is to use mechanized planting. One tractor driver and two workers can plant 6 to 8 ha in one day. Such a large difference in the final production costs could mean the failure or the success of a given agro-industrial, cassava-based enterprise.

The same analysis, done with the harvest component, would be as follows: one worker in eight hours and with normal soil and weather conditions could harvest 400 to 600 kg of root per day. With the use of mechanised lifters (using a tractor), the worker output could be increased to 800-1000 kg per day.

### *e. Cassava genetic resources*

One of the most promising areas to promote quick, significant gains in cassava productivity is to facilitate the introduction and evaluation, in each country, of some of the improved, high yielding cassava varieties that are available at research centers such as CIAT, in Cali, Colombia.

In almost every country in the Caribbean region, attempts have been made in the past to introduce improved cassava varieties. In some cases, the local agricultural research and technology transfer systems were able to manage these new varieties, to expand farmers' options to have a facilitated access to improved genetic material and improving the competitiveness.

Nicaragua offers an excellent example. The National Agricultural Agency in Nicaragua, INTA, has been very active in the past three years, releasing improved cassava varieties, as part of the

national genetic wealth of the country. Farmers are planting these high-yielding varieties and selling the produce to agroindustrial enterprises to produce starch and to process fresh cassava for local and export markets. Nearly 10 years ago, the same varieties were at the cassava genetic banks of CIAT in Cali, Colombia. It took almost a decade of intensive work, before the cassava farmers in Nicaragua were able to have a facilitated access to these improved cassava varieties. What needs to be done is to develop and implement systems that shorten considerably the time required to empower the farmers, allowing them to start using the improved varieties earlier in their cassava production systems. Over the past decade, CLAYUCA has been working actively to transfer cassava genetic resources from the CIAT Cassava Bank, to cassava growing systems in countries in Latin America and the Caribbean region.

The process of introducing new varieties could be implemented very easily. It would begin by sending a request to the cassava group at CIAT. In collaboration with the Genetic Resources Unit, the cassava group would identify an initial list of varieties and, upon further analysis; a final list would be selected and transferred to the requesting country, in the form of cassava *in-vitro* plants. Once the *in-vitro* plants arrive into the country, they need to pass through a hardening process. In about two months, about 30 to 50 plants, for each variety, would be available and ready for transplanting in variety validation trials. The 30-50 cassava plants of each variety could be planted in controlled trials in the first cycle in plots of 16 plants each, grown at distances of 1.0 m by 1.0 m. During the growing cycle, a harvesting plan should be implemented to measure the starch and dry matter content, and root and foliage yield, at various times, i.e. 6, 8, 10 and 12 months after planting.

For all varieties: some of the plants, after being transplanted, can be pruned when they are four months old. The stems so obtained could be replanted in larger trials. The propagation methodology used in this type of management is known as the two-bud, mini-stake system, and the mini-stakes could be planted directly in the cassava plots (Figure 15).

If this genetic empowerment process can be implemented quickly in most of the Caribbean countries, it would be feasible, in five years or less, to give a boost to the cassava genetic resources in each country, with the possibility of having a tremendous impact on the production and productivity levels.

Figure 15. Cassava plants obtained from two-node mini-stakes, ready for transplanting.
*© CLAYUCA Corporation.*

Using this approach, based on the introduction of improved, elite cassava genetic resources, followed by a period of evaluation trials in some of the most important cassava production areas of the country, it is possible to have large areas planted with the improved varieties, in a relatively short period of time.

Figure 16 shows some of the efficiencies that can be obtained using a combined methodology of *in-vitro* plants and vegetative propagation methods. Starting with 50 vitroplants from any given cassava improved variety, after 14 months, it is possible to have 4.5 ha planted using a density of 10,000 plants per ha.

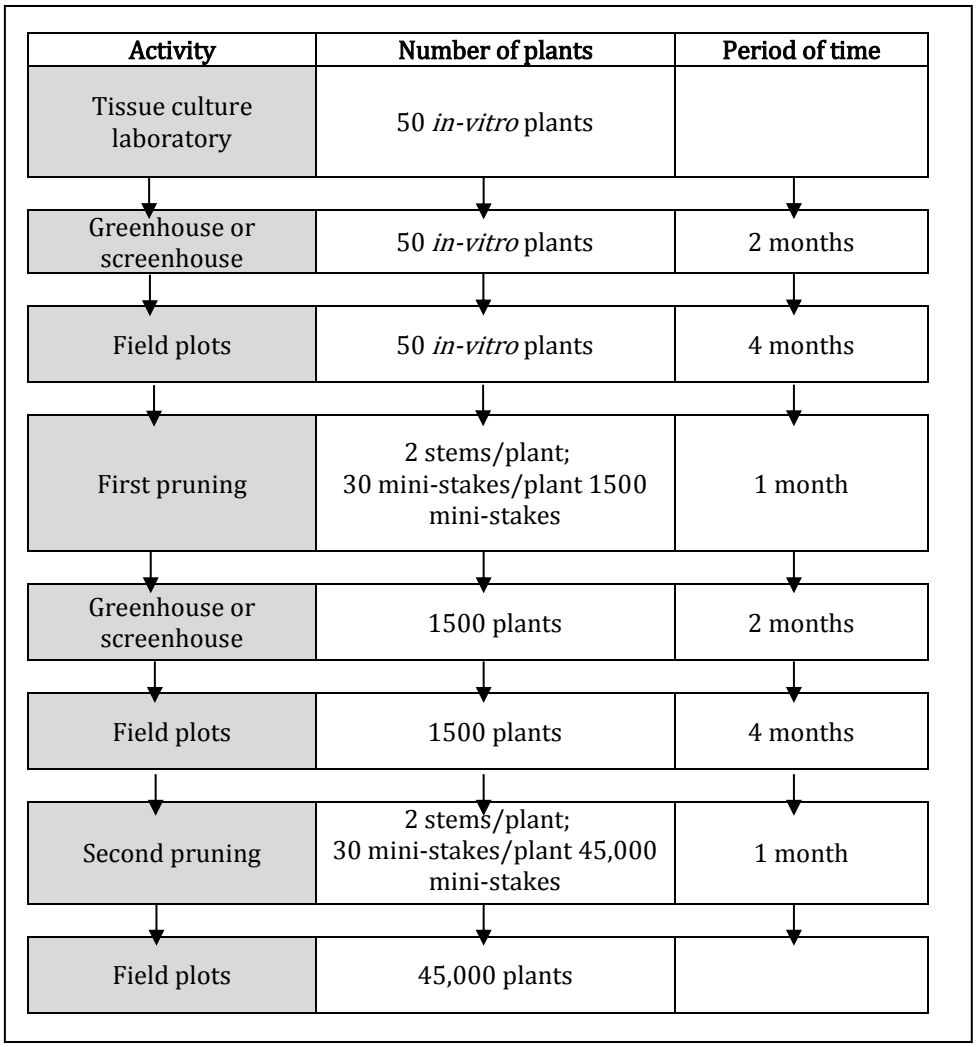


Figure 16. System for rapid multiplication of planting material of imported, improved cassava varieties, included in field evaluation trials.

One interesting adaptation of this method has been implemented recently by the technical personnel of INTA, the National Research and Technology Transfer agency in Nicaragua. The modification consists in establishing multiplication plots in the experimental station, of the cassava varieties that have already been identified as promising. These plots are managed carefully with fertilization and irrigation as needed. It operates basically as the system used with coffee growers, a nursery-type of multiplication plot. These plots can be established using the two-node system; planting each mini-stake in a plastic bag with high quality soil, and when the

plants are about two or three months old, they are delivered to the farmers as ready-to-plant material (Figure 17). This is an interesting difference from the traditional system of delivering planting stakes to cassava growers.

Figure 17. System for rapid multiplication of planting material of improved cassava varieties based on the nursery concept. Farmers receive 2-3 month old plants instead of stakes.
*© CLAYUCA Corporation.*

Advances in facilitating the access of farmers to improved, higher yielding cassava varieties, complemented with the use of improved soil and crop management technologies, could make a great contribution to improve the very low productivity that prevails in most of the cassava growing systems in the CARICOM region. This first pillar could be addressed quickly to start changing the current situation.

### PILLAR 2. IMPROVED PROCESSING, VALUE ADDING TECHNOLOGIES

In several Caribbean countries, cassava is generally not used much in the fresh form (boiled or fried). On the other hand, cassava is processed into diverse range of products that are consumed as traditional food products, including bread, flour, farine, and snacks. The scale of the processing facilities is small, with manual operations predominantly carried out by family labour. The processing units operate seasonally, coinciding with the harvest season when there is sufficient raw material. The processed products are generally destined for local markets although in some cases there is also a connection with regional and extra-regional export markets. It can be said that in almost every country in the region, there are already processing technologies available and there are also various food products available. One dimension of the work that needs to be done in this pillar, relates to improving the efficiency of these processing technologies that are already available in the region. Most of them are cottage-type, small-scale processing facilities, operating with low levels of efficiency and high costs, thus making the food products obtained very expensive.

In recent years, regional institutions such as CARDI, IICA and FAO have promoted an updated model of cassava production and processing with mechanization of some of the processing operations, modifying the infrastructure and lay-out of the processing facilities and training farmers and technical personnel in good management and processing pratices. This has resulted in larger scale production at the field and value-added levels, and better quality of processed

products. These improved technologies have had a great impact and could become an important trend for the countries and governments of the CARICOM region considering that: the demand for cassava-based products is increasing; the technologies promoted are easily adopted by the farmers and processors; and the countries are putting in place specific policies aimed at promoting higher production and local consumption of cassava. These strategies should be continued, strengthened and disseminated throughout the region, especially in those countries in which it is absent.

The other dimension of the work required in this pillar is related to the introduction and adaptation of new processing technologies that will help to develop new food products, with high market potential. Farmers could develop new market linkages with these new food products, to obain additional incomes and employment opportunities. This could be the best motivation for farmers to adopt improved production and processing technologies that are included in pillars one and two.

CARICOM countries have already adopted a strategic initiative aimed at reducing the ever-increasing food-import bill. Although the current status of the cassava crop, in most countries of the region, looks promising, with positive trends of increased consumption, growing markets and higher demand, this situation is not enough to give cassava the push that is needed to acquire an important role as a policy option.

Cassava agroindustrial development, based on modern technologies for production, processing and utilization, could help to give cassava an important role among the strategies required to reduce the high food-import bill. These technologies have not yet been developed and/or implemented in most CARICOM countries. It is very important to have the first operational example of such a cassava-based, agroindustrial development strategy, implemented successfully in at least one of the countries, so that the model could be used as an example for the other countries of the region.

In an attempt to contribute to this objective, the following section presents a simplified financial analysis model for an agroindustrial development project, based on the production and processing of cassava roots to obtain high quality cassava flour for human consumption (HQCF). The HQCF, produced at competitive costs and with the required quality, could be used as part of a strategy to reduce wheat imports, with direct implications on helping to reduce the food import bill, in any of the countries of the CARICOM region.

## Financial analysis model for the establishment of a processing plant for high quality cassava flour for human consumption

### *Introduction*

The processing plant that has been used as a reference for the calculations presented in the financial model refers to the type of technology proposed by CLAYUCA Corporation, that process cassava roots into high quality cassava flour, and generates one by-product and raw flour for use in animal feed. This technology option is simple, affordable, reliable and could be operated and administrated very easily by any farmers group.

The basic data used to feed the financial analysis model is the following:

| Input Data | Amount | Unit |
|---|---|---|
| Cassava flour output: | 44.2 | MT/month |
| Fresh cassava root requirements (a) | 6.4 | MT/day |
| Fresh cassava root requirements (b) | 1997 | MT/year |
| Cassava flour output (c) | 1.70 | MT/day |
| Cassava flour output (d) | 530 | MT/year |
| Price of fresh cassava roots (e) | 140 | US$/MT |
| Price Cassava flour (f) | 735 | US/MT |
| Sub-product output ( fiber residue for use in animal feeding) | 0.51 | MT/day |
| Sub-product output ( fiber residue for use in animal feeding) | 159.1 | MT/year |
| Labor cost per worker per year | 12000 | US$/year |

(a) Amount of fresh cassava chips that can be loaded in the processing plant per batch of eight hours.
(b) The cassava flour processing plant operates 26 days per month, 12 months of the year.
(c) Conversion factor is 3.75 MT fresh cassava roots per 1 MT cassava flour.
(d) Total amount of cassava flour produced per year.
(e) Target intervention price suggested for cassava roots, per MT.
(f) Target price suggested for cassava flour, per MT (based on assumption of 60% of the price for wheat flour in February 2014, in Barbados, (US$ 1225/MT).

## Financial analysis model for the cassava flour processing plant

| Years | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Inputs** | | | | | | | | | | | | |
| **Fresh Cassava Roots required** | | | | | | | | | | | | |
| Cassava flour output (MT) | | 212 | 424 | 530 | 530 | 530 | 530 | 530 | 530 | 530 | 530 | |
| Price of cassava flour (US$ x MT) | | 735 | 735 | 735 | 735 | 735 | 735 | 735 | 735 | 735 | 735 | |
| Income by selling cassava flour (US$) | | 155937,6 | 311875,2 | 389844 | 389844 | 389844 | 389844 | 389844 | 389844 | 389844 | 389844 | |
| Cassava flour by-product output (MT) | | 64 | 127 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | |
| Price of cassava flour by-product (US$ x MT) | | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | |
| Income by selling cassava flour by-product (US$) | | 12730 | 25459 | 31824 | 31824 | 31824 | 31824 | 31824 | 31824 | 31824 | 31824 | |
| **Total Revenues** | | **168667.2** | **337334.4** | **421668** | **421668** | **421668** | **421668** | **421668** | **421668** | **421668** | **421668** | **3879345.6** |
| **Expenses** | | | | | | | | | | | | |
| Fixed Investment-Cassava flour plant + installation costs) | 180000 | | | | | | | | | | | |
| Cost of cassava roots | | 111821 | 223642 | 279580 | 279580 | 279580 | 279580 | 279580 | 279580 | 279580 | 279580 | |
| Fresh cassava roots (MT / year) | | 799 | 1597 | 1997 | 1997 | 1997 | 1997 | 1997 | 1997 | 1997 | 1997 | |
| Price fresh cassava roots (US$ /MT) | | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | |
| Processing Labor Costs (2 persons per day; US$ 25 per person) | | 24000 | 24000 | 24000 | 24000 | 24000 | 24000 | 24000 | 24000 | 24000 | 24000 | |
| Other processing costs (energy, etc) (25 US / MT of cassava flour) | | 5304 | 10608 | 13260 | 13260 | 13260 | 13260 | 13260 | 13260 | 13260 | 13260 | |
| **Total Expenses** | **180000** | **141125** | **258250** | **316840** | **316840** | **316840** | **316840** | **316840** | **316840** | **316840** | **316840** | **3114094** |
| **Earnings before interest and tax** | **180000** | 27542 | 79085 | 104828 | 104828 | 104828 | 104828 | 104828 | 104828 | 104828 | 104828 | 1125251 |
| Debt service | | 5400 | 5400 | 27225 | 26550 | 25875 | 25200 | 24525 | 23850 | 23175 | 22500 | |

| | Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Interest | | 5400 | 5400 | 4725 | 4050 | 3375 | 2700 | 2025 | 1350 | 675 | 0 |
| Capital payments | | | | 22500 | 22500 | 22500 | 22500 | 22500 | 22500 | 22500 | 22500 |
| Interest rate | | 3% | 3% | 3% | 3% | 3% | 3% | 3% | 3% | 3% | |
| **Earnings before amortisation** | 180000 | 22142.4 | 73684.8 | 77603.0 | 78278.0 | 78953.0 | 79628.0 | 80303.0 | 80978.0 | 81653.0 | 82328.0 |
| **Depreciation and amortisation** | | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 |
| **Net Earnings** | | 4142 | 55685 | 59603 | 60278 | 60953 | 61628 | 62303 | 62978 | 63653 | 64328 |
| Memo items | | | | | | | | | | | |
| Assets | | | | | | | | | | | |
| year end cash | | 22142.4 | 95827.2 | 173430.2 | 251708.2 | 330661.2 | 410289.2 | 490592.2 | 571570.2 | 653223.2 | 735551.2 |
| Equipment residual value | 180000 | 157500 | 135000 | 112500 | 90000 | 67500 | 45000 | 22500 | 0 | | |
| **Total Actives** | **180000** | **179642.4** | **230827.2** | **285930.2** | **341708.2** | **398161.2** | **455289.2** | **513092.2** | **571570.2** | **653223.2** | **735551.2** |
| Liabilities | | | | | | | | | | | |
| Long-term credit outstanding | 180000 | 180000 | 180000 | 157500 | 135000 | 112500 | 90000 | 67500 | 45000 | 22500 | 0 |
| **Total liabilities** | | **180000** | **180000** | 157500 | **135000** | **112500** | **90000** | **67500** | **45000** | **22500** | |
| **Equity** | | -357.6 | 50827.2 | 128430.2 | 206708.2 | 285661.2 | 365289.2 | 445592.2 | 526570.2 | 630723.2 | 735551.2 |
| Debt service | 180000 | 5400 | 5400 | 27225 | 26550 | 25875 | 25200 | 24525 | 23850 | 23175 | 22500 |

## Internal rate of return

With the information obtained through the financial analysis model, the internal rate of return can be estimated for the conditions assumed:
Price of cassava roots = 140 US$ per MT and
Price of cassava flour = 735 US$ per MT

**Financial Analysis Model for the cassava flour processing plant**

| | Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Inputs*** | | | | | | | | | | | | |
| ***Fresh Cassava Roots required*** | | | | | | | | | | | | |
| Cassava flour output (MT) | | 212 | 424 | 530 | 530 | 530 | 530 | 530 | 530 | 530 | 530 | |
| Price of cassava flour (US$ x MT) | | 735 | 735 | 735 | 735 | 735 | 735 | 735 | 735 | 735 | 735 | |
| Income by selling cassava flour (US$) | | 155937,6 | 311875,2 | 389844 | 389844 | 389844 | 389844 | 389844 | 389844 | 389844 | 389844 | |
| Cassava flour by-product output (MT) | | 64 | 127 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | |
| Price of cassava flour by-product (US$ x MT) | | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | |
| Income by selling cassava flour by-product (US$) | | 12730 | 25459 | 31824 | 31824 | 31824 | 31824 | 31824 | 31824 | 31824 | 31824 | |
| ***Total Revenues*** | | **168667,2** | **337334,4** | **421668** | **421668** | **421668** | **421668** | **421668** | **421668** | **421668** | **421668** | **3879345,6** |
| ***Expenses*** | | | | | | | | | | | | |
| Fixed Investment-Cassava flour plant + installation costs) | 180000 | | | | | | | | | | | |
| Cost of cassava roots | | 111821 | 223642 | 279580 | 279580 | 279580 | 279580 | 279580 | 279580 | 279580 | 279580 | |
| Fresh cassava roots (MT / year) | | 799 | 1597 | 1997 | 1997 | 1997 | 1997 | 1997 | 1997 | 1997 | 1997 | |
| Price fresh cassava roots (US$ /MT) | | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | |
| Processing Labor Costs (2 persons per day; US$ 25 per person) | | 24000 | 24000 | 24000 | 24000 | 24000 | 24000 | 24000 | 24000 | 24000 | 24000 | |
| Other processing costs (energy, etc) (25 US / MT of cassava flour) | | 5304 | 10608 | 13260 | 13260 | 13260 | 13260 | 13260 | 13260 | 13260 | 13260 | |
| ***Total Expenses*** | **180000** | **141125** | **258250** | **316840** | **316840** | **316840** | **316840** | **316840** | **316840** | **316840** | **316840** | **3114094** |
| **Earnings before interest and tax** | **180000** | 27542 | 79085 | 104828 | 104828 | 104828 | 104828 | 104828 | 104828 | 104828 | 104828 | 1125251 |
| Debt service | | 5400 | 5400 | 27225 | 26550 | 25875 | 25200 | 24525 | 23850 | 23175 | 22500 | |
| Interest | | 5400 | 5400 | 4725 | 4050 | 3375 | 2700 | 2025 | 1350 | 675 | 0 | |
| Capital payments | | | | 22500 | 22500 | 22500 | 22500 | 22500 | 22500 | 22500 | 22500 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Interest rate | | 3% | 3% | 3% | 3% | 3% | 3% | 3% | 3% | 3% | |
| **Earnings before amortisation** | 180000 | 22142,4 | 73684,8 | 77603,0 | 78278,0 | 78953,0 | 79628,0 | 80303,0 | 80978,0 | 81653,0 | 82328,0 |
| **Depreciation and amortisation** | | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 |
| ***Net Earnings*** | | 4142 | 55685 | 59603 | 60278 | 60953 | 61628 | 62303 | 62978 | 63653 | 64328 |
| Memo items | | | | | | | | | | | |
| Assets | | | | | | | | | | | |
| year end cash | | 22142,4 | 95827,2 | 173430,2 | 251708,2 | 330661,2 | 410289,2 | 490592,2 | 571570,2 | 653223,2 | 735551,2 |
| Equipment residual value | 180000 | 157500 | 135000 | 112500 | 90000 | 67500 | 45000 | 22500 | 0 | | |
| ***Total Actives*** | **180000** | **179642,4** | **230827,2** | **285930,2** | **341708,2** | **398161,2** | **455289,2** | **513092,2** | **571570,2** | **653223,2** | **735551,2** |
| Liabilities | | | | | | | | | | | |
| Long-term credit outstanding | 180000 | 180000 | 180000 | 157500 | 135000 | 112500 | 90000 | 67500 | 45000 | 22500 | 0 |
| **Total liabilities** | | **180000** | **180000** | 157500 | **135000** | **112500** | **90000** | **67500** | **45000** | **22500** | |
| **Equity** | | -357,6 | 50827,2 | 128430,2 | 206708,2 | 285661,2 | 365289,2 | 445592,2 | 526570,2 | 630723,2 | 735551,2 |
| Debt service | 180000 | 5400 | 5400 | 27225 | 26550 | 25875 | 25200 | 24525 | 23850 | 23175 | 22500 |

## Internal rate of return

| | Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Net sales** | | | | | | | | | | | |
| Flour | | 155938 | 311875 | 389844 | 389844 | 389844 | 389844 | 389844 | 389844 | 389844 | 389844 |
| By product | | 12730 | 25459 | 31824 | 31824 | 31824 | 31824 | 31824 | 31824 | 31824 | 31824 |
| Total | | 168667 | 337334 | 421668 | 421668 | 421668 | 421668 | 421668 | 421668 | 421668 | 421668 |
| **Costs** | 180000 | 141125 | 258250 | 316840 | 316840 | 316840 | 316840 | 316840 | 316840 | 316840 | 316840 |
| **Net Flow** | -180000 | 27542 | 79085 | 104828 | 104828 | 104828 | 104828 | 104828 | 104828 | 104828 | 104828 |
| | | | | | | | | | | | |
| **IRR** | **40.9%** | | | | | | | | | | |

To complement the information obtained with the financial analysis model, a sensitivity analysis was conductedcted, using different prices for purchasing the cassava roots, and different prices for selling the cassava flour.

## Sensitivity analysis

| Prices of cassava roots (US$ per MT) | Prices of cassava flour (US$ per MT) | | | | |
|---|---|---|---|---|---|
| | **500** | **600** | **735** | **800** | **900** |
| **120** | -1% | 28% | 49% | 67% | 83% |
| **130** | | 19% | 41,5% | 60% | 77% |
| **140** | | 8% | **40,9%** | 53% | 71% |
| **150** | | -8% | 25% | 46% | 64% |
| **160** | | | 16% | 39% | 58% |
| **170** | | | 4% | 31% | 51% |

It can be concluded from the previous analysis that there are different options to having a successful, competitive cassava agroindustrial project operating, for selling high quality cassava flour. The most important condition is the possibility of producing the cassava roots at competitive prices. This could be a challenge considering the current situation of most of the countries in the CARICOM region. There is an urgent need to establish, at least on a pilot basis, a project that shows the feasibility of producing cassava at competitive prices, to be used as the raw material for the cassava processing agroindustrial projects.

There are other options for processing, value-adding technologies that could be considered, such as the use of paraffin-coated cassava roots, the frozen cassava logs, the grated cassava (mash) for use in bakery products and the fried cassava snacks. All these processing technology options could become options to help cassava farmers in the region to become more competitive and sustainable.

## PILLAR 3. NEW COMMERCIALIZATION/MARKETING AND MARKET SYSTEMS

The third pillar that needs to be addressed simultaneously with the improvements in the production and processing components is related to the need for establishing new commercialization and marketing arrangements for cassava farmers in the region. The most common strategy that farmers use is to market the roots near their farms or to sell it to traders. In a good year with high production, farmers are likely to receive low returns due to a glut in the market. In subsequent year(s), if farmers reduce the areas planted, the supply of roots is reduced, and the traders and processing enterprises are then forced to raise the prices for the raw material, which results in farmers making more money. This cycle is repeated year after year, and serious attempts need to be made to change this situation.

The work required on this pillar must include the organization of the farmers for the marketing, so that instead of dealing individually with markets, they get more bargaining power by doing the marketing as a group, with delivery contracts, with prices and volumes negotiated and agreed upon before harvest

This organizational intervention could be even more important if the work on the two pillars related to production and processing technologies is successful because with increased productivity, increased processing facilities and processed products and increased market options, there will also be a consequent higher need for steady, reliable supply of cassava roots to address the demand of the diversified markets. In some cases, once the processing facilities are established, the current level of production and productivity will not be enough. This could be an excellent opportunity to promote the establishment of plantation type cassava farms, 10-30 ha each, that could be implemented using the larger plots of government-owned or private lands that are available in most countries. This semi-commercial type of cassava farms could help to rapidly increase the availability of cassava for the different markets.

The larger-size cassava farms could also become the learning ground in the region for the adaptation of mechanized technologies for planting and semi-mechanized systems for harvesting of cassava. The combination of these two management options could help to reduce the costs of production in the region, which is currently very high. FAO and CARDI are already working in the adaptation of these strategies in the Caribbean region.

## PILLAR 4. PROMOTION OF CONSUMPTION

Promoting higher consumption of the cassava crop, in the fresh form and as processed / value-added products is also a very important area of work. The crop is widely consumed in the Caribbean, especially in the form of farine and bread (bammy) or grated cassava (mash). The consumption of cassava in fresh form is not very common. The proposal to establish processing enterprises that could produce high quality cassava flour for human consumption could be a sound strategy to promote higher consumption of the crop. The cassava flour could easily be used as partial substitute of wheat flour in bakery products. Most of the countries have school feeding programs, and the foods that are prepared currently, include huge mounts of wheat flour. Even modest levels of incorporation of cassava flour in these institutional markets could help to create higher consumption of the cassava crop in the region. For example, in Jamaica, one company is currently producing breakfast and lunch for 160,000 children daily. One of the ingredients used are wheat tortillas, imported from USA. These tortillas could very easily be replaced by tortillas made with cassava flour. The same could happen with other products like bread, cakes, muffins, etc.

However, there are important changes and adjustments that have to be made before. One, perhaps the most important, is to reduce the current cost of cassava. Promoting higher consumption of the crop at the current price levels for cassava roots, and especially for food products, are not likely to yield good results. For example, the price at which cassava flour is sold on the retail market is on average US$ 10 per kilogram. Compare this to the high quality cassava starch that is available in international markets at US$ 1.0 to US$ 1.2 per kilogram.

Thus, on the on hand, there is an urgent need to start producing cassava crop, cassava flour and other cassava-based food products at reasonable prices that would allow farmers to make money as producers. On the other hand, it is necessary to encourage consumers to increase their levels of consumption but at prices that are reasonable. This can only be achieved via increased production and productivity.

## CONCLUSIONS

- The potential of the cassava crop in the Latin America and the Caribbean region goes beyond its contribution to the food and nutrition security of millions of families. Given the large number of diverse uses for human, animal and industrial consumption, with steadily growing markets, cassava can become the first link towards a great agroindustrial development process in the region, with enormous potential to contribute to the creation of jobs, higher incomes and greater prosperity. Similar processes have ocurred in the past in regions such as Southern Brazil, Costa Rica, and some parts of Colombia.

- This potential is based on the fact that the LAC region has a comparative advantage, with excellent agro-ecological conditions for efficient, competitive production of cassava, complemented with a strong tradition of production, processing and utilization, and the presence of research and technology transfer institutions / centers with years of experience. Additionally, cassava is becoming a highly demanded crop worldwide, with potential to be used in different forms, by different industrial sectors and markets. Cassava starch, for example, is considered a commodity with a very dynamic international trade. For the Caribbean region, the most attractive option for cassava appears to be related to the substitution of part of the huge imports of food products, especially staples and cereals that is currently happening in most of the countries, resulting in a very high food import bill.

- Despite these positive perspectives, there is high volatility in cassava prices due to the high risk that farmers face. They make very little investments to produce the crop, allocating very small areas, making the cassava growing very uncompetitive. Most of the production is done by small farmers with few resources and incentives to invest. Low access to information on market opportunities and new production and processing technologies, geographical dispersion and very poor organizational and association opportunities are other constraining factors that give the cassava farmers in the Caribbean region very little bargaining power.

- In this scenario, future development of cassava in the Caribbean must be based on developing the capacity to overcome the limiting factors that are constraining the sustainable and competitive development of the sector. These limiting factors are generally associated with the lack of capacity of the cassava sectors in the region to meet the requirements of the growing markets in terms of quality, quantity, competitive prices, constant supply, etc.

Some of the main constraints that are affecting the development of the cassava sector in the LAC region are summarized below. These need to be urgently addressed if a viable, sustainable cassava industry is to be developed in the Latin America and Caribbean region.

**1. Small, scattered production units**, often located in marginal areas and lacking organization. Most of the cassava production in the region comes from small farmers, producing different crops simultaneously, with only one portion dedicated to cassava. This factor limits economies of scale, increases production costs, reduces the profit margins and limits the ability of the farmers to adopt new, more efficient technologies. These small production units are in most cases spread over vast areas, away from the main centers of consumption and with very poor infrastructure. Farmers usually lack the ability to meet the demands of different markets in terms of volumes and frequency, as the raw material industry requires constant supply throughout the year while farmers can consistently supply raw material during the harvest season. Another consequence of this situation is the lack of connection with the markets, in most cases the only link farmers have

with the markets is through intermediaries which pay them only a fraction of the price paid by the final consumer.

One possible way to overcome this constraint is to train and inform farmers about the advantages of establishing their own organisations, and if possible, their own processing operations. Only through partnerships would they be able to have sufficient capacity to acquire and efficiently use the new technologies such as irrigation, mechanization, fertilization, improved varieties, etc, generating economies of scale in the production units, and developing greater access to growing markets.

**2. Lack of statistical and market information**. In most countries of the region there is no accurate, updated statistical information on the developments and trends on prices, production costs, production volumes, and other relevant information on the different markets. This information is important to project, plan, evaluate and make decisions. Often this lack of information is a limiting factor for the investor as it limits his view of the market opportunities and the risks that must be faced. Generating this type of information has some costs and this is the reason why, in most cases, it is under the control of private groups, particularly medium and large investors, making it very difficult for small farmers to have access to it.

**3. Lack of commercial vision**. Most of the cassava production in the region is in the hands of small producers, with low levels of both technical and commercial training, and lacking a commercial vision for the crop. The isolation from markets, low level of representation and competitiveness as well as the lack of access to and links with new markets limit the access of farmers to strategic information that could encourage them to develop an entrepreneurial, commercial vision for the production of cassava.

**4. Lack of sharing and dissemination of new technologies**. Modern technologies for cassava production and processing are usually available but in most cases, its dissemination is not adequate and the groups of small farmers do not have a facilitated access to these technologies.

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| Trinidad and Tobago | Melissa Agbeko | Roots and Tubers, bananas, plantains | Food Technologist | Food Technologist, Research and Development | Division of Agriculture, Marketing Department | m2agbeko@gmail.com | TCOSWAF Building, Shaw Park, TOBAGO | 868-639-5091 Ext2222 |
| Trinidad and Tobago | Ganesh Gangapersad | Roots and Tubers, Bananas and Plantain | Quality Assurance Manager | Ag CEO NAMDEVCO | NAMDEVCO | ggangapersad@namdevco.com | S.S. Penal Road, Debe | (868) 6473218 |
| Trinidad and Tobago | Nirmala Persad | Roots and Tubers | Food Technologist | Pack House Manager | NAMDEVCO | npersad@namdevco.com | Namdevco Pack House, E16 Caroni North Bank Rd., Piarco | 669-7092 |
| Trinidad and Tobago | Janelle Yard - Blackman | Chill and frozen cassava and sweet potato fries. Chill and frozen sweet potato, cassava, dasheen (cubes, chunks, | Food Technologist | Quality Manager, Research and Development | Trinidad and Tobago Agribusiness Association TTBA | jayarde@gmail.com | Pt Lisas Plant | 1 (868) 645-9204 |

| Country | Name | Crop | Professional | Position | Institution | Email | Office Address | Phone |
|---|---|---|---|---|---|---|---|---|
| | | wedges ) | | | | | | |
| Trinidad and Tobago | Mynie Ramlal-Osman | Root and Tubers | Agronomist | Agricultural Office | Ministry of Food Production | mramlalousman@gmail.com | Ministry of Food Production, Research Division, Centeno, Caroni North Bank Road, | (868) 7756391 |
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| Trinidad and Tobago | Margaret Taylor | Roots and Tubers | Food Technologist | Head, Research & Dev Unit | Caribbean Industrial Research Institute (CARIRI) | biotech@cariri.com | Caribbean Industrial Research Institute, University of the West Indies St. Augustine, TRINIDAD W.I | Tel: 868-662-7161 Ext 2230 |
| Trinidad and Tobago | Wendel Berkley | Roots and Tubers | Processor/Marketing | Chairman | Tobago Cassava Products Ltd Wilson Rd., Tobago | assistantsec@hotmail.com | Tobago Cassava Products Ltd Wilson Rd., Tobago | 741-2016 |
| Trinidad and Tobago | Tarran Guyadeen | Roots and Tubers, (Chips, flour, mixes) | Processor | Owner | Trinie Style Products | triniestyleproducts@hotmail.com | Monroe Rd., Cunupia | (868) 475-4183 |
| Trinidad and Tobago | Chemraj and Sita Ramsaroop | Cassava production | Farmers and Inventors of mechanical implements for cassava production | Leader | Freeport Cassava Farmers Association | chemrajramsaroop@gmail.com | #121 Madhoo Trace, Arena Road, Freeport | (868) 7991249 |
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| Trinidad and Tobago | Diana Francis | | IICA Specialist in Policy and Trade | | | diana.francis@iica.int | | |
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|---|---|---|---|---|---|---|---|---|
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| Trinidad and Tobago | Edric Harry | | IICA Policy Analyst and Planning Specialist | | | edric.harry@iica.int | | |
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| Trinidad and Tobago | Bruce Lauckner | | | Head, Strategic Alliances | Caribbean Agricultural Research and Development Institute-CARDI | blauckner@cardi.org | 868-6451205, 06, 07 | |
| Trinidad and Tobago | Pathleen Titus | | | Country Representative | Caribbean Agricultural Research and Development Institute (CARDI) | pathleen@hotmail.com cardiskn@sisterisles.kn | 869 465 1498 | |
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| Trinidad and Tobago | Grace Sirju-Charran | | | Head Department of Life Sciences | University of the West Indies St. Augustine, Trinidad | gcharran@fans.uwi.tt | | |
| Trinidad and Tobago | Racheal Henry | | | | Henry's Farm Products Limited | hnryfarm@yahoo.com | (868) 781-4501 | |
| Trinidad and Tobago | Gregory Gouveia | | | Lecturer in Soil Chemistry | University of the West Indies. St. Augustine, Trinidad | Gregory.Gouveia@sta.uwi.edu | 868-6622002 Ext. 3516 | |
| Trinidad and Tobago | Sam L. James | | | Director Department of Food Crop Production | Tobago House of Assembly | administrator-agri@tstt.net.tt | 868-6399515 | |
| Trinidad and Tobago | Puran Bridgemohan | | | Principal Officer | Ministry of Agriculture, Lands and Marine Resources | research@tstt.net.tt | 868-6732730 / 868-7577975 | |

| Country | Name | Crop | Professional | Position | Institution | Email | Office Address | Phone |
|---|---|---|---|---|---|---|---|---|
| Trinidad and Tobago | Liaquat Ali Shah | | | Chef Executive Officer / Director | CARIRI - Caribbean Industrial Research Institute | ceocariri@tstt.tt | (868) 662-7161/2 | |
| Trinidad and Tobago | Ann Sooting | | | Lab Technician - Tissue Culture Lab | University of the West Indies (UWI) | annestee@yahoo.com | | |
| Trinidad and Tobago | Marilyn Patricia Bailey-Goddard | | | Laboratory assistant technician | University of the West Indies (UWI) | marilyn.goddard@sta.uwi.edu | | |
| Trinidad and Tobago | Oscar Brathwaite | | | Agricultural Officer | Tobago House of Assembly, Division of Agriculture, Marine Affairs, Marketing and the Environment | obraff@yahoo.com | 868-735-4098 | |
| Trinidad and Tobago | Omaira Avila | | | | | omariavila@gmail.com | | (868) 7995690 |
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| Trinidad and Tobago | Theo Brent | | | | IICA | brenttheo@gmail.com | | (868) 7570008 |
| Trinidad and Tobago | Yagram Ramkissoon | Roots and tubers | | Farmer an owner of cassava planter and land preparation equipment. | Brasso Caparo Valley Food Crop Farmers Association | orostant@fp.gov.tt | | (868)4992461 |
| Trinidad and Tobago | Latchmidath Maharajh | Owner of a cassava planter from Planti Center | Services provider for land preparation and plating cassava | Owner of a cassava planter from Planti Center | Root and Tubers Association of Trinidad and Tobago | orostant@fp.gov.tt | | (868) 4967083 |
| Trinidad and Tobago | Anthony St Hill | | | | Ministry of Food Production. Research Division | asthill@gov.tt | | (868) 6466284 |
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# ANNEX 2. ON-LINE SURVEY

**Mapping of the cassava agro-productive chain in selected countries of Latin America and The Caribbean**

Dear colleagues and friends. You are receiving this Electronic Survey with our kind invitation to help us answering it, as part of an Analysis of the Current State of the Cassava Agro-productive Chain in Saint Vincent and the Grenadines, that IICA/CLAYUCA/FAO are ccordinating. Your collaboration in the implementation of this study is highly appreciated.

## 1. General Information of the Person Answering the Survey

1.1 Data of the person answering the Survey
Name: _____
E-mail: _____
Telephone (s): _____

**1.2 Country of Residence**
*(Country in which the person answering the survey is living currently)*
___ Guyana
___ Trinidad and Tobago
___ Barbados
___ Suriname
___ Belize
___ Dominical Republic
___ Jamaica
___ St. Lucia
___ St. Vincent and the Grenadines
___ Ecuador
___ Nicaragua
___ Paraguay

**1.3 Name of the Institution, Organization, University, Farmers Group, Private Sector Company, etc, in which the person answering the survey is working.**
_____
_____

**1.4 Gender**
Male: _____
Female: ___

**1.5 In which segment of the cassava agroproductive chain do you participate?**
*If you work in different segments of the cassava chain please indicate them.*
___ Production
___ Processing
___ Commercialization and marketing
___ Agricultural Researcher
___ Policy Maker
___ Donor Agency
___ Credit Bank Officer
___ University Professor
___ NGO Technician
___ Other

**1.6 Years of experience working with the cassava agroproductive chain.**

_____
_____

## 2. Actors in the cassava agroproductive chain in each selected country

The answers in this section will help to understand the charactersitics of the cassava agro-productive chain in each country.

**2.1 What is your role in the cassava agro-productive chain in which you participate?**
*(If you consider that your work is in several sectors, please indicate it chosing the respective sectors)*

___ Researcher (Research institution, university, etc)
___ Farmer
___ Inputs selling and distribution
___ Officer of support agency (bank, NGO, etc)
___ Policy maker officer
___ Processing
___ Technology transfer agent
___ Transport
___ Quality control
___ Other

**2.2 With which other actors of the cassava agroproductive chain do you have any relation/communication?**
*(If you have relationships and interaction with various sectors, please select all the options that apply)*
___ Researcher (Research institution, university, etc)
___ Tecnology transfer agent
___ Farmer
___ Inputs selling and distribution
___ Officer of support agency (bank, NGO, etc)
___ Policy maker officer
___ Processing
___ Other

## 3. Characteristics of the cassava production technology system in each country

The following section includes questions that will help to undesrtand the current status and characteristics of the cassava production technology system that is used in each country.

**3.1 Do you grow cassava?**
___ yes
___ no

**3.2 If you grow cassava, you do it for:**
___ self-consumption
___ commercial sales
___ agro-processing
___ Other

## 4. Cassava Genetic Resources in each country

The questions in this section will help to understand what is the current status of the country in relation to cassava genetic resources (varieties available (local, introduced), institutional capacity, etc.

**4.1. Could you mention some of the most important cassava varieties grown in your country?**
Variety 1: _____

**4.2. Of the list of cassava varieties mentioned in question 4.1, please indicate those that you actually plant in your cassava plots**
Variety 1: _____
Variety 2: _____
Variety 3: _____
Variety 4: _____
Variety 5: _____

**4.3. How many years have you been growing cassava?**
___ 0-5 years
___ 5-10 years
___ 10-20 years
___ more than 20 years

**4.4. What is the size of the cassava area that you planted in 2013?**

| | *Acres* | *Hectares* |
|---|---|---|
| *Size of area planted* | | |
| *< 1* | | |
| *1-3* | | |
| *3-5* | | |
| *5-10* | | |
| *10-20* | | |
| *> 20* | | |

**4.5 Which of the cassava varieties mentioned is in your opinion the best in the country?**
The cassava variety that you prefer to plant.
_____
_____

**4.6 Why do you consider this cassava variety as the best in the country?**
(you could choose various options)
___ Good yields
___ Good cooking quality
___ Good acceptance in the markets
___ Good resistance/tolerance to diseases
___ Good resistance/tolerance to insects
___ Produces quickly
___ Gives good production even in dry years

**4.7 If you are convinced that a new cassava variety is better than the variety you grow, would you be willing to pay for planting material of the new variety?**
___ Yes
___ No

**4.8 Where do you get the cassava planting material or seeds for your cassava plots every year?**
(you could choose various options)
___ from my own cassava fields
___ given by a neighbour or friend
___ given by a reserach or technology transfer agency
___ purchased from another farm

**4.8 During the last 5-10 years, have you been able to grow any new cassava varierty?**
___ yes
___ no

**4.9 If yes, could you mention the name of the new variety or varieties that you have planted?**
Variety 1: _____
Variety 2: _____
Variety 3: _____
Variety 4: _____
Variety 5: _____

**4.10 Is there any cassava germplasm bank in your country that could provide you with improved new, cassava varieties?**
___ yes
___ no

**4.11 Is there any institution in your country that is working with the local cassava varieties, trying to improve their productivity?**
___ yes
___ no

**4.12 During the past 10 years, has there been any introduction (s) of of new, improved varieties in this country?**
(this question will probably have to be answered by technical personnel from the Agricutural Research Agencies)
___ yes
___ no

**4.13 If the answer to 4.12 is yes, could you please describe the names of the varieties introduced, the year that the introduction took place and the origen of the cassava varieties introduced in this country during the last 10 years?**
(this question will probably have to be answered by technical personnel from the Agricutural Research Agencies)

## 5. Technological Profile of the Cassava Production System

The questions included in this section will help to undertsand the different cassava production technological systems that exist in each country, with their specific characteristics.

**5.1 How do you prepare the soils for cassava planting?**
___ Manually
___ Animal Traction
___ Mechanically
___ Mixed

**5.2 In which months of the year do you realize the soil preparation activity for cassava planting?**
___ January
___ February

___ March
___ April
___ May
___ June
___ July
___ August
___ September
___ October
___ November
___ December

**5.3 If you prepare the soil mechanically, which of the following activities is performed?**
___ Plowing
___ Harrowing
___ Chizel plowing
___ Ridging

**5.4 In which months of the year do you plant the cassava crop?**
___ January
___ February
___ March
___ April
___ May
___ June
___ July
___ August
___ September
___ October
___ November
___ December

**5.5 What planting distances do you use for cassava planting? (please indicate the unit, centimeters or feet)**
Distance between rows
_____

Distance between plants
_____

**5.6. How is the cassava planting done in your country?**
___ Manually
___ Mechanically (cassava planters)
___ Both methods

**5.7 What are the principal weeds affecting the cassava crop in your country?**
Weed 1
_____

Weed 2
_____

Weed 3
_____

Weed 4
_____

Weed 5
_____

**5.8 Do you control the weeds during the growing cycle of your cassava crops?**
___ yes
___ no

**5.9 If your answer is "Yes", how do you do it?**
___ By hand
___ Mechanically
___ With herbicides
___ A combination of methods
___ Otro: _____

**5.10 Do you use fertilizers in your cassava crop?**
___ yes
___ no

**5.11 Why do you use or not use fertilizers in the cassava crop?**
Please explain the reasons
_____
_____

**5.12 If you use fertilizers, at which moment do you apply them to the crop?**
___ During soil preparation
___ After soil preparation, before planting
___ After planting
___ Both, before and after planting
___ Several times during the growing cycle
___ Otro: _____

**5.13 What amount of fertilizer do you use in your cassava crop? (Kgr/ha) (pounds/acre).**
_____

**5.14 Do you use soil analysis to determine the amount of fertilizers that will be used.**
___ yes
___ no

**5.15 What are the principal diseases that affect the cassava crop in your country.**
Disease 1: _____
Disease 2: _____
Disease 3: _____
Disease 4: _____
Disease 5: _____

**5.16 How are the cassava diseases controlled in your country?**
___ Manual control
___ Mechanical control
___ Chemical control
___ Biological control
___ Integrated control

**5.17 What are the principal insects attacking the cassava crop in your country?**
Insect 1: _____
Insect 2: _____

Insect 3: _____
Insect 4: _____
Insect 5: _____

**5.18 How are the insects that attack the cassava crop in your country controlled?**
___ Manual control
___ Mechanical control
___ Chemical control
___ Biological control
___ Integrated control

**5.19 Are there any cassava production systems in your country with orientation towards ecological/organic production?**
___ yes
___ no

**5.20 Are the cassava farmers in your country receiving any technical assistance from national institutions related to cassava production technology?**
___ yes
___ no

**5.21 If your answer is "Yes", how is it done?**
(you could choose various options)
___ Manuals with recommendations
___ Field Days
___ Farmers courses
___ Study tours
___ Periodic visits by extension agents
___ Otro: _____

**5.22 The cassava producers in your country could be classified as:**
(more than one option is possible)
___ farmers with very small size cassava plots that use traditional technologies and obtain very low yields
___ farmers with medium size cassava plots that use some improved technologies and obtain intermediate yields
___ farmers that plant large scale cassava plots , use modern technologies and obtain high yields

**5.23 In this country, what are the yields obtained in cassava production by farmers with very small size cassava plots that use traditional technologies?:**
(please indicate the unit of your answer, MT/ha or Pounds/Acre)
_____
_____
_____

**5.24 In this country, what are the yields obtained in cassava production by farmers with medium size cassava plots that use some improved technologies?:**
(please indicate the unit of your answer, MT/ha or Pounds/Acre)
_____
_____

**5.25 In this country, what are the yields obtained in cassava production by farmers with large size cassava plots that use improved technologies?:**
(please indicate the unit of your answer, MT/ha or Pounds/Acre)
_____
_____
_____

**5.26 How is the cassava harvested in your country?**
___ Manually
___ Semi-mechanized systems
___ Both methods

**5.27 In relation to the cassava production technology that is used in your country, which are in your opinion the main problems and limitations that are affecting the productivity and the competitiveness of the cassava agro-productive chain?**
___ Low yields with the cassava crop
___ Low quality of the cassava crop for selling to processing markets
___ Lack of organization of the farmers to supply to different markets in a organized system
___ Lack of options for improved varieties (knowledge, availability)
___ Lack of options of technological innovation for the cassava crop
___ Lack of credits (availability, timely delivery)
___ Otro:_____

**5.28 What institutions in your country are working to help the cassava agro-productive chain to solve the problems and limitations mentioned in question 5.25?**
Institution 1: _____
Institution 2: _____
Institution 3: _____
Institution 4: _____
Institution 5: _____

## 6. Technological Profile of the Cassava Processing System

The questions included in this section will help to undertsand the different cassava processing technoly systems that exist in each country, with their specific characteristics.

**6.1 Are you involved or participate in any cassava processing activity in your country?**
___ yes
___ no

**6.2 The cassava processing operation in which you participate is of what type?**
(Various options could be possible)
___ Sole owner
___ Family owned
___ Private company
___ Community owned
___ Farmers cooperative
___ State owned
___ Partnership

**6.3 Do you process cassava for:**
___ your own business only
___ your business as well as other businesses
___ you do not process cassava

**6.4 Including yourself, how many employes are participating in your cassava processing operation?**
___ owner with one employee
___ owner with 2-5 employees
___ owner with 6-10 employees
___ Otro: _____

**6.5 What was the scale of operations of your cassava processing unit during the year 2013? (total amount obtained for each processed product in 2013; please indicate the units (Tons, pounds))**

Product 1: _____
Product 2: _____
Product 3: _____
Product 4: _____

**6.6 For the scale of cassava processing operation that you conducted in 2013, where did you obtain the raw material (cassava roots)? (please indicate the percentajes obtained with each source)**

Source 1: _____
Source 2: _____
Source 3: _____
Source 4: _____
Source 5: _____

**6.7 As a cassava processor , what are the top three varieties that you prefer to use in your processing operations?**

Variety 1: _____
Variety 2: _____
Variety 3: _____

**6.8 Could you please indicate the reasons of your preference for these 3 varieties?**

Variety 1: _____
Variety 2: _____
Variety 3: _____

**6.9 Was the supply of cassava roots enough for your cassava processing operations, during the year 2013?**

__ yes
__ no

**6.10 What was the price that you paid for cassava roots in your processing unit, during 2013? (Please use the price paid at the gate of the cassava processing unit and indicate the unit, US Dollars or local currency per MT or per pound))**

Price paid for cassava roots

_____
_____
_____

**6.11. Which of the following operations in your cassava processing unit is mechanized or is done manually?**

| Activity or Operation | Manual | Mechanical / Electrical |
|---|---|---|
| Sorting | | |
| Grading | | |
| Washing | | |
| Peeling | | |
| Grating | | |
| Slicing | | |
| Pressing | | |
| Cooking | | |
| Drying | | |
| Extruding | | |
| Labeling | | |
| Chipping | | |

**6.12 During the next 3-5 years, are you considering/planning to expand the current scale of your cassava processing operation?**
___ yes
___ no

**6.13 Which characteristics would you like to see in a cassava variety to make your processing operation more efficient and competitive?**
(indicate all the characteristics that you consider appropriate)
___ Uniformity of root shape
___ Ease of peeling
___ Thinner skin
___ Uniform flesh colour
___ High dry matter content
___ High starch content
___ Good cooking quality
___ Low cyanide content (sweet)
___ Otro: _____

**6.14 Do you consider that the demand for the cassava products that you process and commercialize is increasing in your country?**
___ yes
___ no

**6.15 Have any of your customers requested that you develop a new cassava processed product for them?**
___ yes
___ no

**6.16 If yes, what type of cassava processed product?**
_____
_____
_____

**6.17 How would you consider the current profitability of your cassava processing operation?**
___ High profitability
___ Medium profitability
___ Low profitability
___ Not profitable

**6.18 Would you be interested in doing things differently in your cassava processing operations to improve your profits?**
(Please explain your answer)
_____
_____
_____

**6.19 With which markets are you currently linked and at which percentages? (Each sector at which you sold cassava processed products in 2013, and the % from the total production sold to each sector)**
Sector 1: _____
Sector 2: _____
Sector 3: _____
Sector 4: _____
Sector 5: _____

**6.20 As a cassava agro-processor in your country, do you receive financial support for your business, from any of the sources listed?**
___ Commercial Bank

___ Government (soft loan)
___ Agricultural bank
___ Small business Development Support Institution
___ Grant from foreign institution
___ Credit union
___ Informal lending
___ Own funds (reinvestment of profits)
___ Otro: _____

**6.21 From your experience as a cassava agro-processor in your country, what are the main problems/limitations that are affecting the competitiveness of your cassava processing operation?**
___ Lack of adequate technology and equipment
___ Lack of technical support
___ Small market size
___ High cost of supplies
___ High costo of labour
___ Lack of training activities
___ Low quality of cassava roots
___ Inadequate supply of cassava roots
___ Limited access to financial sources
___ Lack of business and marketing support
___ Lack of government policies to support small scale cassava agro-processing units
___ Lack of inadequate infraestructure and buildings at the cassava processing units
___ Shortage of skilled labour
___ Otro: _____

**6.22 From your experience as a cassava agro-processor in your country, what areas should be addressed to make your cassava agro-processing more efficient and competitive?**
___ Better tchnology and equipment
___ Better quality of cassava roots
___ Adequate suplly of labour
___ Adequate financial support
___ Reduced costs of inputs
___ More research and product development activities
___ Improved cassava roots supply systems
___ More technical support
___ More training activities
___ Better infraestructure and buildings
___ More business and marketing support policies
___ Larger market size
___ Reduced cost of labour
___ Otro: _____

## 7. Informations at the Macro Level for the Cassava Agro-Productive Chain in each country

The questions included in this section will help to undertsand the current status of the cassava chain in each country at the macro level. It is not expected that this type of data will be given by all the members of the cassava chain. It is a section to be answered mainly by technical personnel of Government agencies and other institutions that deal with data at macro economic level and that are more familiar with the agricultural policies of each country, related to the cassava sector.

**7.1. What is the best data available about the current cassava planted area in your country, in 2013?**
_____
_____
_____

**7.2. What is the best data available about the volumes of cassava produced in your country in 2013?**

_____
_____
_____

**7.3. What is the best data available about the volumes of cassava exported in your country in 2013?**

_____
_____
_____

**7.4. What is the best data available about the % of the total cassava production in your country that is destinated for farm household consumption, in 2013?**

_____
_____
_____

**7.5. What is the best data available about the % of the total cassava production in your country that is destinated for fresh consumption market, in 2013?**

_____
_____
_____

**7.6. What is the best data available about the % of the total cassava production in your country that is destinated for agro-processing activities, in 2013?**

_____
_____
_____

**7.7. What is the best data available about the % of the total cassava production in your country that is destinated for export markets?**

_____
_____
_____

**7.8. What is the best data available about the % of the total cassava production in your country that is destinated for other markets, in 2013?**
(Please specify the other markets)

_____
_____

## 8. Prospective Analysis of the Cassava Agro-Productive Chain in each country

This section is to be answered mainly by technical personnel of Government agencies and other institutions that deal with planning, have access to data at macro-economic level and that are familiar with the agricultural policies of the cassava sector. The answers provided in this section will help to understand the goals for the cassava agro-productive chain about the potential of the sector to grow in the future, in terms of areas planted, volumes produced, increased competitiveness, new markets and competitive development of the cassava chain.

**8.1 What is the area planted with cassava that is expected to have the country in 2020?**
(please indicate the unit of your answer, hectares or acres)

_____
_____
_____

**8.2 What is the volume of cassava production that is planned to have the country in 2020?**

(please indicate the unit of your answer, MT or pounds)

_____
_____
_____

**8.3 What is the cassava production yield that is planned to have the country in 2020, by small scale farmers with traditional technology?**
(please indicate the unit of your answer, MT per hectare or pounds per acre).

_____
_____
_____

**8.4 What is the cassava production yield that is planned to have the country in 2020, by medium scale farmers with some improved technology?**
(please indicate the unit of your answer, MT per hectare or pounds per acre).

_____
_____
_____

**8.5 What is the cassava production yield that is planned to have the country in 2020, by large scale farmers with improved technology?**
(please indicate the unit of your answer, MT per hectare or pounds per acre).

_____
_____
_____

**8.6 In 2020, what percentage of the total cassava production is planned that will be destinated for farm household consumption?**

_____
_____
_____

**8.7 In 2020, what percentage of the total cassava production is planned that will be destinated for fresh consumption markets?**

_____
_____
_____

**8.8 In 2020, what percentage of the total cassava production is planned that will be destinated for agro-processing activities and markets?**

_____
_____
_____

**8.9 In 2020, what percentage of the total cassava production is planned that will be destinated for export markets?**

_____
_____
_____

## 9. Participation of Women in the Cassava Agro-Productive Chain

The questions included in this section will help to understand the current level of participation of women in activities of the cassava agro-productive chain in the different countries included in the FAO Initiative to promote intensification of cassava production and industrialization in selected countries of Latin America and the Caribbean region.

**9.1 How is the participation of women in the different activities of the cassava agro-productive chain?**

| Activity | Participate | Do not participate |
|---|---|---|
| Land renting arrangements (for landless farm households) | | |
| Procurement of planting material | | |
| Procurement of planting material | | |
| Land preparation | | |
| Planting | | |
| Weed control | | |
| Pest and disease control | | |
| Fertilization | | |
| Harvesting | | |
| Commercialization | | |
| Negotiation of the production obtained | | |
| Cassava processing activities | | |
| Wages generation through labor days given to other farmers | | |
| Training activities | | |
| Other (specify) | | |

ISBN 978-92-5-109348-1

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I5974E1/08.16