Food and Agriculture Organization
of the United Nations

REGIONAL CONFERENCE ON CASSAVA IN THE CARIBBEAN AND LATIN AMERICA

CONFERENCE REPORT
10-12 FEBRUARY 2014

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REGIONAL CONFERENCE ON CASSAVA IN THE CARIBBEAN AND LATIN AMERICA

THE UNIVERSITY OF THE WEST INDIES CAVE HILL CAMPUS
MINISTRY OF AGRICULTURE, FOOD, FISHERIES & WATER RESOURCE MANAGEMENT, BARBADOS
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO)
AND THE
CLAYUCA, LATIN AMERICAN AND CARIBBEAN CONSORTIUM TO SUPPORT RESEARCH AND DEVELOPMENT

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Acronyms

AEZ	Agro-ecological Zones
BADC	Barbados Agricultural Development Corporation
BADMC	Barbados Agricultural Development and Marketing Corporation
BMC	Barbados Marketing Corporation
BOS	Bureau of Standards
CABA	Caribbean Agribusiness Association
CaCESA	Cassava Diseases in Central, Eastern and Southern Africa
CaFAN	Caribbean Farmers Network
CARDI	Caribbean Agricultural Research & Development Institute
CARICOM	Caribbean Community
CARIRI	The Caribbean Industrial Research Institute
CDB	Caribbean Development Bank
CELOS	Centre for Agricultural Research in Suriname
CIAT	International Centre for Tropical Agriculture
CLAYUCA	Latin American and Caribbean Consortium to Support Research and Development
CLM	Cassava Leaf Meal
CLP	Critical Loss Points
COTED	Council for Trade and Economic Development
CRDF	Cassava Research and Development Fund
CROSQ	CARICOM Regional Organisation for Standards and Quality
FAO	Food and Agriculture Organization of the United Nations
FFS	Farm Field Schools
GAEZ	Global Agro-Ecological Zone
GDP	Gross Domestic Product
GMP	Good Manufacturing Practice
HCN	Hydrogen Cyanide
HQCF	High Quality Cassava Flour

IFM	Institute for Food and Management
IIASA	International Institute for Applied Systems Analysis
IICA	Inter-American Institute for Cooperation on Agriculture
IPM	Integrated Pest Management
LRM	Local Raw Material
MJ	mega joules
MOA	Ministry of Agriculture
NAMDEVCO	National Agricultural Marketing and Development Corporation
NDFD	National Digital Forecast Database
NFM	National Flour Mills
NGO	Non-governmental Organisation
OCR	Ordinary Capital Resource
OECS	Organisation of Eastern Caribbean States
PPD	Post-harvest Physiological Deterioration
SAMS	Stakeholders in the Sustainable Agricultural Mechanization Strategies
SFR	Special Fund Resource
THA	Tobago House of Assembly
TTABA	Trinidad and Tobago Agri-Business Association
UWI	University of the West Indies
VS	Vascular Streaking

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BACKGROUND

The countries of the Caribbean Community (CARICOM) have a huge import replacement opportunity for food, flour, feed and beer (and possibly energy) that can be addressed by the development of the cassava industry which already has a production base in almost all of the countries of the region. Recent estimates suggest that the Caribbean currently imports, on an annual basis, nearly 900,000 metric tonnes (MT) of wheat for flour and 420,000 MT of corn (mainly for poultry feed). Furthermore, regional beer industry imports nearly 100,000 tons of malt annually and has already tested and accepted as possible the utilization of locally-produced cassava in its beer production. To address these demands, it is essential to develop the entire value chain, from production and yields to processing and marketing technologies. The Food and Agricultural Organization's Sub-regional Office for the Caribbean (FAO-SLC) in partnership with key regional and national agencies, is therefore seeking to assist in the development of a regional plan and strategy for the cassava industry.

An informal Regional Cassava Industry Development Committee (IDC) has been established, comprising development agencies, the University of the West Indies (UWI) and the agri-business sector, to initiate and coordinate the first phases of the development process. FAO has been providing considerable technical and administrative support for this initiative. The Caribbean Development Bank (CDB) agriculture representative is a member of the Committee and in keeping with the Bank's mandate to provide financing for the development of the agri-business sector, has agreed to consider complementary funding.

One of the upcoming activities under the initiative is the organization of a Regional Conference in partnership with UWI, hosted under the auspices of the Ministry of Agriculture, Barbados.

1. OBJECTIVES

Contribute to the regional coordination and collaboration between cassava programs and initiatives in Latin America and the Caribbean, with the aim of establishing a regional strategy and program for the sustainable intensification of a cassava industry in the Caribbean region.

Specific objectives:

1. Determine current state of the regional cassava industry particularly with respect to technologies for primary production and value-addition.
2. Investigate issues related to determining the relative competitiveness of CARICOM producers/products and the potential market for import substitution and export and corresponding potential economic/social /environment impact of the industry.
3. Identify technological gaps for the sustainable development of the cassava industry in the region.
4. Develop a Road Map for collaboration and implementation of strategies / actions for the development of the cassava industry in the Caribbean.

Expected outputs:

1. A strategic framework for the promotion of the sustainable intensification of cassava in the region
2. A baseline of the current status of cassava production, processing and marketing in the region
3. Identification and prioritization of training needs at the level of policy-makers, producers, and extensionists.

2. SUMMARY OF EVENTS

- ✓ Keynote speakers will present the status of cassava production, processing and marketing in the region, with focus on Caribbean countries.
- ✓ Working groups will be formed for analysis and discussion by topics and presentation of reports
- ✓ A Road-Map of collaboration and actions will be developed and agreed on


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Session 1

State of Cassava Global and in the Region

Session Chair

Ms. Nisa Surujbally

CARICOM Secretariat

1. Why the Cassava Industry Now?

Deep Ford

Before answering the question 'why the cassava industry now', it is important to understand what we are visioning when we say cassava industry. When we say we are developing the cassava sector the tendency is to vision small farmers and agricultural extensionists providing services. When we say cassava industry it is very different. To develop a cassava industry is to arrive at a stage where large acreages of cassava are planted and harvested, cassava trucks are lined up outside a cassava factory ready to unload, a cassava factory is producing several intermediate and final products, and trucks for distributing the products are being loaded to go to supermarkets and other cassava product consumption points. Thus, we are envisioning farmers, processors, distributors, consumers, all along the value chain. That is the vision of a cassava industry that we want to establish. This can be a reality, we have done it before with other products, in Belize with citrus, in Guyana with rice, in Barbados with sugar, and in St. Lucia with bananas. We are working to do this with cassava in several countries of the Caribbean.

The answer to the question "Why cassava now" speaks directly to the challenges of Caribbean economies and the agricultural sectors in our countries. It recognises the need to address the fact that the two agricultural pillars that have supported almost all of the economies of the Caribbean no longer play the central role that they played in the past – that is sugar is no longer King and farmers can no longer easily say 'by me and my big right hand I will live and die a banana man'. Why cassava now speaks to the urgent need for new pillars of economic and agricultural development in the Caribbean. The leaders at the highest levels have agreed that agriculture will be one of the drivers of economic revitalization and agricultural agencies across the Caribbean have agreed that cassava is one of the crops that have immense potential to be one of the new pillars of development. Thus, we present the reasons for "cassava now", from a historical, economic, health standpoint.

Historically, cassava is native to Latin America and the Caribbean. This region is the evolutionary homeland of cassava and it is an integral part of the food and cultural fabric of our lives. Cassava was taken to Africa and Asia by Portuguese traders and today these other regions utilize cassava widely and in some senses have managed to commercialize, trade and consume cassava in more ways than in Latin America and the Caribbean. While we think that there are limited methods of preparation and use of fresh cassava, we know that through the use of diverse processing methods and utilization systems, the product development opportunities have proven to be many and diverse. The well known uses for cassava include flour, bread, confectionary, starch and animal feed. More recently , it has also been used commercially as an ingredient in beer, and recognizing its broad genetic diversity, it has been used as biological control agent for pest and diseases.

Economically, the key pillars of agriculture in the region have fallen. The first pillar to have fallen is sugar – a product which allowed Barbados and many other Caribbean countries to achieve a high standard of living and one of the highest human development indices (HDI) in the region. A good example of the power of this pillar is the case of Barclay's Bank which rose to be one of the dominant commercial banks globally based on the earnings from a sugar plantation in Jamaica. In almost all sugar producing countries of the Caribbean the industry has declined so much that it is a shadow of its former importance. The second pillar that has faltered is bananas, the export decline in Dominica and Grenada are examples of this. As a result of the loss of these two pillars throughout the region food and agricultural exports are declining while imports are increasing. Thus, addressing the food import bill is perhaps second only in importance for Caribbean development to the need for agricultural revitalization. The data presented by FAO clearly demonstrates this decline in exports and increase in imports and shows the high levels of debt to GDP ratios that result largely from the inability to generate sufficient foreign exchange to cover consumption and investment import needs. An opportunity identified to address both of these challenges, agricultural revitalization and the food import bill, is through the development of the cassava industry. This opportunity is

one which would contribute to increasing food independence, reducing poverty and a possible way to fill the economic space created by the decline of the banana and sugar industries.

The cassava opportunity is based on the fact that wheat and corn are among the top ten food and agricultural imports into the region. Wheat is imported to serve the bakery industry primarily, producing the bread and all related baked goods in each country. It has been analysed and it is recommended that all flours used in the Caribbean in the future be mixed flours. Through such a programme and policy at least forty percent of the wheaten flour imports can be substituted, mainly by cassava and other flours (sweet potato, breadfruit.) Similarly another major import, for almost all the poultry produced and consumed in the region is corn. A substantial percentage of corn for animal feed can also be replaced by cassava. Clearly, competitiveness and preference issues must be addressed and all indications are that these will not prove to limit the development of the cassava industry. There is also a possibility to replace a significant amount of the white potatoes and french fries served across the region with cassava and other root crops. Aggressive policies are needed to drive the consumption of local products, especially through the establishment of targets, for example, starting at 10 per cent consumption of local products to replace imported wheat, corn, and potatoes and then increasing these targets periodically.

In 2011, Jamaica imported more than 56 per cent of the corn in the region, mainly to feed poultry. A strategic import policy needs to be introduced to increase the productivity and competitiveness of cassava to facilitate the replacement of some of this feed. It is estimated that cassava can replace at least 30 percent of the corn poultry rations without adverse effect. Cassava can also replace other animal feed. Further it is estimated that it can replace approximately 1 million metric tons of flour. Cassava alone has the potential to reduce 10 per cent of the regional food import bill. One of the most important social protection programs can be used as a vehicle – local school feeding programmes. A new model of school feeding is being promoted which considers them as an important path to changing lifelong consumption habits in favour of local products and better health. Thus, school feeding programs should be seen as much more than a hot meal at lunch time to learn better. They should be linked to promotion of better nutrition, better health, better long life food choices, increased demand and consumption of local products.

Another example of the potential for cassava is in beer production. We have representatives from Jamaica Red Stripe beer in this conference. This company is leading the way in the Caribbean in the use of cassava in beer, following successful production and marketing by the Miller brewery in West Africa of a beer named Impala. Red Stripe has tested the production of beer with cassava and we expect Red Stripe with cassava to be marketed in the Caribbean in 2014/2015. We are advised that this has the potential to create 3,700 jobs. Essentially, cassava can be processed to facilitate the replacement of imported corn syrup. It is anticipated that there will be approximately 2,500 acres of cassava planted in Jamaica within the next five years. Commercial opportunities need to be started and expanded, including the use of cassava to produce various foods (fresh, chilled, frozen, and grated products), flour and starch, animal feed (produced using cassava leaves and chips) as well as beer and biofuels.

Increased use of improved technology for production and processing of cassava is needed. High yielding varieties of cassava planting material for different uses and purposes should be introduced and adopted. Utilizing these with best practices of crop husbandry/management will be essential for the productivity increases required. It is also expected that there will be increased use of mechanization in production, harvesting and post-harvest processing of cassava. Policy issues also need to be addressed, such as the moving of planting material across borders within the region and promotion of utilization of cassava by bakeries, restaurants and consumers in general.

Health benefits are also derived from increased use of cassava products. Obesity is associated with the increased volume of imported food products across the region. More specifically, current eating habits are linked to a high incidence of diet-related non-communicable diseases (NCDs) in a wide cross-section of Caribbean populations. There is an abundance of health literature related to cassava which is free of gluten, and has higher starch content than potatoes. Additionally, cassava

starch can be used in the preparation of special foods, for example, for patients with celiac disease. Cassava is also considered to be a moderate source of some of the valuable B-complex group of vitamins such as foliates, thiamine, pyridoxine (vitamin B-6), riboflavin and pantothenic acid. The root is also a chief source of some important minerals like zinc, magnesium, copper, iron, and manganese for many inhabitants in the tropical belts.

Compelling historical, economic and health reasons for building a cassava industry exist. This crop can contribute to agricultural revitalization, addressing the food import bill and a healthier Caribbean population. Essentially, the development of a viable cassava industry is a key component of the regional strategy for addressing food insecurity, rural development and promoting economic growth. That is why we say "cassava now".

2. Global Cassava Trends

Adam Prakash

Cassava is cultivated mainly in the tropical belt and is the largest grown staple crop in the world after maize. Global production is expanding on average by 1.2 percent per year, where much of this growth is being fuelled in sub Saharan Africa, the world's largest producing region. In the Caribbean and Latin America, almost all countries have a formal cassava sector. Within the region, Latin America accounts for 13 per cent of the global output of cassava production, with Brazil dominating in terms of production.

Global productivity of cassava currently stands at around 12 tons per hectare. Productivity differentials are however enormous, with high yield gaps persisting where cassava has an important role in food security, especially in Africa. Productivity in Latin America and the Caribbean is erratic, largely following trends in Brazil, which is the region's largest producer of cassava.

Globally, only 37 calories per day on a typical person's plate is derived from cassava. In some countries, notably in Africa, nearly one third of calories come from cassava, while in Indonesia, and the Philippines, cassava forms a key food staple. In Latin America, this figure is on average70 calories per person per day, making cassava a food crop of relatively less importance in the region. However, cassava's use as livestock feed in Latin America is greater than its use as food. Indeed, production and productivity trends underscore a growing geographical divide between the contrasting roles of cassava in agricultural economies. For instance, food security (Africa) and energy security (Asia) are driving rapid commercialization and investments for upscaling processing, and hence have contributed significantly to global expansion of the crop.

There are several economic drivers of cassava for use as food: it requires few inputs and provides great flexibility for farmers in terms of timing of the harvest. It is being increasingly targeted by government food security initiatives, as well as a crop to trigger rural development. Cassava's tolerance to erratic weather conditions, including drought, makes it all important in climate change adaptation strategies, and compared with other staples, the crop competes favourably in terms of price and the diversity with which the commodity can be utilized. This versatility of cassava also allows it to compete very well with other food crops. Increasingly, cassava is regarded as a strategic crop to reduce (price-volatile) cereal imports, notably in the form of High Quality Cassava Flour (HCQF). The production of high quality cassava flour can help reduce the volume of wheat imports, therefore lowering food import bills and conserving precious foreign exchange. Cassava also promotes industry, jobs and ultimately rural development.

With regard to trade, being too bulky and highly perishable, international transactions in the form of roots are few. However, in processed form it manages to compete fiercely on the global arena, such as with maize-based starch and cereal pellets.

Policy drivers have been fostered the greater use of cassava, for example there are mandates on blending cassava flour with cereal flour, also the imposition of large import duties on imported cereal flour. Also, the drive towards energy security is also aiding the cassava industry, through the establishment of ethanol distilleries using cassava as a feedstock. In exploring policy drivers, the following examples are noteworthy:

1. Promotion of domestic cassava flour over imported cereals, especially through blending. For this purpose, the example of Brazil (mentioned earlier) can be used since this country mandates the blending of 10 percent cassava flour (50 per cent of entire crop) with wheat flour for bread making, Nigeria has also imposed a 100 per cent duty charge on imported wheat flour and in tandem, bakeries are required to apply blending rates of 20 per cent (bio-fortification to counter vitamin A deficiency is being taken into consideration).

2. The use of cassava by countries in the Caribbean and Africa in the brewing of beer. In Kenya for example, tax rebates are given on beer made from cassava, in Mozambique, breweries are using as much as 70 per cent cassava in the production of beer, and in Jamaica where 20 per cent of imported brewing ingredients have been targeted for substitution by 2016 with locally grown substitutes (especially cassava).

3. The use of cassava to increase energy security which was evidenced by the fact that a typical ethanol distillery can produce approximately 280 litres of 96 per cent pure ethanol from one tonne of cassava roots with 30 per cent starch content. In order to achieve this end, China has been at the forefront of this initiative and has already commenced sourcing cassava pellets beyond its borders in areas such as Cambodia, Lao People's Democratic Republic and Viet Nam. Additionally, Thailand and Viet Nam have large scale cassava-based ethanol refineries in operation. Here uptake is driven by mandatory fuel blending, and this initiative has become highly competitive with sugar cane.

In terms of the long term outlook, cassava is no longer considered to be a subsistence crop, but now is acknowledged for its potential for value-addition. As such, it is seen as a key instrument for rural development, food security, energy security and wider macroeconomic goals. These benefits should foster a continued expansion of the crop. Notwithstanding, a big constraint towards greater commercialization is ensuring a consistent supply of high quality roots (namely high starch content). Production and productivity gaps are being bridged through the introduction of superior planting materials (high yielding – 30 metric tons per hectare and short maturing – 6 months). Additionally, the distribution of new highly productive varieties allows poor farmers to participate more fully in the value chain. Here the objective is to create a win-win situation in which costs are lowered, competition-inducing technologies introduced and business models tailored, providing economic incentives for all value chain participants.

An issue of complacency in terms of cassava production also needs to be addressed. The distribution of new planting material brings with it risks of large-scale dissemination of pest and diseases. The issue of vector-borne diseases also needs to be taken into consideration, for example the pink mealy bug in Thailand, which was responsible for wiping out one-third of the national crop.

In terms of moving forward however, better statistics are needed, especially in order to successfully monitor every part of the value chain. This will help greater investment as well as the better targeting of policies. Some of the most important indicators include those on production and productivity, area harvested, processing volumes (input, output and extraction rates), prices and margins.

3. The Challenge of Feeding Nine Million People: The World Needs Sustainable and Equitable Food Security

Bernardo Ospina

The average annual percent projected population growth across the region, between 2015 and 2050, is expected to be significantly high, and this is anticipated to create a great challenge to the food security status of the countries. The population growth is further compounded by trends in urbanization, changing food demands, increasing incomes, the scarcity/increasing costs of inputs to production, climate change, the movement of pests and diseases across the region, as well as the degradation of the existing natural resources base.

These realities, which have become challenges to regional agricultural development, include: reducing rural poverty, increasing food security, improving human nutrition and health, as well as implementing more sustainable management of natural resources. Agriculture offers a huge potential in achieving these end results.

According to statistics from the Food and Agriculture Organization of the United Nations (FAO), global trends for the world's most important food crops have changed in the 30 years leading up to 2009. These changes have shown a decrease in the production of crops such as barley, sorghum, sweet potato and oats, and a general increase in the production of potato, millet, wheat, rice and maize. During the same period, the growth in cassava production has been the highest among all crops, increasing by over 100%, with a 44% increase in the area harvested and a 40% increase in the overall yield. These figures suggest that cassava is an option for addressing the agricultural development challenges. Currently, 54% of the world cassava production takes place in Africa, 30% in Asia and 16% in LAC. However, the trade aspects are totally different: 95% of the global exports of cassava products are from three countries (Thailand, Vietnam, Indonesia), and 85% of the total global imports of cassava products occur in Asia, of which China alone is responsible for 75%.

Between 2005 and 2007, cassava was ranked fourth, both in terms of production and consumption among developing countries (a broad group of 177 countries from Latin America, the Caribbean, Africa and Asia), and second among the least developed countries (a group of 50 low-income countries, as defined by FAO).

In the tropics, the most demanding crops occupy the best soils and climates. But cassava is often grown under the most challenging conditions, where other crops do not compete well: sloping lands with low fertility and drought prone areas with limited access to roads and markets. Cassava has the potential to respond to good management and to produce very high yields.

In most parts of the world, cassava is considered a 'women's crop' as women are most often involved in the harvesting and processing of the crop. Globally, 65% of the crop is used for human consumption, while the remaining 35% is used for the feed and fuel industry. In Latin America and the Caribbean, cassava is an ancient crop. In China, cassava has been cultivated for over 200 years and is currently grown on over 450,000 hectares of land. From the amounts currently produced, 80-90% is used for the processing of starch and ethanol, and the remainder is used for animal feed.

In China, despite the high levels of cassava production, the industry faces challenges, as it imports 500,000 tons of cassava starch, and 3.5 million tons of dry cassava chips (equivalent to 12 million tons of cassava roots) each year. This equates to 1.5 times the country's current cassava production.

In the case of Nigeria, a cassava transformation strategy has been implemented as a National policy since 2004. Five main elements of the strategy include the annual production of:

1. 400,000 tons of high quality cassava flour;
2. 230,000 tons of native and modified starches;
3. 520,000 tons of dried chips;
4. 100,000 litres of sweeteners in the form of high fructose cassava syrup; and
5. 3.75 billion Litres of ethanol for cooking fuel.

In the Caribbean and Latin America, the intention is to intensify production and industrialise cassava. This will be achieved through a strategy which possesses three (3) key elements:

1. National policies;
2. Agro production / agri-business value chain development and
3. Science-based, research, technology development and innovation.

Value-added traits for developing new products and new markets could offer a huge potential for promoting cassava development: these include the production of amylose-free (waxy) cassava which has multiple food and industrial applications; varieties with small granule starch which is used in rapid hydrolysis for the ethanol industry; varieties with high beta-carotene content to aid vitamin-A deficit areas; and forage varieties which could provide a strategic animal component into small-holder systems. Current threats to the proposed production system include poor crop management and intensification and the movement of pests and diseases. These can however be dealt with through the use of resistant varieties coupled with proper crop and soil management, where sustaining soil fertility is essential.

4. Status of Cassava in the Caribbean: Multipurpose Crop of the 21st Century

Janet Lawrence

Traditionally, Cassava, (*Manihot esculenta* Crantz) has been an important staple in the historical and cultural space in both the food basket and livelihoods of many thousand rural households in the Caribbean Region. The crop therefore plays a role in the alleviation of poverty and hunger in several rural communities. Recently, there has been a thrust by the Governments of the Region as well as developmental agencies to improve the competitiveness and viability of the cassava industry such that food and nutrition security goals as it pertains to staples are met and the food import bill is reduced through the substitution of grains and cereals with cassava by-products for human and animal consumption. Within this context, this paper seeks to outline the current status of cassava production, processing and marketing in the CARICOM Region and the research and development efforts being undertaken to assist the Region to attain the goal for the sub-sector.

Production system profile

Traditionally, cassava has been planted by small scale subsistence farmers on hillsides and on marginal lands of less than 2 ha of land. For subsistence purposes, one or two varieties are usually planted manually under rain fed systems. This production system gives limited attention to agronomy and to the protection of the crop from pests (arthropods and pathogens). Cassava is generally cultivated as a monocrop, as well as in mixed production systems with other root and vegetable crops (e.g. corn, beans and tannia).

In recent years, with the growing importance of cassava for attaining food and nutrition security goals of the Region, there has been a shift in the profile of the production systems in that, some

farmers have begun to cultivate the crop on a larger scale. In these semi-commercial systems, high-yielding varieties are generally planted on 2-30 ha of land under rain-fed conditions with the application of fertilizers and pesticides. In some cases there is the use of mechanization for the planting and harvesting of the crop. Typically the crop is marketed locally, mainly as fresh roots at municipal markets, supermarkets chains, and small local establishments.

There are several constraints impacting the production and marketing system of cassava in the CARICOM Region, these include poor yields (quality and quantity); significant pre- and post-harvest losses (often >50%); inadequate infrastructure; limited market information and distribution channels (e.g. linkages to processing entities); and fragmented/unorganized farmer groups.

Despite these constraints, collectively the CARICOM Region produces on average, 35 million tonnes of cassava per annum (*review period 2007-2011*) with Guyana and Jamaica producing approximately 85% of the total (**Table 1.1**). Productivity within the Region ranges from 6.25 to 18.53 tons/ha. When compared to world productivity levels are similar to countries in Latin America and Asia.

Table 1.1. Cassava Production in Select CARICOM Countries (MT)

Country	2007	2008	2009	2010	2011
Antigua & Barbuda	78	72	77	99	108
Bahamas	190	175	188	241	262
Barbados	448	466	691	400	308
Dominica	819	752	809	1,037	1,127
Grenada	172	170	159	204	222
Guyana	20,184	4,127	7,100	10,092	10,269
Jamaica	18,519	14,991	13,995	18,490	20,533
St Lucia	1,030	1,100	898	1,151	1,251
St Vincent & the Grenadines	770	707	780	1,000	1,087
Trinidad & Tobago	1,200	1,350	1,400	1,794	1,950
Total	**43,410**	**23,910**	**26,097**	**34,508**	**37,117**

Source: FAOSTAT

Processing of cassava

In terms of processing of cassava into value added products, less than 0.5% of total production is utilized. The majority of cassava processors in the Caribbean operate at a small scale, with low-input operations often within a family farm environment and heavy reliance on traditional knowledge. Products made from cassava include bammy/flatbread, biscuits/cookies, bread, cassareep, chips, coarse flour, farine, fine flour, fries, frozen chips, frozen wedges, meal, pone, starch, wafers, grated frozen cassava and frozen cassava logs.

Constraints to the expansion of processing operations include the lack of use or the inappropriate use of equipment / machinery for small scale processing; limited market support; lack of training and technical support; high cost of labour; quality and cost of raw materials; limited knowledge of the suitability of local raw materials (i.e. crop varieties) for processing; limited diversity of value-

added products available to consumers; and as well as issues with packaging and labelling.

Strengthening the values chain through research and development

In order to address these challenges, there have been numerous interventions geared towards advancing the cassava industry in the Region. Some of the key players undertaking these initiatives include farmers' organisations, Ministries of Agriculture (inclusive of extension agencies), Caribbean Agricultural Research & Development Institute (CARDI), Food and Agriculture Organization of the United Nations (FAO), University of the West Indies (UWI), Caribbean Industrial Research Institute (CARIRI), Inter-American Institute for the Cooperation on Agriculture (IICA), Trinidad and Tobago Agribusiness Association (TTBA), Barbados Agricultural Development and Marketing Cooperation (BADMC) and the Scientific Research Council (SRC) of Jamaica.

Within the context of the value chain, interventions by key stakeholders seek to strengthen the key nodes along the chain in particular in the areas of inputs, production, harvest and post-harvest, processing and marketing (**Figure 1.1**). In addition, efforts are being made to facilitate the development of systems and services that create an enabling environment for the transitioning of the industry into a competitive and sustainability.

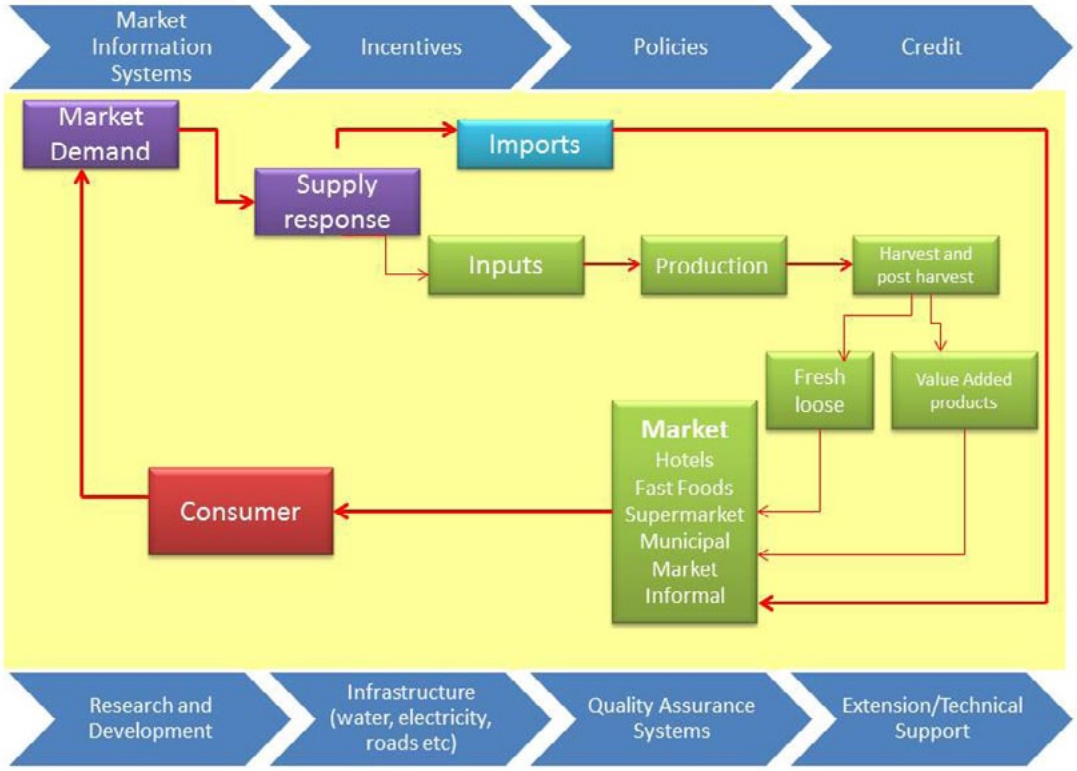

Figure 1.1. Value Chain: Key areas of intervention being undertaken to strengthen the Cassava industry

In relation to the provision of inputs, specifically, the production of high quality planting material in sufficient quantities to meet Regional production targets, significant work has been undertaken to conserve market acceptable varieties, build the capacity of stakeholders in the rapid propagation of planting material, import high yielding varieties as well as establish and strengthen the requisite infrastructure for mass propagation.

(i) Inputs

A key intervention by Governments and Developmental agencies has been the establishment of conservation banks both *in-vitro* and *in-vivo* of traditional and imported varieties with market potential. Currently there are several hundred cassava varieties *in-vivo* conserved in gene banks in Dominica, Grenada, Guyana, Jamaica, St. Kitts & Nevis, Trinidad & Tobago. In addition, tissue culture facilities have been strengthened for the conservation of varieties as well as the

commercial production of plantlets. This has been largely undertaken in Jamaica and St. Vincent & the Grenadines. To meet the quality standards of new *in-vitro* material, a virus testing laboratory has been refurbished in Barbados by CARDI. In several countries, hardening facilities have been refurbished together with propagation bins/sheds to facilitate the production of high quality planting material (Barbados, Dominica, Jamaica, St. Vincent & the Grenadines, Trinidad & Tobago). Capacity building of key technical support staff in the public and private sector has also been undertaken by Institutions such as CARDI and the UWI to meet the demands for high quality planting material.

(ii) Production

In relation to strengthening the capacity of producers to increase current yields; across the Region, plots have been established to demonstrate the value of using Good Agricultural Practices (GAP). Specifically, the benefits of proper land preparation, the use of clean planting material, fertilization, and Integrated Pest Management (IPM). These plots have produced yields greater than twice that of current yields. In addition, new high yielding varieties have been imported into the Region by several Institutions and plots established to demonstrate the potential and market acceptance of these new high yielding varieties. Yield from these trials have demonstrated greater than three times increase in yields (**Table 1.2.**). Other inputs such as biostimulants are also being explored as a means to increase yields. Over the past five years, more than 1,000 producers and other key stakeholders have been trained in GAPs of cassava.

Table 1.2. Yield of traditional local and introduced HYV of Cassava (CARDI Field Station St Vincent and the Grenadines; kg/ha)

Cassava Varieties	Total yield (kg/ha)
Traditional Local Varieties	
Butter Stick	13,688
Punt Stick	30,313
White Stick	27,313
Improved High Yielding Varieties	
Bra 383	34,313
CM7514	36,688
SM 1565-15	49,750
CM 7514-7	52,375
CM 4919-1	44,813

(iii) Processing, Value Addition

In relation to the processing of cassava; research and development activities are being conducted by the BADMC, CARDI, IICA, SRC, UWI in the areas of: (i) suitability of varieties for value addition, (ii) value added product development, (iii) Infrastructure strengthening of SMEs, (iv) capacity building of processors and other value chain actors.

With respect to the suitability of varieties for product suitability; the physico-chemical properties of 12 popular cassava varieties from Dominica, St Kitts and Nevis and Trinidad and Tobago were determined by CARDI and IICA. The Value added products identified as being most suited: included flour, farine, fries, chips/crisps as primary products and bread, cakes, thickners and extruded snacks as secondary products. This work is on-going for the UWI, St Augustine Campus.

In relation to the popular cereal farine, it should be noted that evaluations were conducted to determine the farine yield from new high yielding varieties. Yielded up to 50% farine to meal weight were obtained; this is an improvement over some of the traditional varieties being used.

With respect to product development, research is being undertaken (SRC – Jamaica, BADMC - Barbados, UWI, CARIRI, TTABA) on formulation and packaging for a number of products. Of note are the efforts to replace wheat flour with cassava meal &/or flour; up to 25% replacement. Other products being evaluation include bread, cakes, cookies, extruded snacks

Efforts have also been made to improve the infrastructure and introduce appropriate equipment in small and medium enterprises. E.g. in Dominica and St. Vincent & the Grenadines, the physical infrastructure of cassava bread and farine processing facilities has been upgraded and appropriate equipment provided to increase the efficiency of operations. E.g. in Jamaica, there has been a 300 percent increase in the demand for fresh cassava by the processor "Twickenham Bammy Industries", due to assistance received in acquiring oven equipment and training for personnel.

Capacity building in for small and medium enterprises is being undertaken, wherein processors and other key stakeholders are being trained in the principles of food safety management systems, Good Manufacturing Practice (GMP), use of machinery, as well as product development (in Dominica, Jamaica, Haiti, St. Vincent & the Grenadines and Trinidad & Tobago). Over the past five years, both IICA and CARDI have trained over 400 persons involved in the processing of cassava.

Development of an improved industry framework

(i) Public-private sector partnerships

Public-private sector partnerships have also been explored as a key element to accelerate the development of the cassava industry. Two interesting model systems of private-public sector partnership are that of Trinidad and Tobago Agri-business Association (TTABA) and Red Stripe Limited, Jamaica.

TTABA was established in May 2006 by private sector agri-business stakeholders with government's support to accelerate national economic and social development through the sustainable expansion of the Agri-business sector. The main objective of the Association is the provision of technical services for the development of selected agricultural commodity/industry value-chains and the provision of high quality agro-processing services. Roots and tubers, in particular cassava is one of the commodities of focus. Of note is the commercial development of minimally processed cassava products as well as bread prepared with cassava meal. These products are readily available in retail stores.

Secondly, of note has been the exploration of cassava as The Government of Jamaica and the brewing company Red Stripe are currently working towards the replacement of imported high maltose syrup with locally grown material (starch and sugars). The Ministry of Agriculture and Fisheries (MoAF) and Red Stripe have a lease agreement for land to facilitate the initial 36.2 acres of cassava cultivation as a pilot project. The target is approximately 500 acres over an 18-month period by Diageo/Red Stripe, which will account for a total investment of US$1 million. The goal of this venture is 20% replacement of imported inputs, primarily barley, by 2016. This initiative will include the cultivation of 2,400 acres over a five-year period, and will involve about 2,500 stakeholders, primarily farmers. Other partners include CARDI which will be responsible for the provision of planting material and technology transfer and the MoAF. Cassava has also been considered as a feed source to be used in the production of feeding rations for livestock, including poultry and pigs, as well as small ruminants.

(ii) Marketing and Promotions

In the area of marketing, the thrust has been towards strengthening the existing marketing systems and improving promotions. This is expected to be carried out through the establishment of up–to-date databases populated by data on cost of production, prices, production levels, as well as the import and export of both fresh and processed cassava. Promotion strategies have been developed and in several countries food fairs have been held to expose the public to the culinary potential of cassava. For example, both Jamaica and Trinidad and Tobago have had "Cassava Day" and "Cassava Week"; respectively. Of interest is a "cassava shop" in Tobago that retails a variety of value added products made from cassava; these products are being produced by small processors.

(ii) Group Strengthening and value chain development

Group Strengthening and Agri-business Cluster Development is also being promoted through the efforts of the CARDI and IICA in Dominica, St. Vincent & the Grenadines, Jamaica and Trinidad & Tobago. Producers and processors in some of these countries have formed commodity groups and assistance has been given to develop an action plan geared towards improving the cassava industry. Training has also been conducted in the principles of group dynamics for all categories, including extension workers, researchers, farmer groups and students.

A methodology has been developed for assessing root and tuber value chains in the Caribbean; this is being led by CARDI in collaboration with the CTA. The approach employs the use of "multi-stakeholder" techniques to gather information, identify solutions to value-chain problems, and identify opportunities for enhancement of livelihoods of the value-chain actors. These initiatives, carried out in Barbados, St. Kitts & Nevis, St. Vincent & the Grenadines, Jamaica and Trinidad & Tobago, are intended to contribute to improved roots and tubers value chains for increased domestic consumption, increased farmer incomes and food security.

Wayforward

In charting the way forward, it is important to acknowledge that this kind of strategic repositioning requires innovative change. This will entail in part, a structured approach to industry development, the scaling-up of pilot initiatives, better integration of players, increased use of technologies and sustainable practices, improved information access, advocacy and marketing, as well as capacity building of technical personnel to support industry development. Such efforts are critical for attaining the goal of a viable and competitive cassava industry which supports food and nutrition security, reduces the food import bill, facilitates employment and improves incomes and rural development.

5. Cassava - Constraints and Challenges – The Caribbean Perspective

Vincent Little and Vyjayanthi Lopez

A key component of the regional strategy for addressing hunger, food insecurity and malnutrition is the development of a viable cassava industry. The current cassava industry is institutionally underdeveloped. This status may be attributed to limited public-sector support, which is partly due to constraints in human, technological and financial resources. In addition, support through private sector investment has been *ad-hoc* at best. In the case of Trinidad and Tobago however, significant strides have been made by the Trinidad & Tobago Agribusiness Association (TTABA), although these efforts have been somewhat challenged in recent times.

Some of the main constraints relate to the policy environment which is unfavourable to the promotion of production, value added product development, utilization and marketing of cassava and cassava based products. Currently, the existing production systems vary between countries. The variation exists between the uses of single or mixed-cropping systems, usually take place on marginal lands in the form of low input-output operations, and are generally subject to biotic stresses, for example, pests and diseases.

There has been an increase in the area of land used for cultivation of cassava. Notwithstanding, this area is still insufficient to support a thriving food (fresh and processed) or feed industry. As a perennial crop, cassava roots can be harvested between 8-12 months after planting. Productivity is a key constraint towards the development of the cassava industry. The average yield across the region is currently less than 10 tonnes per hectare, but is significantly higher in some countries. Based on statistics provided by the FAO, the countries in the region with the highest yield of cassava, that is tonnes per hectare, are Suriname, Jamaica and Barbados (**Table 1.3**).

Table 1.3. Cassava Yields by Country 2001-2011.

COUNTRY	2001		2006		2011	
	Area (ha)	Yield (T/ha)	Area (ha)	Yield (T/ha)	Area (ha)	Yield (T/ha)
Antigua and Barbuda	11	4.1	20	4.0	20	5.4
The Bahamas	13	10.2	16	106	25	10.5
Barbados	25	17.2	20	18.8	17	18.1
Belize	115	14.0	17	14.1	25	13.5
Dominica	102	11.2	87	9.7	141	8.0
Grenada	29	6.7	25	6.6	27	8.2
Guyana	2,600	11.1	2 100	11.0	880	11.7
Haiti	74,418	4.5	63,970	6.3	155,361	4.2
Jamaica	781	18.9	951	18.6	1,087	18.9
Saint Lucia	337	3.6	269	3.8	566	2.2
Saint Vincent & the Grenadines	42	6.8	78	7.7	168	6.5
Trinidad and Tobago	25	10.7	90	12.2	149	13.1
Suriname	265	19.8	206	20.0	146	22.8

Source: Food and Agriculture Organization of the United Nations (FAO)

FAO's Global Agro-Ecology Zone (GAEZ) model estimates that a yield of 13 tons per hectare is needed as a break-even point from a commercial perspective. According to the model, this increase in production will provide considerable opportunity to improve production systems, and result in consistent and sustainable productivity of cassava.

Post-harvest issues include:

1. High water content which result in short shelf-life for freshly-harvested cassava roots;
2. Shortage of adequate post-harvest facilities, both on-farm and at the national level;
3. Use of cassava for immediate home consumption and for sale on the local market; and
4. Waste of any surplus of cassava produced.

Traditionally, cassava processing has been limited to small-scale cottage industries, with processing methods and appropriate equipment being among the key constraints. Regardless, there have been several projects which have attempted to address processing issues, and have resulted in innovative methods and equipment. While processing equipment like graters, presses, mills and stoves may be easily acquired, they are expensive, non-standardized and often of poor quality. In addition, access to credit for investment in equipment remains a challenge. The processing chain has high unit costs, generally low labour productivity and low innovation rates (artisanal mechanization). The results are that products are often of irregular quality. This in turn reduces the competitiveness of cassava on the domestic market, where it competes with imported wheat and other staples.

In terms of utilization, cassava has long been used as food and (limited) feed source. Traditional products are made through the use of fresh and processed cassava. Generally, the freshly-harvested root is consumed boiled, roasted or baked. Utilization, including awareness of newer processing and product options (beer, cassava hay/leaves, sweeteners, paper, and starch products) remains limited, and there are newer, more innovative methods of preparation, presentation and preservation which remain to be exploited.

The market segment and market geography for the cassava product market varies both regionally and domestically with different time frames for opportunity. This includes the marketing of traditional food products, animal feed, flour for baking and confectionary, as well as cassava starch and other derivatives, for example ethanol (**Table 1.4**).

Table 1.4. Cassava Markets in the Caribbean and Latin America

MARKET	PRODUCT FAMILY
Traditional Food Product	Kwak, domini, foto, boiled roots, cassava leaves, kaseripo (cassava juice), etc.
Feed	Chips and pellets, dry cassava leaf meal, cassava leaf silage
Food-grade Flour	Flour/farine (bread, biscuits, bammy etc.), snacks (fermented/unfermented flour), High quality cassava flour (HQCF)
Starch and Derivatives	Textile, paper and plywood, glucose syrup, alcohol, monosodium glutamate, bio-degradable plastics, industrial chemicals
Ethanol	Fresh roots/chips for ethanol production

In terms of marketing, current limitations and challenges include the lack of reliable strategies (e.g. farmer associations/cooperatives), infrastructure, information and intelligence for marketing. In addition, there is also a limited number of promotional activities geared towards exploiting existing market opportunities (tourism, fast-food), and attracting tourists/visitors and the growing urban population to consume more cassava products. Further limitations exist in the areas of research and extension and include a lack of adequate research funds and human capacity for relevant research along the value chain. There is also inadequate involvement of the private sector in research and extension programmes, quite likely because cassava has been given low research and extension ranking. As such, stakeholder collaboration in the area of cassava research has been inadequate.

Regardless of these limitations, there are several opportunities which remain to be exploited. In the case of the Caribbean Community (CARICOM) there is a large, growing market of 16 million people in 15 member states. The annual food import bill across the region is US$4 billion, a figure which has nearly doubled in the last 10 years. There is therefore a rapidly-growing market for

imported food, with semi-/highly-processed staples comprising a large and growing percentage of food imports. In terms of Caribbean imports, roughly 900,000 metric tons of wheat is imported for making flour and 420,000 metric tons of corn, mainly for the processing of animal feed, is imported annually. In 2003, the per capita annual consumption of staples was estimated at less than 140 kilograms, which equals 2.25 million metric tons, of which 1.4 million tons was imported. The value of imported, semi-processed staples, including corn, wheat, white potato and rice, is estimated at US$750 million. These high import levels of food staples are of great concern to CARICOM policymakers. Essentially, the reliability of supplies and prices are erratic, posing a threat to the region's food security. Also, imported staples, especially wheat and its derivatives, contribute to several non-communicable diseases.

Health practitioners recognize the superior nutritional value of common staples, in particular that of root crops, plantains, bananas and breadfruit. There is also the potential for enormous economic and social benefits to be derived, by capturing a percentage of the large import market with regionally-produced staples. Consequently, public and private sector leaders have been strongly advocating the need to seek aggressively the substitution of imported staples. Some governments have responded with policies and strategies, aimed at encouraging this shift. So too, the Regional Food Security Strategy of CARICOM, which emphasizes the importance and need to develop the staples subsector. In addition, development agencies like the Food and Agriculture Organization of the United Nations (FAO), Caribbean Agriculture Research and Development Institute (CARDI) and the Inter-American Institute for Cooperation on Agriculture (IICA), as well as the private sector where the Caribbean Agribusiness Association (CABA) and agro-input agencies have responded with research and development projects aimed at increasing productivity and generating new innovative products from cassava.

To address these challenges, a cassava programme has been proposed which has the capacity to address the challenges and limitations being faced in the cassava industry. Some of the components of the proposed programme include strategies to address and improve:

1. On-farm production/yield and raw-material supply;
2. Processing and commercialization;
3. Consumer / markets / marketing / promotion;
4. Research and Development along the value chain;
5. Business / entrepreneurship / leadership; and
6. Caribbean Cassava Industry Network and Caribbean Cassava Information and Knowledge Platform.

Discussion

Questions/Comments	Responses
Is there any alliance geared towards enabling grass root farmers across the region to deliver the protocol?	The initiatives which are being discussed at this event, regardless of the country, should involve farmers which are an integral part of the initiative. The efficiency and productivity which currently exists needs to be upgraded. The aim is to involve some regional and international organisations in the initiatives e.g. FAO, CARDI, IICA. However, there is a difficulty working at the organisation level. One solution could be a training of trainers and this could help to provide technical support for this strategy.
The government contribution to agriculture was omitted from the presentation, and it is critical to take into consideration extension systems, as well as the importance of collaboration in order to strengthen these specific areas. While this is a government responsibility, support is also expected from external organisations.	That is the reaction that is required and attempts will be made to stimulate the industry as best as possible. Additionally, there needs to be ownership in the event that CARDI and the government cannot meet all the demands for materials. Notwithstanding, full support will be provided in the form of training. It will also be a challenge to organise farmers within the existing extensions to grow this industry. Regardless of the fact that education is required in these areas, another issue is that of marketing of the specific product being offered, particularly as it relates to a specific variety of cassava.
What is required is an entire revolution which is not something that happens overnight. This has to be carried out in stages, and done against the backdrop of climate change and its effects – drought, flooding, salt water intrusion and pests. It is also unlikely to sustain an industry on just a few varieties of a product.	

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Session 2

Sustainable Intensification of Production

Session Chair

Mr. Leslie Brereton

Barbados

6. Cassava in Latin America and the Caribbean

Norville Abraham and Donovan McLaren

The Caribbean Farmers Network (CaFAN) is a legally registered non-profit, non-governmental regional network of farmers' organisations with over 500,000 small farmers in 15 countries. CaFAN was incorporated under the Companies Act of 1994 in St. Vincent & the Grenadines in February 2009. CaFAN is willing to partner with the Food and Agriculture Organization of the United Nations (FAO) and the University of the West Indies (UWI) to improve the production and marketing of cassava in the Caribbean. CaFAN has established very good working relationships with the respective Ministries of Agriculture, FAO, UWI, CARDI and IICA, in the Caribbean especially in St. Vincent & the Grenadines, Guyana, St. Lucia and Jamaica. This working relationship has served the region and stakeholders well. A well-organized market for cassava will see farmers investing more in its production. In addition, the availability of finance, agricultural inputs and technical support to farmers and agro-processors will greatly assist in the development of the cassava industry.

Cassava is a tropical root crop, originally from Amazonia that provides the staple food of an estimated 800 million people worldwide. The crop is grown almost exclusively by low-income, smallholder farmers. It is one of the few staple crops that can be produced efficiently on a small scale, without the need for mechanization or purchased inputs, and in marginal areas with poor soils and unpredictable rainfall. Cassava, whose scientific name is Manihot esculenta Crantz, is grown in over 90 countries and is the third most important source of calories in the tropics, after rice and maize. Only 14 percent of the world's cassava, or some 34.3 million tons, is grown in Latin America and the Caribbean, where *Manihot esculenta* was domesticated. Between 1980 and 2011, the harvested area grew by less than 1 percent, to 2.6 million hectares, while production increased by 15 percent, thanks to modest improvements in yields. The average annual growth in production since 2000 has been twice the rate recorded in the previous two decades.

In order to address the sustainable intensification of cassava production the combination of traditional knowledge with modern technologies in order to meet the needs of small-scale producers should be considered. This strategy includes minimizing tillage to protect soil health, optimizing timing and methods of planting, and using biological control agents to counter pests and diseases. This approach shows that well-balanced applications of mineral fertilizer, in combination with intercropping, crop rotation, mulching, manure and compost, can make a cassava-based farming system not only more productive and profitable, but also more sustainable. Sustainability is underpinned by resilience and food security for farming households. This can be achieved through the provision of improved varieties and healthy planting material and other productivity-enhancing technologies through a participatory community-based approach. Income generation and equity can be fostered by linking smallholder farmers to high value markets where the majority of the value is retained in the rural sector. This requires collective action, stakeholder participation and development of enterprise skills, as well as the use of best practices. This will in turn facilitate an improvement in the input supply chain. In this context, the strategy will help developing countries identify what needs to be put in place to ensure that farmers and local entrepreneurs as well as policy-makers can take advantage of opportunities offered by the crop, and thus promote its production, processing, utilization, marketing and trade.

Latin America has had a number of experiences where expanded production found inadequate market opportunities, and where production could not keep pace with new markets. The need for a parallel development is clear. "Cassava a Sustainable Intensification of Production"[1] 2013 is the subject of a guide, the first in a series to the practical application of FAO's "Save and Grow" model of agriculture to specific smallholder crops and farming systems. This guide along with the stated approach will ensure sustainability. The establishment of an appropriate agriculture and

1 http://www.fao.org/ag/save-and-grow/cassava/index_en.html

trade policy is a fundamental prerequisite to cassava's ability to act as a catalyst for development. Additionally, cassava varieties are sensitive to the production environment. As such, the crop needs to be developed for adaptation to the relevant biological and physical stresses, and tested in the respective target environments.

7. Cassava Global and Regional Production Systems and Relevance to the Caribbean and Latin America

Makiko Taguchi and Alberto Pantoja

Cassava originated in the northwest of South America, between Brazil, Paraguay, and southern México (between latitude 33°N and longitude 33°S). There are approximately ninety-eight (98) species of cassava. Africa currently produces 8 percent of the world's cassava, of which Nigeria is responsible for roughly 18 percent. The crop is known for being drought resistant, and capable of growing in arid, poor soils, mainly non-irrigated croplands. Cassava serves as a staple crop for 500 million people in the humid tropics. Fifty-three per cent of the cassava produced is used for human consumption, 24 per cent is used for feed, while the remaining cassava is used for other purposes, mainly industrial uses (FAOSTAT, 2014[2]).

The constraints for the sustainable intensification of cassava in Latin America and the Caribbean include low supply & low demand, the cyclical and inconsistent production, low yields (**Figure 2.1**), high production costs, limitations associated with artisanal production, intensive hand labour required in cassava production, post-harvest issues, and the short shelf-life of the fresh product. Other limitations include challenges in the industrialization/transformation of cassava production facilities. There is also a lack of associativity for both production and marketing of cassava and cassava products and a lack of financial incentives to growers. In addition, the balance between industrialization and food security in the region is unknown, along with the fact that there is limited access to modern high yielding varieties of cassava and technological packages to assist in the production cassava by-products.

The general objective of this presentation is to elaborate on the sustainable intensification of cassava production in Latin America and the Caribbean. Alternatives to , improve cassava availability, demand, and access (food security), diversify growers' income by improved commercialization, new industrial uses, and integrated farming systems, strengthen social networks in communities and support/promote public policy for the sustainable intensification of cassava production will be discussed during the workshop. Additionally successful cassava programs from others parts of the word will be discussed

The Food and Agriculture Organization of the United Nations (FAO) Cassava Diseases in Central, Eastern and Southern Africa (CaCESA) Strategic programme framework (2010–2015) is geared towards the supply of healthy cassava stems to vulnerable families as the spread of diseases became critical. It includes wide and comprehensive awareness campaigns, sensitization and publicity, national and regional coordination of stakeholders in the cassava commodity value chain, better cassava growing, processing and conservation practices, and control and management of the spread of the disease, whether this is due to an insect, vector and/or spread of infected cassava stems[3].

Farm Field Schools (FFS) provide season long non formal education to growers which are conducted in farmers' fields. This initiative started as a way to introduce Integrated Pest Management (IPM),

2 http://faostat3.fao.org/faostat-gateway/go/to/home/E

3 Description of the practices can be found at: http://www.fao.org/docrep/012/i1460e/i1460e00.htm

but is now used in many areas of crop management and beyond. This takes place through a participatory process which relies on experiential learning, empowering the farmers to better understand the agro-ecosystem and making crop management decisions based on observation. This process is also facilitated by trained extension officers or farmers. Here the use of quality facilitators is key. FFS methodology can be used to work with small holder cassava farmers in the LAC region to improve productivity and better connect with the market opportunities[4].

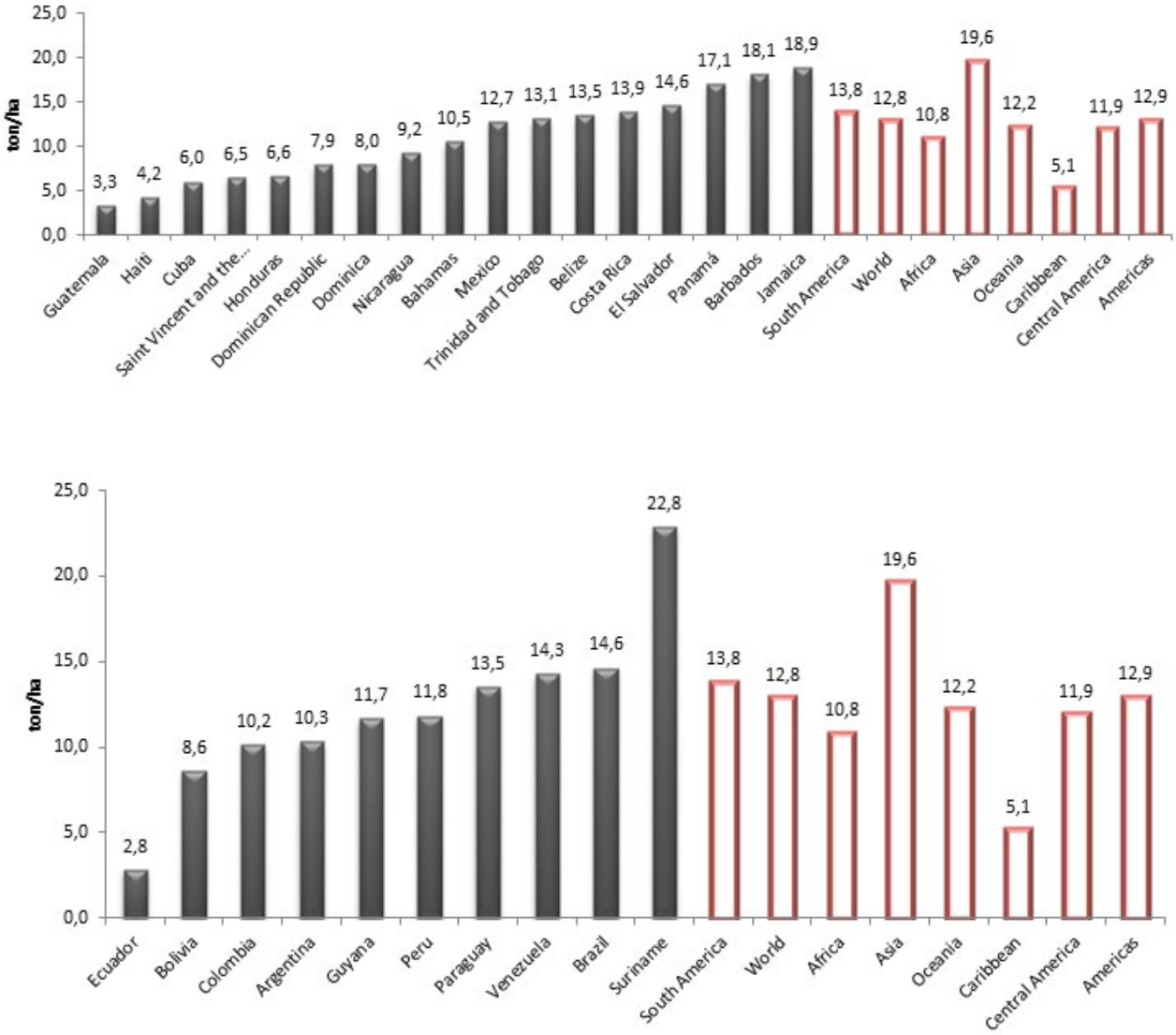

Figure 2.1. Cassava yields in selected countries in Latin America

Source: FAOSTAT, 2014

4 Additional information on FFS can be obtained at: http://www.fao.org/docrep/006/ad487e/ad487e02.htm

8. Land and Water Availability for Sustainable Cassava Production

Lystra Fletcher Paul and Jan VanWambeke

The development of a viable cassava industry is a key component of the regional strategy for addressing hunger, food insecurity and malnutrition in the Caribbean. Land and water availability for cassava production is an important part of that strategy. The key questions to be asked in terms of land and water are:

1. How much land do we need?
2. How much of the available land is suitable for cassava production?
3. Where are the most suitable lands for cassava production?
4. What is the potential productivity of the land?
5. How can we improve productivity in a sustainable manner at what cost?
6. What are the water requirements of the crop?
7. Is there a critical period when water is needed?
8. Rain-fed or irrigated?

To determine the available land we must first set our target production level. The methodology used to determine land suitability, location and potential use is referred to as the Global Agro-Ecological Zone (GAEZ). Over the past 30 years, the FAO and the International Institute for Applied Systems Analysis (IIASA) have been developing the Agro-ecological Zones Methodology to assess resources and agricultural potential. Rapid advances in information technology have generated more detailed and varied global databases, which have made possible the first global assessment of the AEZs in 2000. Since then, there have been annual global assessments of AEZs. With every system upgrade, the topics, the size of the database and the number of results have multiplied.

The database has five (5) thematic areas:

1. Land and water resources - including soils, land and vegetative cover, protected areas and socio-economic data and selected demographics;
2. Agro-climatic resources - including a variety of climatic indicators;
3. Agricultural sustainability and potential yields - of up to 280 crops/land use types with alternative levels of inputs and management for historical, current and future climatic conditions;
4. Actual yield and production at a reduced scale - of the main basic commodities; and
5. Differences in yield and production - in terms of relationships and differences between actual performance and production potential of major crops;

The agro-climatic potential of the land depends largely on the number of days in the year when the temperature and water availability allow the growth and development of crops. This period is called the growth period, and refers to the time during the days during which temperatures allow crop growth and precipitation over the moisture stored in the soil profile exceeds half the potential evapotranspiration. The crop water requirement is between 400 to 750 mm average annual rainfall for a 300 day production cycle. Higher yields are achieved with higher water supply (for example Thailand 1700 mm during 4th – 11th month after planting). Cassava can withstand relatively prolonged drought. Stakes will only sprout and grow well when the temperature is

greater than 15 degrees Celsius (°C) and soil moisture is at least 30 per cent field capacity. Water stress during early growth reduces the growth of roots and shoots and hence impairs storage root development. Thus, cassava can be planted throughout the year if rainfall is evenly distributed, but not during periods of heavy rains or drought.

In summary, the AEZ provides a standardized framework and database for evaluating the potential of natural resources and to analyse alternative uses of land and water resources. It contains an automatic search cropping calendar to evaluate the historical variability of the crop and allows simulations for climate change adaptation. The AEZ considers the suitability and land productivity for many crops (including energy crops) within a variety of environmental conditions. It also calculates the water requirements of crops and irrigation demand and indicates (trade-offs) types of land uses, as well as variations between the use of rain fed and irrigated water supply. In addition, it produces a full statistical resource for current use rates, assesses the differences between yields and productivity changes and identifies conflicts of land use and intensification of production.

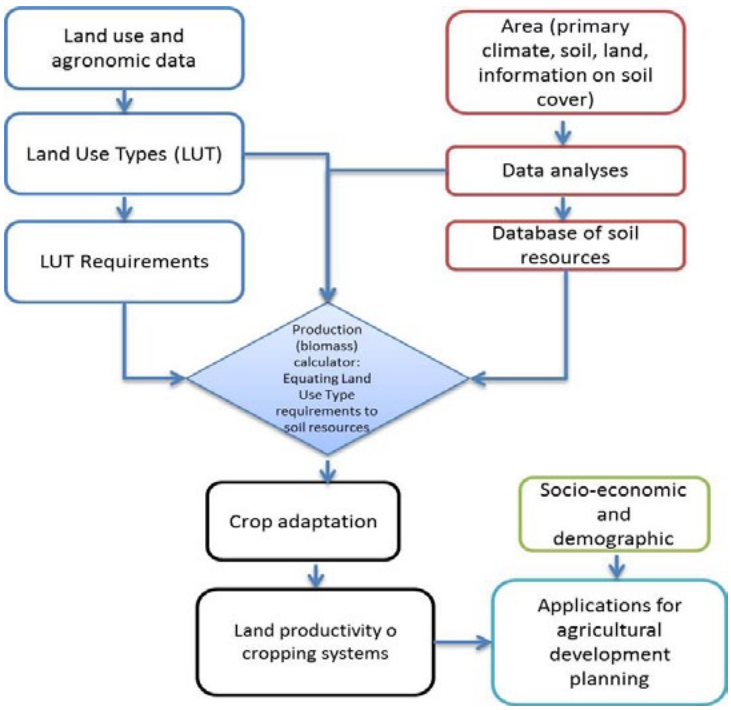

Figure 2.2. Conceptual Framework of the Agro-ecological Zoning Methodology.

In terms of the land area distribution of suitability classes for cassava in the Caribbean, approximately 25 percent (58,706 square kilometres) of the land area is good to very highly suitable. Sixty-one per cent of the total land area (142,569 square kilometres) is in the medium to marginally moderately suitable and roughly 4.9 per cent (11,371 square kilometres) is marginal to unsuitable.

The Caribbean has adequate amounts of good to highly suitable lands available for cassava production. With additional inputs such as improved varieties, and fertilizer use along with pest and water management, higher yields are attainable in the lower suitability categories. Wheat and corn replacement targets are possible, but there is a cost which must be taken into consideration. In pressing forward, more accurate country assessments are required. This entails data collection, especially of biophysical data. Areas with all classes of land suitability need to be identified, and more partnerships need to be created. Policies to ensure the land is sustainably managed will also need to be put in place. Such policy should cover the issues of land use, land tenure, soil and water management, information and capacity building.

9. Mechanization Strategies: Concepts, Principles, and Examples, with Focus on Cassava

Joseph Kienzle

The process of mechanization encompasses all levels of production technology. This includes the use of simple hand tools (human power), use of animal traction equipment (animal power), and motorised equipment. Stationary engine-powered machinery (e.g. pumps, generators), single axle tractors or tractor/trailer combinations and four-wheel tractors and tracklayers are also used. Mechanization also includes post-production/processing at the farm level, such as milling, hulling and cleaning. Rural transportation is also another aspect of mechanization.

Mechanization is to be considered as a means to an end, and not an end in itself. It should be demand driven, thereby making the type and degree of mechanization the decision of the farmer or user. If used appropriately, it should facilitate environmental sustainability, and aid in reducing human drudgery. Regardless, there are several questions associated with mechanization which include:

1. How can food self-sufficiency of an increasing population be met?
2. How can livelihoods be improved, particularly in the rural areas?
3. Can the profitability of agricultural production be increased in a sustainable manner?
4. How should we promote increased levels of sustainable mechanization?
5. How do we ensure environmental sustainability?

The main issues which emanate therefore pertain to the type and level of mechanization which should be promoted, the role of both the private and public sectors. Several stakeholders are involved in the Sustainable Agricultural Mechanization Strategies (SAMS) are shown in **Table 2.1**.

Table 2.1. Stakeholders in the Sustainable Agricultural Mechanization Strategies (SAMS).

Private Sector		Public Sector
Mechanization Demand	**Mechanization supply**	**Institutional support**
Smallholder farmers	Importers	Government
Commercial farmers	Manufacturers	Policy makers
Farmer organizations	Blacksmiths	Associations
Irrigation groups	Distributors	Financial services
Crop processors	Machinery support services	Extension workers
Rural transport		Researchers
		Trainers
		NGOs

The basic principle is to link end users with the subsector, which includes retailers, wholesalers, manufacturers and importers. A manufacturer could make his product more profitable by increasing the price, but then perhaps the farmer could not afford the product. Sales would then drop and the manufacturer would still remain unprofitable. Each party should be able to develop cassava production into a profitable business. This is clearly a complicated system which merits careful analysis.

In order to ensure the success of the Sustainable Agricultural Mechanization Strategies (SAMS), the government has several important policy roles to fulfil, including the establishment of:

1. Exchange rate policies;
2. Policies influencing relative agricultural input prices;
3. Policies influencing agricultural product prices;
4. Policies influencing farm and non-farm employment;
5. Land ownership and tenure policies;
6. Agrarian institutions;
7. Farm power research policy;
8. Infrastructure policy;
9. Agricultural financial markets;
10. Industry policy; and
11. Transport policy and motive power.

This also includes several institutional aspects like research and development in the area of mechanization, testing and quality assurance, as well as education and training in the mechanization sector. Consumer protection strategies are also useful, along with the establishment of extension services (private/public) and the mechanization of departments in the various ministries of agriculture.

The general aim of the Sustainable Agricultural Mechanization Strategies (SAMS) is the creation of effective linkages between each group of stakeholders, while addressing the issues which affect the profitability of these groups. In addition, it is critical that the basic conditions that national governments could provide for a largely self-sustaining development of agricultural mechanization are identified. Such actions should however be planned within a policy of minimum or at least very carefully placed direct interventions. A good approach for formulating Sustainable Agricultural Mechanization Strategies (SAMS) (**Figure 2.3**) is to acknowledge that agricultural mechanization is a complex process and should not just focus a single commodity. Its development depends on many country or region specific factors, especially since it involves a wide range of stakeholders. If the SAMS are to be 'owned' then all stakeholders must be involved in its formulation, through a participatory and holistic approach.

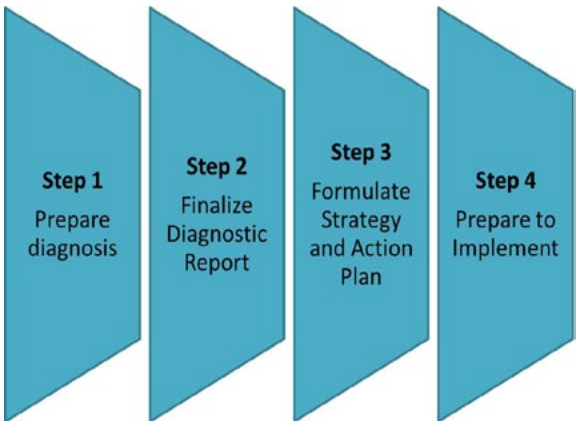

Figure 2.3. The Formulation Process of Sustainable Agricultural Mechanization Strategies (SAMS).

In ensuring success, there are two main aspects for analysis – supply and demand. In terms of supply, the main stakeholders, including contract farmers, commercial farmers, smallholders and service providers should be considered. The various production systems, resource ownership and relevant gender aspects should also be considered. In terms of supply on the other hand, the suppliers are to be considered for obvious reasons. National policies for tax and trade along with the availability of raw materials will also require examination.

Sustainable Agricultural Mechanization Strategies (SAMS) are only one of the governments' policies/strategies. Notwithstanding, they provide several outputs including but not limited to:

1. Institutional and legislation recommendations;
2. Programs and projects oriented towards farm power and equipment supply and use;
3. Programs and projects oriented towards resource efficiency and environmental sustainability; and
4. Components that can be incorporated into other agricultural development projects.

Some of the resulting programmes have included support to commercial mechanization for service providers (including smallholders), the awarding of incentives to farmers to increase demand for services, as well as incentives for innovations such as cassava in no-till/conservation agriculture systems. These incentives for innovation are for the purpose of environmental sustainability, in alignment with the 'Save and Grow' sustainable production intensification. These programmes are also ideal for making existing tasks easier and increase farm power productivity and mechanization (invest in farm power and mechanization services),as well as changing farming practices to methods that use less farm power (towards Conservation agriculture/no-till). The Food and Agriculture Organization of the United Nations (FAO) 'Save and Grow' concept also identifies various areas for intervention. This intervention takes a holistic approach, involves the efficient and safe use of inputs, enhances soil health, relies on water and nutrient availability to ensure the highest possible production, and has an environmental footprint which requires less recovery.

In order to start to formulate Sustainable Agricultural Mechanization Strategies (SAMS), political will is required. It is also critical to recognise the existing bottlenecks for developing the agricultural sector, especially for cassava. The timing of the exercise is also important, as well as ensuring that there is an awareness of the role and place of sustainable agricultural mechanization. In preparation for the exercise, a decision should be taken to determine in which government institution the exercise should be based. A decision also needs to be taken in order to determine whether or not the initiative will take on a national or regional approach. The formulation should be led by a national team and should have a regional focus from the onset, as well as external technical assistance. The strategies are formulated following an analysis of the existing farm mechanization situation, and the definition of the actions required to move from the existing situation to the optimum future situation. The next step is then to organise the implementation process, after which comes the follow-up stage (**Figure 2.2.**).

Discussion

Questions/Comments	Responses
As it relates to standards, are there any set standards for the cassava products made within the region, as well as internationally for example in Thailand. If so, are these standards documented?	A good example of this is a company from Costa Rica which exports roughly 200 containers of cassava per year. In their business, they have to meet very strict requirements, particularly in the case of the flour and the starch. Any company which purchases cassava will require samples and will test these samples in their laboratories. Currently standards exist for both quality and food safety, which are international standards. In Jamaica in particular, a draft standard is being developed which is expected to be entered into the ISO registry.
In terms of competitiveness, some of the experiences in Africa have shown that the costs of drying have served as some of the biggest hindrances to competitiveness. In Nigeria, flash dryers are used. In some cases this is subsidized. Some people employ the use of soda drying. Other regions have been known to cut down entire forests in the interest of drying cassava. Is there a more efficient solution?	There have also been reported cases of using solar dryers which are expensive to run. Basket dryers are also known to be efficient in drying cassava, at a lower cost. Notwithstanding, these basket dryers are small. The question therefore is: 'At what scale does the cassava need to be dried?' Solar powered electric dryers may be expensive to set up, but prove to be cost effective in the long run.

Session 3

Demand for Cassava Products and Commercialization

Session Chair

Dr. Cyril Roberts

Caribbean Agricultural Research & Development Institute (CARDI)

10. Establishment of a Strategic Vision for the Development of the Cassava Sector in selected Countries in Latin America and the Caribbean

Bernardo Ospina

There are five (5) key components in setting the strategic vision for the development of the cassava sector in selected countries in Latin America and the Caribbean. These are:

1. **The agro-productive cassava chain as the scenario.** The process of identifying a common interest is facilitated in a space in which a set of common interests meet.
2. **Promotion of spaces for discussion, negotiation and agreements.** When the different actors of the agro-productive chain have a space to improve information flows, collective search of knowledge, discussion of problems and opportunities and negotiation of potential solutions, the identification of a common interest becomes an easy task.
3. **Appropriate methodology for facilitation.** The use of an appropriate methodology facilitates reaching consensus with minimum interaction costs, thus facilitating the identification and the obtainment of common interests (**Figure 3.1**)

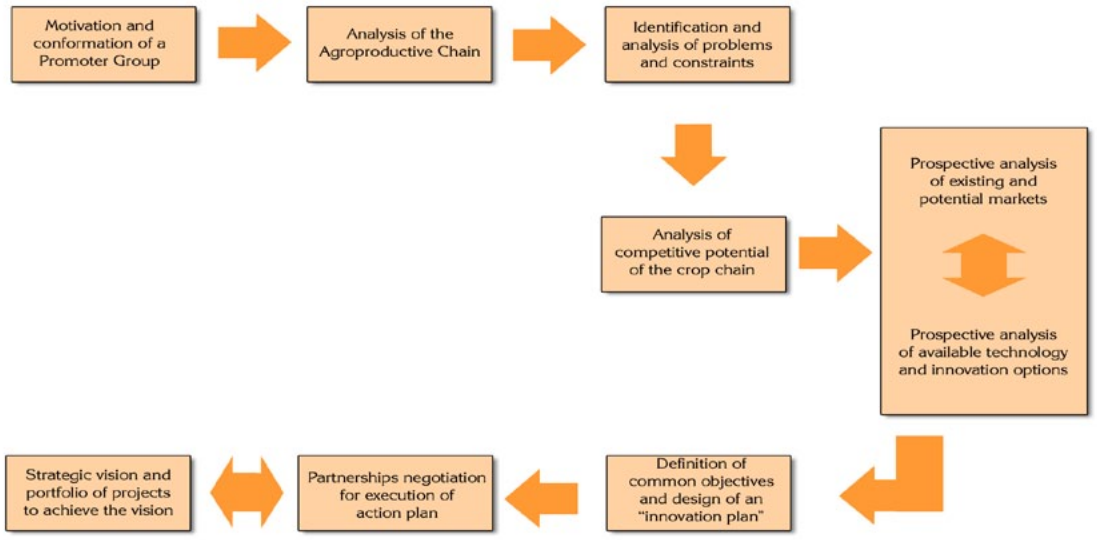

Figure 3.1. Strategic Vision for the Intensification of Cassava Production and Industrialization in Selected Countries in the Caribbean Region

4. **Active participation and commitment by the actors.** The appropriate identification of the common interests and its negotiation require an active participation of all the actors and potential members of the strategic alliance that must be committed and motivated with the process. Motivation and commitment are essential ingredients for success.
5. **Prioritization of the actions with greatest potential.** Although different common interests could be identified amongst the potential actors of the strategic alliance, it is important to define those that are more important and that have the greatest potential to generate changes that will result in improved competitiveness of the cassava agro-productive chain,

It is around these points of agreement with the greatest potential that the strategic alliance must be built to maximize the benefits for the different actors.

In terms of marketing, a growth matrix for the product market could be used (**Table 3.1**). Each aspect of the matrix has a specific focus. Market penetration consist of the analysis of short and medium term opportunities for increasing sales of existing products, in the existing markets, without a need to change the product offered. Market development entails the identification of opportunities for new market segments for the current products. For example, new geographic zones in which the product could be introduced to new population strata-differentiated by age, income, etc. that are not consuming the product currently but that could do so in the future. Product development includes the identification of opportunities for offering new or modified products to the current segments of the population. The products could be differentiated through the packaging, brand, additional processing, or other options. Lastly, diversification refers to the identification of opportunities for producing new products for new markets.

Table 3.1. Growth Matrix for the Cassava Product Market

	Existing Products	New Products
Existing Markets	1. Market Penetration	3. Product Development
New Markets	2. Market Development	4. Diversification

11. Post-Harvest Loss Management and Storage Need along the Cassava Value Chain

Majeed Mohammed and Kelvin Craig

Cassava (*Manihot esculenta* Crantz) is a woody perennial shrub of the Euphorbiaceae family. In view of its favourable agronomic traits, tolerance to abiotic stresses and adverse environments, the crop is produced by small farmers in marginal agricultural areas in the Caribbean as well as other parts of the world. In recent years in African, Caribbean and Latin America countries, cassava production has increased and is projected to increase further because of its demand as human food and its value as raw material for industrial purposes. In Trinidad and Tobago, cassava production has increased by more than 60% from 2007 to 2012 while in Guyana the increase more modest at 11% over the same period. Cassava cultivars are classified into two groups based on the amounts of hydrogen cyanide present. Sweet types contain less than 50 mg kg^{1} (fresh weight) and are generally sold as fresh roots, whereas bitter types have higher amounts of HCN, but have higher yields and starch content.

Fresh cassava roots are highly perishable under ambient conditions, becoming unmarketable in 3 days or less. With proper postharvest handling and management practices fresh roots can be stored up to 30 days (Sanchez *et. al.* 2013). In recognition of the importance of cassava as a source of carbohydrates and the potential for further development of a diverse range of value-added products, FAO in collaboration with CARICOM have initiated a project entitled "*Reduction of postharvest losses along the food chain in the CARICOM sub-region*" and identified cassava as one of the three commodities for postharvest loss measurement.

Objectives:

The main objectives of the investigation include: (a). the conduct of an in-depth analysis of postharvest handling practices of cassava producers, retailers (roadside and mobile market vendors, municipal markets, supermarkets), wholesalers, exporters, processors for development of value-added products and consumers, to obtain a more complete understanding of the system-wide nature of quality deterioration and subsequent losses in order to formulate appropriate solutions for quality management and loss reduction strategies; (b). the analysis of the cassava value chain as items for food consumption, with quality attributes which must be protected and enhanced in various marketing channels; (c). the examination of the significance of losses of both technological and socio-economic origins; (d). the examination of links between growers on the one hand and provisions for transferring relevant research information on identified problems to producers, traders, processors on the other hand; (e). the design and evaluation of improved operations throughout the system and alternative postharvest handling systems; and (f). the description of key factors affecting the logistics performance in CARICOM region with particular emphasis on logistics that affect produce losses in the supply chain.

Methodology and data collection:

The methodology used for this study involved: (i) Carrying out a literature review (ii) Collection and analysis of the documentation and technical information on cassava (iii) Selection of the specific supply chains to the study and justification for this choice. (iv) Identification of 3-4 stages of the food chain where the losses are higher or have the greatest impact and selection of 1-2 for detailed analysis and (v) Participation and contribution in the development of a comprehensive approach, including appropriate tools for data collection and analysis identifying the scope and limitations of the study as well as gaps, to ensure that all marketing aspects, including handling and shipping are included. The implementation strategy for this study embraced the FAO 4S methodology and where necessary adapting it to the Caribbean situation (Mpagalile 2013).

Results:

Critical Loss Points - type and level of food losses

The types of losses associated with cassava in Trinidad and Tobago and Guyana were both quantitative and qualitative with critical loss points occurring at field harvest (CLP#1), packinghouse (CLP#2) and retail marketing (CLP#3) as shown in **Figure 3.2**.

The losses were as follows in Trinidad and Tobago (**Table 3.2**) and Guyana (**Figura 3.3**).

Causes of losses:

Quality losses

Quality losses of cassava roots in both countries began in the field and primarily associated with the manual method of uprooting plants using a fork to loosen the soil from the roots and a cutlass to separate roots from the mother plant. The resultant physical damages were due to punctures and abrasions arising from incisions made on the peel and flesh from the fork as well as breakages at the primordial and distal ends from the manual force exerted during root extraction from the soil and subsequent separation of soil from roots. Quality losses which varied between 30% and 40% in Trinidad and Tobago and Guyana respectively were not only related to the equipment and method of harvest but to the soil type as well. Clay soils, more dominant in Guyana than Trinidad and Tobago, accounted for higher levels of quality losses. Most times in Trinidad and Tobago separate field labourers were engaged in the actual uprooting of the plants from the soil while other labourers were employed to place the harvested roots in polypropylene bags. This often created major logistical deterrents which impacted negatively in accelerating quality losses in the field.

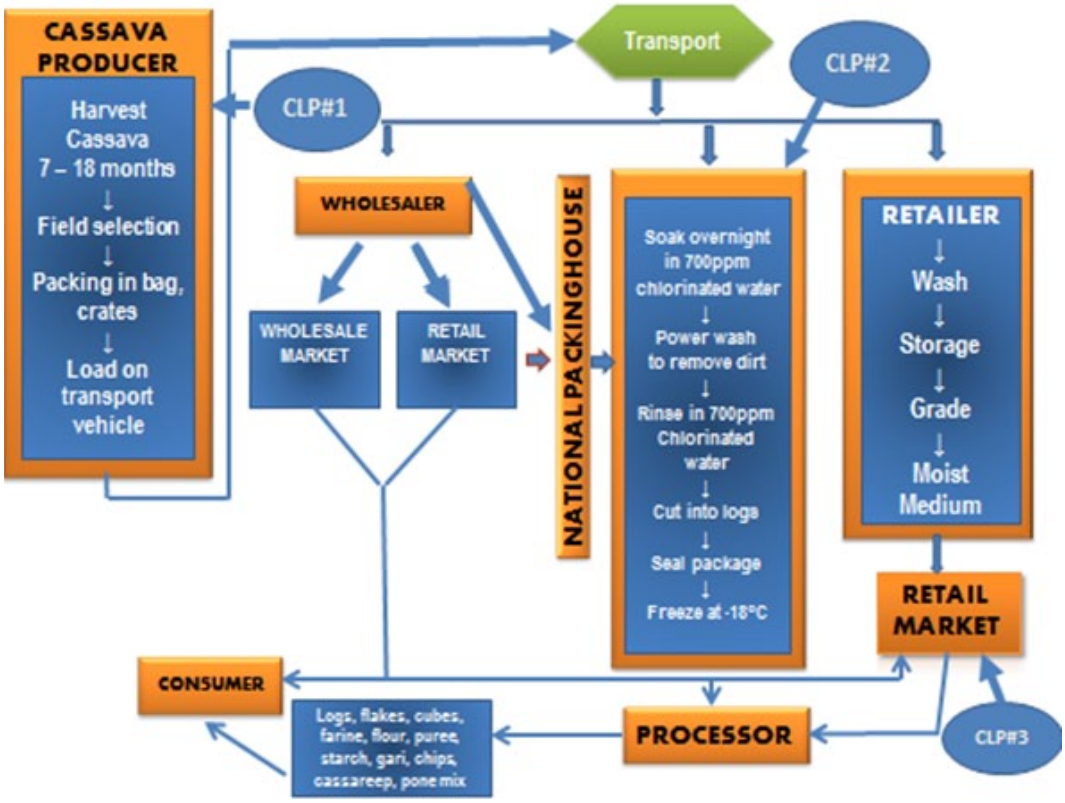

Figure 3.2. Cassava Value Chain in Trinidad and Tobago and Guyana.

Table 3.2. Quantitative and qualitative losses occurring in the cassava value chain in Trinidad and Tobago

Food Supply Chain (FSC) Point	Quality reduction (%)	Quantitative losses		
		% handled	% Losses	% of weighed losses
Harvesting method	15			
Bagging and loading	25			
Transportation and unloading	15			
Critical Loss Points:				
Harvesting CLP#1		100	3.5	3.5
Packinghouse CLP#2		50	3.5	1.8
Retailing CLP#3:				
Day 2	35	25	2.0	0.5
Day 4	45	15	5.0	0.4
Day 6	60	10	6.0	0.3
Supermarket	65	100	7.5	7.5
Total			27.5	14.0

Harvested roots with physical damages created avenues for contamination from adhering soil, damages due to insect infestations, water loss, secondary pathological infections as roots were left exposed to prevailing high temperatures and low relative humidity as shown in **Table 3.4 f**or periods ranging from 4 to 6 hours. In Guyana, labourers performed both functions at the same

time, that is, harvesting and bagging but cassava filled bags remained in the field exposed to environmental conditions and at time intervals as in Trinidad and Tobago before being transported to the packinghouses thereby accounting for quality losses as well.

Table 3.3. Quantitative and qualitative losses occurring in the cassava value chain in Guyana.

Food Supply Chain (FSC) Point	Quality reduction (%)	Quantitative losses		
		% handled	% Losses	% of weighed losses
Harvesting method	25			
Bagging and loading	20			
Transportation and unloading	25			
Ambient (storage)	30			
Critical Loss Points:				
Harvesting CLP#1		100	6.5	6.5
Packinghouse CLP#2		50	2.0	1.0
Retailing CLP#3:				
Day 2	35	25	3.0	0.8
Day 4	50	15	4.0	0.6
Day 6	75	10	7.5	0.8
Total			23.0	9.7

Table 3.4. A. Quality attributes of cassava and B. Environmental conditions at the three critical loss points in Trinidad and Tobago and Guyana.

A. Quality attributes

Parameters	Quality attributes	
	Trinidad and Tobago	Guyana
Fresh weight (kg)	0.28 – 0.48	0.30 – 0.55
Length (mm)	208.6 – 265.1	205.3 – 266.9
Width (mm)	42.8 – 57.6	44.6 – 55.0
Total soluble solids	3.2 – 3.5	3.2 – 3.4

B. Environmental conditions (Trinidad and Tobago and Guyana)

Critical Loss Point	Skin temperature °C	Pulp temperature °C	Relative humidity (%)
CLP#1	30 – 32	34 – 36	60 – 65
CLP#2	27 – 29	29 – 30	55 – 65
CLP#3	31 – 33	35 – 37	55 – 65

In both countries, polypropylene feed bags which were often used were characterised with poor ventilation and slippery surfaces. These bags contained 42-44 kg of cassava roots, tightly packed sometimes with root protrusions permeating the bags. Such handling practices coupled with loading from the field unto the hard surfaces of carts, van trays and tractor driven trailers, accentuated quality losses. In many instances cassava filled bags were loaded at drop heights that

further promoted quality losses averaging 25% and 20% for Trinidad and Tobago and Guyana respectively (**Tables 3.2 and 3.3**). Transport of overfilled slippery bags that were inappropriately stacked over rough roads and hilly terrains accounted for higher quality losses in Guyana than Trinidad and Tobago due to the greater distances between production sites and packinghouses in Guyana compared to Trinidad and Tobago. In Guyana, cassava roots were stored under ambient conditions for longer periods before being sold at market outlets incurring a 30% quality loss (**Table 3.3**).

While several supermarkets in Trinidad and Tobago had small quantities (18-20 kg) of fresh cassava displayed for sale, in Guyana this was not observed. Roots appeared very desiccated when displayed in open plastic crates on supermarket counter tops where air condition temperatures prevailed. Quality losses were 65% due to high incidence of desiccation and vascular streaking (**Table 3.2**).

Quantitative losses

Postharvest losses of cassava in Trinidad and Tobago were 27.5% for farmers who retailed at the public, roadside or mobile markets. At CLP#1 postharvest losses averaged 3.5% similar to that measured from samples measured at CLP#2. At CLP#3 where roots were displayed for sale under ambient conditions postharvest losses were 13% by day 6. Degradation of root quality progressed more at CLP#3 than CLP#1 and CLP#2 respectively, thereby confirming the cumulative nature of posthavest losses (**Table 3.2.**).

Although postharvest losses of cassava roots in Guyana was only 4.5% less than Trinidad and Tobago, the data in Table 2 show major differences in the nature of these losses at the CLPs. At CLP#1 total losses averaged 6.5% mainly due to physical damages and pathological and entomological damages being 3.0% and 3.5% respectively. No physiological losses were measured at CLP#1 and 2 and total losses at CLP#1 were at least three times more than CLP#2. As in Trinidad and Tobago losses were cumulative and the injuries to roots at CLP#1 created avenues for further quality degradation as the commodity moved along the value chain to CLP#3. Nevertheless, while the nature of all types of damages were almost the same percentage (3.5%) after 6 days of retail marketing , the limit to marketability based on qualitative ratings was only up to day 2 .

In both countries, physical damages included splits, lateral cracks and skin abrasions , wounding from harvesting equipment (forks and cutlasses mainly used), skin abrasions, skin and flesh bruises, punctures and stem and distal end breakages. These damages were due to inappropriate harvesting tools, overpacking in polypropylene bags, abusive drop heights during loading and unloading in field unto transport vehicles. Transportation from field to packinghouses over rough, narrow slippery roads with cassava bags stacked 3-4 layers high without any buffer to cushion overhead weights resulted in multiple physical injuries described above. In Guyana limitations in access roads plus dominance of wet clay soils, unstable bridges and longer travelling distances and durations compared to Trinidad and Tobago, made movement of cassava from the field to the packinghouses more challenging and this contributed to the two-fold increase in physical damages at CLP#1 in Guyana compared to Trinidad and Tobago. Harvesting and bagging were usually followed by multiple loading and unloading of the cassava into boats and / or trucks to wholesale and retail markets; thereby accounting for the higher levels of physical damages in Guyana as opposed to Trinidad and Tobago.

Physiological disorders were not detected at CLP#1 but cassava roots had visible evidence of moisture stress. However at CLP#1, pathological and entomological losses accounted for 2% postharvest losses in Trinidad and Tobago as waterlogged soil conditions persisted due to unusual high rainfall in the last 2 months in 2013 which continued in January in 2014 when data were being collected. These conditions ultimately promoted microbial decay causing pith breakdown near the peduncle more so in farms where cassava samples were cultivated in low lying areas such Caroni, Felicity, Cunupia despite having cambered beds. Entomological damages were associated with insect damage causing cassava brown streak to develop, also related to waterlogged soils. Waterlogged soils, poor drainage and high rainfall patterns posed similar challenges in a more

consistent nature in Guyana thereby increasing pathological and entomological losses by an additional 1.5% as compared to Trinidad and Tobago.

Postharvest losses of cassava at CLP#2 amounted to 3.5% in Trinidad and Tobago and only 2.0% in Guyana while losses due to physical damages were similar at 1%. Likewise, physiological disorders such as vascular streaking (VS-11) identified as dark bluish or brownish radial veins or streaks near xylem vessels of the root pith (1%) and pathological and entomological being 1.5% were also consistent in both countries. The incidence of VS-11 was directly related to environmental field conditions where high temperatures above 30-32°C (over 6 hours) impacted negatively on damaged root skin and flesh which eventually became invaded by soil borne pathogens (**Figure 3.3**).

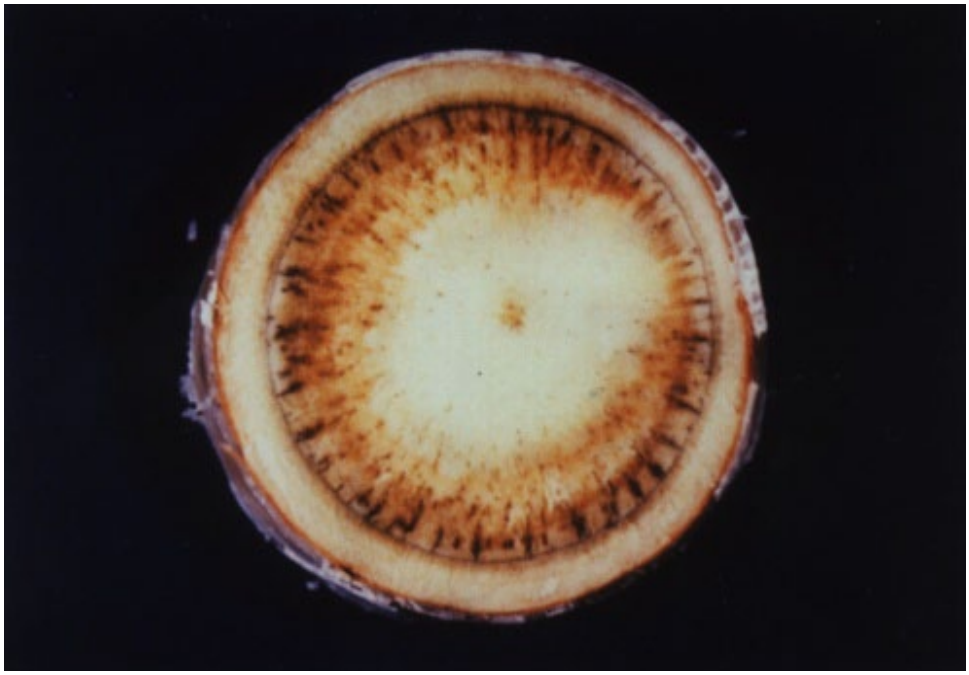

Figure 3.3. Vascular streaking of cassava roots due to severe physical damage followed by secondary microbial development.

In Trinidad and Tobago and Guyana, at CLP#3 cassava roots had the highest levels of losses as duration of retailing increased from 2 to 4 to 6 days. In both countries cassava retailing is usually done under ambient conditions. Thus initiation of physical damages due to wounding at harvest was aggravated by multiple handling times from loading, reloading, handling by consumers at display as well as breakages arising from overpacking in polystyrene bags and emptying from variable drop heights on relatively hard surfaces factored significantly on the severity of damage thereby conferring higher incidences of VS-1 and VS-11 as retailing time increased Similar incidences of VS-1 and VS- 11 were described previously by Garcia *et. al.* (2013) and Reilly *et. al.* (2004). The higher incidence of VS-11 which was indicative of moderate to severe physical damage leading to a blue-black pigmentation of vessels which commonly appeared on or adjacent to microbial infected areas of the root was slightly higher on cassava samples examined at Trinidad and Tobago than Guyana.

Vascular streaking (VS1 and VSII) was a major postharvest problem of cassava displayed for sale in supermarkets in Trinidad and Tobago. Prevalence of low relative humidity (45-55%) within air-conditioned room temperature of 23°C promoted moisture loss particularly where broken roots existed. Extensive desiccation accounted for poor overall appearance. The 7.5% losses incurred were not absorbed by supermarkets but actually sustained by suppliers. A mutually agreed contact between suppliers and supermarket produce managers mandated the former to reclaim all cassava roots classified as unmarketable by the latter.

Food loss reduction strategies: conclusions and recommendations

Field harvest (CLP#1)

The following food loss reduction strategies are recommended for producers and marketers in Trinidad and Tobago and Guyana unless otherwise stated. The use of a manual hand lifter should be recommended and made available to farmers to reduce physical damages during harvest operations. Engineering inputs to design this harvesting aid at an affordable price and or subsidized by governments, national marketing boards and agricultural associations to cassava producers as an incentive should be considered. Also harvest containers should be plastic crates that are sturdy, ventilated and light coloured to reflect heat and stackable so that overfilling would be discouraged. Plastic crates with handles would also reduce abusive handling during loading and unloading as well as reduce potential damages arising from detrimental drop heights.

Trinidad and Tobago cassava producers should pattern the strategy used by their Guyanese counterparts to engage in the uprooting of plants, isolation of roots and containerisation at the same time. This would significantly reduce unwarranted exposure of roots at high field temperatures as described previously which would ultimately minimise water stress and postpone and or delay the incidence of vascular streaking. Farmers in both countries must place roots in a shaded area such as under a tree or preferably a field shed, and then sprinkle water to keep roots moist and even cover containers with broad leaves or polyethylene bags. In the field shed other activities could be performed such as removal of dirt from roots, field sorting to eliminate defective roots, that is, roots that are under sized, with external and internal insect damages, oversized and woody roots with deep lateral skin and flesh wounds and roots characterised with flesh breakdown and discolouration due to pathological agents and other associated field borne diseases. It is essential for farmers to transport harvested cassava in plastic crates to the packinghouse within 1-2 hours following harvest. The current practice of leaving harvested roots for more than 4 hours in the field exposed to high temperatures and then placing roots into containers afterwards must be discouraged. The use of polypropylene bags should be discouraged and replaced with plastic crates. Logistical arrangements to rent or encourage farmers' groups and associations to pool resources to purchase large amounts of plastic crates at affordable prices would be beneficial based on their durability, sanitising efficiency, multi-purpose uses and potential to reduce physical damages during loading, unloading as well as to optimize field to packinghouse to market transportation linkages. This will have to be guided by awareness and economic considerations. Construction of feeder roads and the use of trucks equipped with conveyor belts would significantly reduce the incidence of physical damages due to loading and unloading. Proper drainage and use of cambered beds would reduce losses due to microbes and pests. Field sanitation, weed and pest management practices would also assist in reducing losses. Curing roots after harvest by exposure to temperatures of 32-35^{o}C for 2-3 days at 85-90% relative humidity would induce wound healing and decrease secondary infections.

Field days to demonstrate proper harvesting techniques, the use of the hand lifter equipment and curing procedures, sorting to remove defective and unmarketable roots, benefits of reducing moisture stress must be made available to farmers, farmer groups and associations. Training should be accompanied with samples of successful root treatments as well as manuals, factsheets and techpaks.

Packinghouse (CLP#2)

Cassava roots that are transported to packinghouses in Trinidad and Tobago as well as Guyana should be subjected to the following postharvest treatments to maintain quality. From the field a second sorting and grading procedure should be implemented to remove damaged or unmarketable roots arising from transportation vagaries from the field to the packinghouse. Cured roots should be washed and dipped in an approved sanitizer such as sodium hypochlorite at 500-700 ppm followed by a fungicidal dip consisting of immazalil (Mertec). Treated cassava roots could then be

packed in polyethylene bags which would create a modified atmosphere and high relative humidity within the sealed bags to reduce transpiration, and respiration and so induce an extended shelf life up to 4 weeks and also prevent vascular streaking. However, to achieve this, roots must have minimal or preferably no physical damages, provided with protection from sunlight, treated with a fungicide and packed within 2-3 hours of harvest. Another method to limit vascular streaking is to cover the roots with paraffin wax by dipping the root in wax at a temperature of 55-65°C for a few seconds after treatment with a fungicide to achieve a shelf life up to 2 months.

Retail marketing (CLP#3)

Cassava roots must be subjected to a rigorous sorting procedure to eliminate all types of damages. Roots should not be marketed at CPL#3 beyond 2-3 days unless they are cured, treated with a fungicide, protected from the sunlight and subjected to waxing and refrigerated storage. Cassava can be stored under refrigerated conditions at 3-4°C up to 4 weeks. However, if roots are stored above 4°C, roots develop vascular streaking more rapidly and have to be discarded after 2 weeks of storage. Supermarket produce managers in Trinidad and Tobago and in Guyana should apply the technique of packaging cassava roots in sealed polyethylene bags and storing at 3-4°C to acquire the benefits of modified atmosphere packaging outlined above since this technique is currently applied to other commodities at these outlets where equipment to seal package and refrigerated display facilities already exist. Demonstrations, short workshop sessions and exposure to information are highly recommended to educate suppliers as well as produce managers on these postharvest procedures.

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12. Cassava: Recapturing Lost Ground
Small Scale Processing – A Barbados Experience

Adrian Kirton

During World War II (1943), the government of Barbados erected a cassava processing plant where cassava flour was manufactured. This flour was used in making biscuits without blending, and used for bread when blended with the small amount of available wheat flour. The capacity of the plant was approximately 12 tons per day, but unfortunately the factory was closed during the early 1950s. The Ministry of Agriculture in the late 1970s conducted cassava plant trials with different varieties of cassava for comparison to the existing local Sugar Loaf variety (white stick). Later, in the

1980s, the Caribbean Agricultural Research & Development Institute (CARDI) conducted further plant trials with additional varieties to prepare stock for chipped cassava, for use as a feed ration. During the 1970s, and onwards through the 1980s, through the efforts of the Barbados Agricultural Development Corporation (BADC) recipes utilising cassava were developed and promoted.

During World War II (1943), the government of Barbados erected a cassava processing plant where cassava flour was manufactured. This flour was used in making biscuits without blending, and used for bread when blended with the small amount of available wheat flour. The capacity of the plant was approximately 12 tons per day, but unfortunately the factory was closed during the early 1950s. The Ministry of Agriculture in the late 1970s conducted cassava plant trials with different varieties of cassava for comparison to the existing local Sugar Loaf variety (white stick). Later, in the 1980s, the Caribbean Agricultural Research & Development Institute (CARDI) conducted further plant trials with additional varieties to prepare stock for chipped cassava, for use as a feed ration. During the 1970s, and onwards through the 1980s, through the efforts of the Barbados Agricultural Development Corporation (BADC) recipes utilising cassava were developed and promoted.

From late 1990's and onwards, the Barbados Agricultural Development and Marketing Corporation (BADMC), an amalgamation of the BADC and the Barbados Marketing Corporation (BMC), further increased focus on cassava flour. The BADMC's Food Promotion Unit established a 300 square foot facility which specialised in small-scale processing of cassava flour using a mixture of household and laboratory-type processing equipment. In 2008, a strategic decision was made by the BADMC to further its work in cassava flour preparation and promotion. In 2010, the Barbados Government launched its Medium Term Development Strategy 2010–2014. This strategy includes a focus on agriculture to address the challenges being faced in terms of the island's food security. This further increased the call for greater domestic food production, and in turn an increase in the production of cassava.

The small scale cassava processing carried out by the BADMC relied on cassava supplied by both small and large farms. Small farms were those farms with land plots ranging in size from less than 1 acre to up to 5 acres, while large farms were categorised as those which were both private and government-operated, with land plots of at least 10 acres. The cassava was received from farmers in sacks/bags, three to four times a week. Upon receipt, the cassava was inspected for quality, specifically the absence of dirt/soil and spoilage/rotting. The weight was recorded and the fresh cassava purchased for $2.20 per kilogram. Farmers were generally paid within 3 weeks of delivery.

The flow of cassava processing started with peeling, then washing, then grating, followed by pressing, breaking, drying, milling and then packaging. In 2008, the production was initially operating in a small facility, approximately 300 square feet in size. This provided limited space for effective equipment and process layout. Peeling of the cassava was done manually (peeling, cutting and washing), with staff consisting of two general workers. The output from the facility was approximately 300-500 pounds of peeled root daily. The peelings were discarded or used as mulch. Finely grated cassava was produced using a motorised grater. The cassava pieces were required to be frozen hard for efficient grating operation and the resulting mass squeezed, which was done initially using muslin cloth to manually (by hand) extract liquid and retain grated cassava. Through local funding from the Barbados Manufacturers' Association (BMA) and assistance from the Caribbean Industrial Research Institute (CARIRI), a hand operated press was acquired to extract the liquid. Approximately 25 pounds of grated cassava was pressed in each load. The process involved removing the maximum amount of liquid to shorten drying time.

The liquid removed during pressing was often discarded. Leaving the liquid undisturbed in the collecting vessel, would allow for the starch granules present to settle to the bottom of the container. Carefully discarding the liquid exposed the starch which would be collected and dried separately. Unfortunately, the cassava varieties encountered were not high starch producers. After being dried for 20 -24 hours, the cassava product was removed from drying chamber, cooled and milled, using a table top mill. The production rate using these methods was 30-40 pounds per day, with the ratio of cassava root to flour being 3.5:1. The final packaging was done manually and

the cassava flour placed in stand-up pouches and labelled prior sale. Both fine grain and coarse grain cassava flour was produced, through adjustments to the milling head gap. The cassava flour was sold to individual walk-ins, BADMC's three (3) outlets, to health clinics, at outdoor exhibitions during national activities, at sponsored "health-themed" activities and at farmers markets. Product promotional activities by the organisation included recipe development, organised tasting events, visits to schools islandwide, the distribution of flyers with recipes and a monthly scheduled radio show.

In 2011, the processing operation was relocated to a 1,600 square foot building which was outfitted and designed to increase production output and improve operational activities, in order to meet the ongoing increases in consumer demand for the cassava-related products. The staff component also doubled. Additional milling capacity was also purchased, which had the impact of upgrading the output to match the increased customer requirements. Noted as a concern, the dust generated during the refining and packaging process can prove to be a health & safety hazard, as well as create hygiene problems.

Today, cassava flour has presence on the retail shelves. Besides the BADMC, two (2) other local small processors use locally grown cassava input to manufacture cassava flour. Other locally branded products noted on the retail shelves are sourced from external suppliers in Ghana and Nigeria.

13. Cassava Replacing Wheat Flour

Vassel Stewart

In 2011, the wheat imports of the nine (9) CARICOM countries for which data was readily available (exclude Antigua, Bahamas, Dominica, St.Kitts-Nevis, St. Lucia, Montserrat) exceeded US$250 Million and amounted to some 632,235 tons.

Imported wheat therefore comprises a very large part of our staples consumption, with regional expenditure on wheat flour before value addition averaging US$15/per capita. Jamaica, Haiti, Trinidad & Tobago and Guyana accounts for over 80% and with per capita expenditure ranging from US$6 in Haiti to US$ 37 in Trinidad.

The method of consumption varies across countries based on their culinary history. In Trinidad and Guyana the East Indian population consumes large quantities in homemade flat breads, while in countries with large African population most is consumed as commercial bakery products, particularly fermented breads. In terms of market segment utilisation of the raw wheat flour, it is estimated, depending on the country, that bakeries use between 40-60 per cent, about 30-50 per cent is used in households, while 10-15 per used in food manufacturing, and 5-10 per cent is used in restaurants.

The opportunity for cassava to replace some of the wheat flour, exists in all these segments. There is a good opportunity for cassava to displace at least 10 per cent of the overall wheat market. In order to do so, 63,233 tons of cassava flour equivalent will be required annually. This equates to roughly 210,000 tons of fresh cassava, which in turn translates to approximately 10, 400 acres or 4,251 hectares of cassava fields. This is based on the calculation using target yields of 20 tons per acre or 50 tons per hectare.

There are however, several constraints associated with these ambitions, including inadequate industry leadership and a lack of policy commitment. Current crop yields per acre are usually less than 10 tons. There is however the potential for yields to be over 60 tons.

This can be achieved through the use of specific varieties and proven advanced technologies, involving the use of irrigation, micro nutrients and natural plant growth stimulants. With the

low yields prices are currently very uncompetitive. Inadequate research and development, low processing capacity, limited financing and the absence of ready access to technical and financial resources are significant impedements. Lastly, there is the absence of national co-ordinated programme geared towards the promotion of the health, social and economic benefits of cassava.

In order to seize the opportunity to develop cassava regionally, national and regional Industry Development Committees (IDC's) needs to be established. It will also be important to determine potential market demand and potential economic/social/environmental impact, along with supporting national/regional policy measures. Other priorities should include the use of the highest yielding varieties for the different uses/market segments, and determination of the best technologies for primary & value-added production. It is also important to conduct field evaluations of varieties and technologies, and to undertake pilot programmes, technical and financial assessment of different value-added products. Other necessary initiatives should include preparing investment profiles, establishing industry associations led by the private sector to develop a national and regional plan and a suitable monitoring and evaluation mechanism.

14. Cassava Replacing Corn in Animal Feed

Tito Diaz

Cassava products were long used as raw material for compound animal feeds until World War II, but this declined when grains became cheaper than cassava in Europe. Cassava continues to be widely used in the tropics to feed pigs, cattle, sheep and poultry. Experiments have shown that dehydrated cassava leaves are equivalent in feed value to alfalfa. Current imports of dehydrated alfalfa in Japan are 240,000 tons per year. Cassava is similar to feed grains in that it consists almost entirely of starch and is easy to digest. The starch content of cassava roots ranges from 70 to 85%, increasing with the stage of harvest. Cassava roots are therefore considered as energy feed. Their protein content (typically less than 3%) is however lower than that of cereal grains. Cassava can be substituted for cereals and at high level in rations for all classes of livestock and poultry, provided it is supplemented with a nitrogen source.The fibre content is also extremely low (less than 10%), making cassava roots highly digestible in all livestock species.

The use of fresh cassava roots, up to 50%, is recommended for ruminants; however, the use of bitter varieties is limited by the hydrogen cyanide (HCN) content. Once properly processed, even bitter varieties may serve as a basic energy source for intensive cattle feeding.Studies indicate that the inclusion of cassava to partly replace cereal grains (maize, barley, sorghum) up to 30-40% of diets gave satisfactory animal performance with no negative effects on animal health in beef, dairy cattle, goat and lamb. When cassava tubers are supplemented with non-protein nitrogen, minerals, vitamins, and roughage, high level performances have been registered with dairy and beef cattle, sheep and goats. Palatability can be enhanced with the addition of molasses if pelleting is not possible. The energy value of cassava roots is about 85-93% that of maize grain, depending on the quality and starch content. In beef cattle, dried cassava was found to be as digestible as steam-flaked maize, but more than sorghum grain. Because of the rapid degradation of cassava starch in the rumen, split-feeding several times a day can ensure more efficient utilization of the nitrogen-poor feed by ruminants.

Ruminants consume both fresh and dried cassava roots in different forms (chips, ground, pelleted). Cassava starch has high amylopectin content (70%) making it a suitable energy source when combined with non-protein nitrogen in feeds. Due to high starch content, cassava roots are an excellent source of energy for pigs and can be used in fresh, ensiled or dried forms. The digestible energy value of dried cassava roots for pigs varies between 14.5 and 16.5 mega joules (MJ) per kg. These variations can be attributed to differences in chemical composition, especially in the starch and fibre fractions. Because cassava peels are more than twice as fibrous as the root pulp, peeling

improves energy digestibility and energy content.

For growing-finishing pigs, it is possible to include up to 60% of dried cassava root in the diet. The inclusion rate depends on the growth stage of the pig, but also on the form of distribution.The maximum intake of cassava is about 100 g/kg for dried ground cassava. Cassava root meal is a palatable ingredient in the diets of young pigs. The main concern about the use of cassava roots in pigs is the presence of HCN, especially in bitter cultivars, as there is a negative relationship between HCN content and cassava root intake.

Dried cassava tubers can be efficiently used in poultry feeding. Problems related with cyanogenic compounds are overcome by the use of sweet varieties and/or proper post-harvest treatments as simple as sun-drying on a concrete floor. Pelleting reduces dust and increases the bulk density, favouring feed intake especially in young animals. The protein content of cassava is low, which requires good protein sources in feed formulation. In particular sulphur amino acids (methionine and cystine) have to be supplied in sufficiently high amounts because they can be altered during the metabolization of HCN. The metabolizable value of good cassava meal (72% starch) is equivalent to that of maize. Lower quality cassava (lower starch, higher fibre) have a lower value, and the value of unpeeled cassava meal is about 85 per cent that of maize.

Cassava foliage contains toxic HCN and as a result, is seldom used fresh. It is usually processed by combining sun-drying with chopping and wilting, until the level of HCN in the hay or dried meal (80-92% DM) is safe for animals. Ruminants supplemented in elemental sulphur or sulphur amino acids can eat fresh foliage. When the harvest occurs during the wet season, drying becomes difficult and ensiling may be a better solution. Cassava silage can be prepared with or without a carbohydrate source (such as chopped cassava roots or molasses). The entire cassava plant (roots and aerial parts) can be chopped and ensiled in pit silos for dry-season feeding. Simple equipment is required both for harvest and preparation of the silage.

The main characteristic of cassava leaves is the high protein content (as high as an excellent alfalfa) with good amino acid profile except for methionine. The leaves are a good source of minerals (calcium and trace elements, although phosphorus and sodium content is rather low) and natural pigments (xanthophylls). Cassava hay or cassava leaf meal used as a protein supplement in goats, sheep or cattle fed on poor quality diets have positive effects on animal performance. Cassava foliage is premium-choice supplement forage under scarce conditions. Leaves have been used to partially replace soybean meal in conventional diets for pigs and gave good results if ensiled or dried. Cassava forage may also successfully replace high fibre components of the diet such as rice bran and give good economic results. Up to 36% wilted cassava leaves included in pigs diet increased growth rate. Fresh leaves may be incorporated in pig diets with no toxicity effects at 5 mg HCN by kg of live weight daily intake. The high fibre content of cassava leaf meal (CLM) does not make it suitable for poultry at high levels. However the high protein content of leaves and their availability as a by-product have generated an interest leading to several experimental studies

The processing of cassava roots yields the following by-products that can be valuable livestock feeds when properly processed – peels, pomace, and whey. Fresh peels have three deficiencies: they spoil very quickly, contain phytates and high amounts of cyanogenic glycosides. Different processes are effective in reducing cyanogenic glycosides, including sun-drying, ensiling and soaking then sun-drying. Good quality silage can be obtained after chopping the peels to equal lengths of about 2 cm for easy compaction, and drying for two (2) days to reduce moisture content from 70-75 per cent to about 40 per cent. Under these conditions, cassava peel silage after 21 days is light brown in colour, firm in texture and had a pleasant odour. The pH is 4.4, with no fungal growth. Solid fermentation of a mixture of peels and wastewater from fermented pulp with *Saccharomyces cerevisiae* and *Lactobacillus* spp. results in a product with a higher protein content, lower cyanogenic glycosides and lower phytate content. Cassava peels can represent 5 to 15 per cent of the root. They are obtained after the tubers have been water-cleansed and peeled off mechanically. They may contain high amounts of cyanogenic glycosides and higher protein content than other tuber parts.

Cassava peels can be used as roughage and as an energy feed in ruminant diets. However, sun drying, ensiling and fermentation should be used to prevent HCN poisoning when using bitter varieties. Peels should not be fed alone, as the protein and mineral content do not support optimum rumen function and productivity in ruminants, and the optimal utilization requires sources of readily fermentable protein and by-pass protein as well as micronutrients including sulphur, phosphorus, and vitamin B. Peels then become a valuable feed, and when added to ruminant diets significantly increase animal performance. Cassava peels are a good feed for pigs, but they must be supplemented with sources of protein and lipids in order to improve palatability and digestibility. The fibrous nature of the feed may also limit its inclusion in pig diets. Cassava peels can be used for poultry feeding after sun-drying, since well-processed peels contain HCN levels that are acceptable for poultry.

Cassava pomace (also called bagasse) contains less cyanogenic glucosides than the peels. It can be dried or ensiled. For ensilation, cassava pomace is ground and 0.5% salt (on fresh weight basis)or rapidly fermentable carbohydrates such as ground maize or molasses is added before being placed in anaerobic conditions (in pits or plastic bags). Addition of urea and minerals is also possible. Cassava pomace is also called cassava fibre, cassava bagasse, cassava starch residue and cassava pulp. All these terms refer to the solid fibrous residue (up to 17% of the tuber) that remains after the flour or starch content has been extracted. The quality and appearance of those residues vary with plant age, time after harvest and industrial equipment. Cassava pomace has a lower feeding value than cassava roots but can be included in ruminant diets. Cassava pomace is rich in fibre with a quite variable composition but small amounts can be included in broiler diets. With correctly energy-formulated diets, cassava pomace did not significantlydecrease broiler performance when included at 4% and 8%, while performance was depressed by 12 and 16 per cent respectively.

Cassava whey is the liquid pressed out of the tuber after it has been crushed mechanically. The whey and the pomace may be mixed together and form an effluent (or slurry). Tubers that fail to meet quality standards for processing are discarded and can be used for animal feed. Discarded tubers are sometimes still attached to the peduncle and may contain more fibre. They may also be mixed with the stumps.

The use of cassava in animal feed is not a technical problem but rather an economic one. In order for this thrust to be successful, political commitment is required. This should be accompanied by policies and incentives, public-private alliances, research and innovation, along with training.

15. Cassava Use in Beer as an Adjunct Replacement

Damian Graham

The use of cassava as a local raw material in beer can provide employment opportunities for people living in rural areas. This will see small scale farmers migrated into cash-crop farming increasing their disposable income, and local farmers becoming integrated in the brewery value chain. Migration from maize to sorghum in water stressed areas will decrease crop risk, and the ventures will also result in an improvement of local processing and raw material handling capabilities and capacities. There is also the potential to create an attractive business opportunity for prospective purchasers within the raw material supply and grain handling industry.

The use of cassava as a local raw material is a cost effective alternative to imported cereals, and will help reduce hedging cost and minimize currency exposure. It also has the potential to unlock tax and duty benefits from local Governments for material sourcing within the country, while enhancing and sustaining year-on-year local availability of quality raw material in economically viable volumes. Other benefits include the reduction of environmental impact on water stressed areas, as some local raw materials such as sorghum are generically adapted to arid and semi-arid conditions, requiring less water compared to 'imported' crops such as maize.

Sorghum is a prefect rotation crop for 'low tillage' or 'zero tillage' planting systems, helping to maintain soil quality and moisture to grow crops like wheat or barley in water-stressed areas. Cassava and sorghum are currently the two main crops which have held the interests of brewers. Sorghum is Africa's second most important cereal. Africa produces about 20 million tonnes of sorghum per annum, about one-third of the world's crop. Sorghum is uniquely adapted to Africa's climate, being both drought resistant and able to withstand periods of water-logging. Sorghum has been proven to be the best alternative to barley for clear beer brewing, and is the grain of choice for brewing traditional African beers. On the other hand, cassava is the world's 3rd largest source of carbohydrates. In Africa it is mainly boiled or roasted for food to safely remove cyanogenic glycosides prior to consumption and/or processing. Freshly harvested cassava tubers quickly deteriorate within 24 – 48 hours and need to be processed immediately into stable intermediate products such as cassava chips, raw flour or cassava cake. The cassava chips and cassava cake can be further refined into cassava starch (tapioca).

Local raw material production is in line with Diageo's sustainable agriculture guidelines which include improving water use efficiency throughout agricultural supply chain prioritizing crops from water stressed areas, improving energy usage and improving carbon emission in the growing and transport of our key ingredients, and playing a positive role in supporting local economies and livelihoods. Sorghum and cassava are the preferred sources of local cereal-derived brewing extract, because it's uniquely adapted to the African climate, being resistant to drought and waterlogging as well as being quite robust to grow on lower quality soils. Sorghum has been proven to be a very competitive alternative to barley by cost and quality for lager beer brewing. With industrialised production of cassava starch widespread, the starch has found over 1,000 applications in industry. Cassava starch is gluten free and cultivars farmed are free from genetic modification. Additionally, cassava starch or 'amido' is traded globally as a commodity.

If Red Stripe/Diageo replaced some of the existing grist with cassava starch, the potential impact is:

1. Commercial cultivation of a few thousand acres across dispersed cluster plots island wide;
2. Starch factory capable of daily root tonnage processing;
3. Potential for direct jobs plus a 1.5 multiplier for indirect jobs; and
4. Opportunity for skills development of workers in the supply chain through training under the sustainable training program.

Some of the immediate challenges to achieving consistent brewing quality supply of cassava starch however are the quality of the varieties selected among growers, the quantity and stability of supply (forecast and production schedule), issues related to improving agronomic practices including mechanization, fertilization, and irrigation, risks associated with guaranteeing long-term supply contracts with agro-processors and up-stream farms and yield management to address price volatility of final starch. Another question is how to make the opportunity of working in the supply chain lucrative to attract and retain youth. Recipe and infrastructural changes would also be required as it pertains to the brew house technology.

The Red Stripe Project Grow has a high level timeframe attached, which sees the development of a pilot farm and factory over three 6-month phases. Phase One of the project (Feb 2014- Oct 2014) targets the planting of 36 acres of land and the installation of a model factory to process 20 root tons per day. Phase Two of the project (Oct 2014-Feb 2015) has targeted the planting of 300 acres of cassava, while Phase Three estimates between 340-2,400 acres of cassava planted. This symbolises the start of the scaling up process after April 2016. The farming model is based on the use of tractors to plough, harrow and plant the crop, along with the use of best practice soil fertility and irrigation management. Plant density is aimed at 11,000 plants per hectare. For harvesting purposes, semi-mechanized harvesting will be carried out using a cassava harvester and tractor. The target yield is 40-60 tons per hectare, with a target tuber cost of $5 to $7/kg, and a target farm gate price of $11-$13/kg.

A pilot farm has been set up in Bernard Lodge, located in St. Catherine, Jamaica. Clearing of the lot of land has commenced since January 31, 2014 and is expected to take approximately two weeks. CARDI has been selected as the agricultural consultants and a contract signing is imminent to proceed with ground breaking by February 17, 2014. A farm manager is being resourced to operationalize strategy, and the planting material has been gathered and supplemental land made available for a third party nursery.

The first trial brew of cassava beer was done during the first week of January 2014 using 4 per cent cassava flour and starch available. All brewing parameters were up to standard on the first brew, which is now ready for tasting and bottling. The Rural Agricultural Development Authority (RADA) has processed a further 7,000 lbs of cassava for a second trial brew (5% flour). Additional cassava will be available to complete a third brew (5% flour), which is to be obtained from the plot at Bernard Lodge.

16. Tobago Experiences with Cassava Development

Pathleen Titus

Traditional cassava processing in Tobago had farine as the predominant value-added product. This product was of varying quality in terms of consistency, colour, taste and texture. The product was produced in practically every village, with the main pockets being Les Coteaux, Glamorgan and Belle Garden - each with a unique taste, flavour and texture. The main varieties used were the traditional ones – 'bitter' and 'butterstick'.'

Cassava processing at the Tobago House of Assembly began in the late 1990's, at the Marketing Department of the Division of Agriculture, as part of an initiative to produce cassava flour. The product was of a high quality and when exhibited at an expo in Trinidad, local and regional marketing opportunities presented themselves. There were, however, immediate limitations attached to exploiting these opportunities. Limitations included the limited and inconsistent supply of cassava, the high cost of production (market price for produce), inefficient equipment and the small existing production plants. In addition, the processing of cassava was labour intensive, as the peeling was done manually. Due to the inadequate supply of cassava, the industry has experienced very limited rowth, and still functions at the subsistence level.

Following the conduct of a market survey by Mary King and Associates (2008), which was commissioned by the Division of Finance and Enterprise Development, there was a general thrust towards the development of the cassava industry. The survey indicated that cassava was among the most viable crops for agro-processing, and identified specific products to be targeted for production, including farine, frozen cassava and cassava flour. The company called The Tobago Cassava Products Limited was established in 2009 as a result of the market survey by the then Division of Finance and Enterprise Development, Labour and Co-operatives. This company was owned by the Tobago House of Assembly, and had the vision of spurring economic development, employment and income generation, while improving foreign exchange earnings and food security in Tobago. The ensuing mission was therefore to increase the capacity of the Tobago Agriculture sector to produce cassava and cassava-based products for domestic use and export. Following this, a cassava processing facility was to be established at Cove Eco Industrial Park, Cove Estate. The enterprise was to rely on contract farmers in Tobago to produce cassava, which was also to be supplemented with supplies from Trinidad.

Initially the venture was to be funded by the Tobago House of Assembly, and later bolstered by bank loans and profits made. The Cassava Shop was later set up as a strategic business unit and now serves as an outlet for a wide range of products made by Tobago agro-processors. The current situation is that the Tobago House of Assembly still funds the recurrent and developmental budget.

The Cassava Shop operates by contracting farmers and processors. Inventory levels at the shop are small, but there are favourable local markets for Tobago farine along with a regional market for flour.

Some of the existing constraints include the small acreages of land under production, low yields by current varieties (fresh, meal), along with the fact that small scale processing predominates the industry in Tobago. In addition, product formulation is not recorded, resulting in inconsistent quality of the product. There is also a high cost of inputs, questionable sustainability, and poor sales possibly due to the location of the shop and the lack of advertising. Notwithstanding, there have been several lessons learnt, which include the fact that a wide range of products exist in Tobago, and the importance of linkages, for example with CARDI, CARIRI, IICA etc. There is also the need for the formation of cluster groups with committed farmers to guarantee the supply of the produce. Start-up capital is also critical to the success of the venture.

In Tobago, there is a strong will to develop the cassava industry, and in moving forward, one of the major objectives is to develop a Strategic Action Plan for the Tobago Cassava Industry. This will be matched with a suitable and complementary implementation plan which will address the constraints identified. Expected initiatives include the introduction of high yielding varieties, the strengthening of farmers' organizations, improved land tenure arrangements and investment in appropriate technology for flour processing. There is also a drive towards the pursuit of multi-sectoral linkages, specifically in the areas of health, tourism and education. The need for public-private partnerships to drive industry development has also been recognised.

17. Costa Rica Experiences with Cassava Development

Rocio Valerio

Costa Rica has a geographical area of 51,100 square kilometres, with a population of 4,586,353. The official language of the country is Spanish. Roughly 11,000 hectares of cassava planted across the country, in the North Atlantic Zone sharing a coastline with both the Atlantic and the Pacific Oceans. In 2013, the country exported roughly 132,089 tons of cassava, which amounted to earnings of $64.6 million. Costa Rica is the leading supplier of roots and tubers to the USA and the EU (for human consumption). Costa Rica is the fourth largest cassava exporter in the world and the sixth largest exporter of roots and tubers globally. The soil in Costa Rica is volcanic, and the country experiences North-East trade winds. The country has two seasons – a wet season (May to December) and a dry season (January to April), with average temperatures ranging between 20.5 - 34 °C.

Costa Rica first exported cassava in 1970 when a Cuban residing in Costa Rica sent cassava to another Cuban in Miami, U.S.A. The cassava was fresh without wax, only with soil, for the purpose of conservation. The process was however unsuccessful due to the oxidation of the cassava, and its limited shelf life. In August 1973 Costa Rica exported its first batch of commercial frozen cassava in a container. In 1984, the first commercial export of waxed (paraffin) cassava was made. At that time, Costa Rica had good availability of cassava of excellent food quality (the cassava was whiter, softer and more tender than others). This cassava was usually used for family consumption. Later in the 1980s, due to the falling prices of coffee, banana and sugarcane, cassava production began to emerge as part of the local culture. Tax credit certificates were created in 1973 (but were withdrawn in 1984) in order to help exporters of non-traditional products with taxes (until 1984, non-traditional exports paid income and sales taxes). Following this, most exporters invested in land, machinery, plant improvements and market intelligence. The last Tax Credit Certificate was issued in 1999.

The country has several advantages in terms of cassava production. Costa Rica concentrates on the cultivation of the sweet variety of cassava called "Valencia", with an average yield of 20 tons per hectare. The crop is produced year-round and harvested between 9-11 months after planting.

The current objectives in the industry are to maintain the product quality consistently, both at the plant and the farm levels. This is expected to be achieved through clean planting material, proper management practices, research and development, along with training. Minimising waste, as well as obtaining quality certification are two other main priorities in Costa Rica.

18. Suriname Experiences with Cassava Development

Hesdie Grauwde

Suriname is situated on the north coast of South-America, bordering Guyana to the west and French Guiana to the east, Brazil to the south and the Atlantic Ocean in the North. The North of the country has an extensive road system, with the heart in the capital of the country, Paramaribo. The global economic crisis has had little impact on the economy of Suriname. The country experienced economic growth of 5.1 per cent in 2008, 3.4 per cent in 2009 and 4.5 per cent in 2010. The main sectors of the economy are mining, agriculture and tourism. The contribution of the agriculture sector to GDP is about 7.5 per cent. Following a government declaration, the following Policy Targets were formulated for sustainable development:

1. Sustainable employment
2. Investments
3. Education and Innovation
4. Food Security enhancement

These targets are geared towards increasing income generation through the expansion and development of the agriculture sector. This will in turn result not only in an increase in production, but also an increase in employment and a reduction in poverty.

In Suriname, cassava is the fourth most important staple food after rice, wheat flour (bread) and plantain. Cassava was the main food security crop for Amerindians and Maroons, especially in the remote areas. The crop is cultivated on all soil types, although the loamy sands are preferred. It is also the most planted root crop. Cassava is an important source of income for many small farmers and micro food processors.

Leaf cutting ants can be a major challenge to the cassava industry in Suriname. No other serious pests have been identified in the country to date. The crop presents huge potential for full time employment generation, as well as the expansion of production, processing and export, by tapping into the crop's potential to substitute wheat flour, maize and potato. The basis for the new innovation policy is to adequately address globalization challenges, increase competitiveness, and address measures to protect the country from cheap, subsidized food imports. The spin-off benefits of this include a reduction in fiscal deficits.

Suriname has also embarked on the establishment of a cassava gene bank, with a focus on varieties geared towards a focus on poultry feeds. This will involve the use of root flour as well as leaf flour. In 2010, there was an initiative to increase economic activity in the District of Para which focused on tourism, water and cassava development. Women were heavily involved in this process. The main conclusions drawn from the cassava initiatives in Suriname include the need to:

1. Formulate a roadmap for the strategic development of the cassava subsector to a technology-based, innovative and commercially-viable industry;
2. Foster national and international cooperation with governments, private sectors, research and development, marketing institutions and organizations;

3. Adopt value chain approach;
4. Mobilize financial and institutional support; and
5. Increase efforts for improving production systems and promoting farmer (production) and processors' organizations.

Associated challenges include the absence of commercially identified cassava varieties, weak quarantine measures regarding movement of planting material, under-utilization of cassava plant and root, post-harvest losses, limited (currently) capital investment in the cassava chain, absence of land zoning, shortage of labour, frequent seasonal attacks in some areas by leaf cutter ants, non-familiarity with pests and diseases in large scale commercial production, difficulty meeting international industry measures and standards and the absence of land zoning legislation.

19. UWI Mona Activities on the Cassava Project

Ian Thompson and Chadwick Anderson

Jamaica has tried on many occasions over the last 40 years to stimulate a sustainable cassava industry, with the last being in 2007/2009 when the then Minister of Agriculture encouraged the use of cassava for food security. Feedback from multiple sources suggests that many farmers responded and ended up making financial losses. From these results, there is a lack of confidence that a modern, sustainable and profitable cassava industry is possible in Jamaica. For this to be achieved, a comprehensive and sustained strategy is required.

It is easy to convert the tuber to cassava flour and nationally, a 10 per cent substitution in wheat flour could reduce the wheat import bill by US$6 million per annum. In order to achieve this, local cassava production would need to increase by roughly six fold – from 14,000 to 85,000 tons. Cassava has several health benefits which are related to the product's fibre content, the fact that it is gluten free, and may be a low glycemic index food. The intention is to stimulate demand by developing value added consumer products which are market ready. Research has shown that bread containing 10 per cent cassava flour tastes the same as 100 per cent wheat bread. This eliminates the need for consumers to change their eating habits.

The interest of the Department of Chemistry at the University of the West Indies (UWI) in cassava emerged from an opportunity to acquire and assess technologies for the production of cassava flour. In a nutshell, the Government of Colombia has partnered with the Government of Jamaica and has donated a High Quality Cassava Flour (HCQF) processing pilot plant. The University of the West Indies had been selected to receive and operate the pilot plant and has responded by providing substantial funds to support the set-up of the infrastructure and to sustain this pilot plant, which has a nominal processing capacity of 1 ton flour per eight hour shift. Delivery and commissioning is expected within the second quarter of 2014, with commercial production anticipated in the third quarter of 2014. Overtime, the commercialization of research output is expected to improve productivity at the farm level through mechanisation, improved crop yield by developing production systems consistent with agro-ecological and socio-economic conditions, promote the sale of cassava flour produced, while encouraging technology transfer.

Through an integrated approach, the view is towards improved economies of scale. To this end, mechanisation is justified. The goal is to establish at least four (4) processing centres across the island. The natural geography of the island suggests that two (2) should be on the northern corridor (coast), and two (2) along the southern corridor (coast). This strategy should help to reduce transportation costs (farm to factory) if situated within an economic range. Proximity of farms to factories will additionally reduce post-harvest losses since cassava root are highly perishable and need to be processed within 48 hours of harvesting.

In terms of future opportunities, the possible areas for research include process optimisation, variety characterisation, agronomy, starch modification, bio-fuel and health benefits. A long term prospectus is being pursued which has several objectives which include:

1. The generation of accurate information and giving support to government in developing policy in support of the industry;
2. The generation of accurate information and proposing policy for the replacement of at least 10% of wheat flour with cassava flour;
3. The creation of an ongoing database of what varieties are most suitable to national and community specific growing environment;
4. Demonstration of the benchmark yields and agronomic best practices;
5. Creation of a database of varieties and their most suitable (and profitable) value added products and other commercial applications;
6. Validation of varieties (including new bio-fortified) most suitable for food and nutrition security;
7. Developing laboratories to support the needs of the industry; and
8. Developing technologies & innovations in support of the cassava industry.

An interdisciplinary approach is being pursued and will involve multiple departments and faculties within the University as the need arises. The Department of Life Sciences is currently developing a work plan focusing on its area of expertise and it is anticipated that other departments – e.g. Chemistry, Biotechnology, Engineering, Computing, and Geology will contribute meaningfully to the success of this initiative - until a seamless integrated teaching and research support system has been developed. Undergraduate programs may also be developed through the creation of various courses and projects to allow undergraduates to develop skillsets in support of the industry. There is also a further vision to further build local capacity through the development of post-graduate level programmes for specialization in cassava systems. It is anticipated that by as early as 2017 there should be skilled graduates with concentration in the cassava industry while short term training programmes for existing players in the industry will also be pursued.

Discussion

Questions/Comments	Responses
In planting material, if it becomes infected by a certain disease, specifically the frog skin disease, is there a way to clean it first to eliminate the disease?	Plants sent out have to be certified, the variety has to pass a battery of tests. As such, once they arrive in the country they should be clean. Starting with clean material, the odds of infection are almost non-existent.
It was mentioned that there is a fungicide in which cassava can be dipped and placed in a sealed plastic bag. Does that practice have practical technical implications?	Yes, if there is a three hour delay, the benefits of this technique will be limited. Additionally, the cassava has to be dried first. This technology originates from 1975.
Regarding the use of an electrically powered dryer, isn't that expensive to use and operate?	Relative to the previous energy source used, it is a matter of practicality. The options of solar power, natural gas, liquefied petroleum gas (LPG) could have been explored, except that at the time of set up, there was a lack of technical support. LPG rates were non-competitive and there was no natural gas available. Solar power is still an option; however the question is where in the process the use of solar power should be applied. The best fit may be the mixing of solar power, gas and electricity. The equipment currently being used is German and functions extremely well. Going forward however, there are opportunities to look at these issues. A photo voltaic system could be applied to the generator, which would require 5-7 years for payback – with the benefit being 15 years of free technology to benefit from.
Working for a country in Suriname, where can machinery and advice regarding the start-up for cassava manufacturing be obtained?	There are several sources through which equipment can be obtained. The most efficient methods however are to extend bids for services. Other options include seeking expertise from other factories across the world.
Is it possible, given the system of production, to attain a level of 40 tons per hectare within a relatively short space of time? Regarding cassava for food, there is interest in producing a cassava variety that reduces the need for supplementation; however a major issue is that if the nutritional content based on the variety cultivated.	Through the efforts of organisations like CARDI there was a programme pioneered by Jamaica Producers Ltd. using some of the best practices observed across the industry. The yields obtained ranged from 37-67 tons per hectare, with the lowest yields being obtained during harsh weather conditions, for example during times of a hurricane. These results have provided confidence in the capacity to obtain high yields. More recently a small farmer was able to obtain 77 tons per hectare.
There is an issue of consistency in the field, as inconsistency does not lend itself to proper business transactions.	Technology available now indicates that there is the capacity to produce at those levels. What exists is a management issue, as opposed to a technology issue. Well trained and committed farmers will be critical towards achieving this end – specifically treating the cultivation of cassava as a science.
What strategies will be put in place to ensure that there is an intermediary to ensure that the product from the farmers is properly utilised? These should include owners and operators of feed mills and other relevant stakeholders at this level of the value chain.	Regarding feed mills, one issue to take into consideration is the role of the feed millers. In most cases, they are the ones who have made the feed mill investment and have linked it to the livestock industry, for example in the case of Jamaica. It is not anticipated that any other intermediary would be in a position to take on this responsibility or that ownership of feed mills within the region will change.

Questions/Comments	Responses
Contract farming should be a critical component of the cassava development agenda. This needs to be addressed at the macro level by bringing smaller producers into the development process.	-
Is cassava a bio-accumulator of metals from the soil? Has any work been done to establish whether or not there are metal residues introduced into the cassava from the soil?	There are certain limits in terms of the alumina and manganese that are necessary for growth. As such, it is recommended that the product be planted in an area that will not make the root toxic. In terms of wet extraction also, there is a risk of poisoning , however measures are taken to ensure that toxins are not passed on to the consumer.
The cassava industry can produce many products. Going forward, which of these products will be focused on? Will there be demand studies to determine which products are more profitable or of higher demand?	The value chain at each part of the process is what will be analysed. There are many players, but each aspect of the process will be analysed. The policy framework will have to address the findings of this during the process of planning. It is also encouraged to look at different business models as existing processes may change. The likelihood of vertical integration also shows sign of promise. The investors and businesses are expected to take the lead, while market analyses will inform the demand of different products along with an assessment of the production costs of each product – varying production costs and the costs of final products along the value chain. To this end, it is critical to have the right information, especially in terms of avoiding risks.
What are the successful strategies which have been used to reduce the volume of dry matter associated with the cultivation of cassava?	Pruning of leaves and stems above 30-40 cm above the ground about 2-3 weeks before harvest has been one of the practices which have been found to reduce the amount of dry matter, without any effect on quality.
Concerning the issue of production level and the implication for cost, what is the status of production in Brazil where the methods of production differ from those employed in Thailand?	While the target is a 40-60 ton per hectare yield, one of the things done in the feasibility assessment was to identify the yields for the worst years of production. Yield movement was juxtaposed against the acreage planted. When the lowest average was inserted the cost which emerged revealed that when the yield goes down, the acreage has to be increased to compensate for the reduction. The intention is therefore to plan based on the lowest possible yield and then to compensate. A pilot process, followed by a strategy of scaling up is being proposed. Compensations will also need to be made in terms of soil composition and varieties, which can significantly affect yield. This requires a model that is sensitive enough to compensate for acres planted.

Questions/Comments	Responses
What is required from cassava is a product which is competitive with corn, for example, a product that can fetch 30 cents US in a dry product form. There are, however, other models and markets who will be willing to invest more, for example, in the manufacturing of pet foods, where the cassava would be replacing rice as opposed to corn.	A major issue is that the cost of manufacturing is very high – partly as a result of productivity being so low. Profitability can only be increased by increasing productivity. This will require long term commitment, technology and the buy-in and dedication of farmers, for example for a period of 20-30 years. However, people are generally unwilling to make sacrifices that are not to their own benefit.

Session 4

Cassava Policy, Marketing and Financing Issues

Session Chair

Professor Leonard O'Garro & Dr. Angela Alleyn

University of the West Indies

20. Commercialization and Marketing of Cassava and Cassava Products: Challenges and Opportunities

Robert Reid

There are several marketing opportunities available upon exploration of the potential of cassava and cassava products. Some of these opportunities include supermarkets, hotels, restaurants, as well as fast food and catering services. In order to capture and maintain these markets, consistency is required in the areas of cost, quality control, portion and product branding. For some specific products, for example cassava bread and cassava based snacks; there is the issue of price point competition. This refers to the suggested retail price of a product which can be altered based on the demand for the product and the existing competition. In terms of bread for instance, the retail market is becoming increasingly competitive. There is even competition for the acquisition of prime retail shelf space. Additionally, consumers are becoming increasingly sensitive to prices, possibly due to the high rates of unemployment and low discretionary income. Consumers also take into consideration convenience and the freshness of products.

In order to promote the successful commercialization of cassava and cassava products, there is much that needs to be done. Firstly, data needs to be gathered and analysed regarding product price, segment off-take and competitors. All of this is required for fresh cassava, frozen cassava, baked cassava products and cassava snacks. The next step should be the determination of target products, price entry points, chain margins and the various types of promotion which are suitable for the relevant products. Following this, a marketing plan should be devised which has the capability to respond to the increasingly price sensitive and health conscious consumers.

More specifically, the ingredients required for achieving mastery in terms of the commercialization of the cassava industry are the:

1. Establishment of a chain actor/service provider dialogue mechanism for joint decision-making;
2. Realignment of the production market/trade intelligence services to support actor business decision;
3. Finalization of a development plan and policy framework for the cassava industry production & market; and
4. Proper matching of the right producers, processors, and retailers for selected cassava products.

21. Financing and Investment for Cassava Industry Development – Criteria and Opportunities

Luther St. Ville

The purpose of the Caribbean Development Bank (CDB) is to contribute to the harmonious economic growth and development of member countries in the Caribbean (hereinafter called the "Region") and to promote economic cooperation and integration among them, having special and urgent regard to the needs of the less developed members of the Region. Regional borrowing members of the Caribbean Development Bank (CDB) include:

Anguilla

Antigua and Barbuda

Bahamas, The

Barbados

Belize

British Virgin Islands

Cayman Islands

Dominica

Grenada

Guyana

Haiti

Jamaica

Montserrat

St. Kitts and Nevis

St. Lucia

St. Vincent & the Grenadines

Suriname

Trinidad and Tobago

Turks and Caicos Islands

Non-borrowing members within the region are Columbia, Mexico and Venezuela. Other non-regional non-borrowing members are Canada, China, Germany, Italy and the United Kingdom. The main functions of the Caribbean Development Bank (CDB) are to:

1. Coordinate Development Programmes;
2. Mobilise Financial Resources for Development;
3. Finance Projects and Programmes;
4. Provide Technical Assistance;
5. Provide Policy Advice;
6. Support Regional Integration; and
7. Encourage Capital Market Development.

These functions are funded through the mobilization of financial resources on favourable terms from the private capital market, that is, ordinary capital resource (OCR) loans and from official sources such as special fund resource (SFR) loans and grants.

As a focus of investment, agriculture is viewed as a good area by the CDB based on the fact that its contribution to Gross Domestic Product (GDP) is higher than 20 per cent in two BMCs and over 10 per cent in another two. Agriculture is also a significant contributor to employment and nutrition even in countries where the contribution to GDP is low. Despite its declining contribution to GDP, agriculture is likely to remain an important contributor to food security and socio-economic development in the short to medium term. Areas of intervention in the agricultural sector by the CDB include public infrastructure, research and development, along with related information and advisory services, development of risk management and transfer systems, natural resource management, as well as training and capacity building.

The CDB application process takes the form of a letter of request for funding in the case of the public sector and regional institutions. For the private sector however, the application process entails filling out a loan application form which requires basic legal and financial data for preliminary screening and eligibility assessment. The CDB also provides technical assistance grants which are designed to assist BMCs in accelerating economic development through planning, programme development, programme implementation and institutional support at the level of individual projects and in terms of national economic management.

Regarding the CDB's evaluation system, each application requires an implementation plan, including appropriate timing and sequencing of activities, a detailed phasing and financing plan, and information on the economic contribution and benefits of the specific venture to be funded. Applications are then assessed based on their:

1. Strategic Relevance – How well does the project conform to the development strategy of the BMC and meet the CDB's strategic objectives and corporate priorities?

2. Poverty Relevance – How does the project enhance the capability of the poor by equipping them to take advantage of economic opportunities? Does the project prevent the poor from descending deeper into poverty?

3. Efficacy – To what extent is the project expected to achieve its declared policy objective?

4. Cost Efficiency – To what extent does the project's benefits exceed the cost? What are the economic and financial rates of return? Are there adequate maintenance arrangements?

5. Sustainability –What and how great are the risks and uncertainties faced by the project? Are adequate arrangements in place to help avoid known operational risks or mitigate their impact?

In summary, the Caribbean Development Bank (CDB) provides members with a long-term relationship. The Bank has had 42 years of experience in dealing with small economies. It facilitates flexible in operations, partly because of its size. The Bank also provides competitive advantage in dealing with small projects, has special knowledge of the region, a good understanding of its development challenges and a sound reputation as an honest broker with donors and BMCs.

22. Policy Incentive Framework for Cassava Industry Development in the Caribbean

Vincent Little

The Highest Level Forums of Heads and Ministers of Governments have over the past six years identified the agricultural and food sector as one of the main pillars of economic and social transformation of the countries of the Caribbean as a way of contributing to the major national challenges of low economic growth, high debt to GDP ratios, high unemployment. Notwithstanding, the Caribbean is characterized by a number of food and agricultural sector

challenges, including:

- High levels of food insecurity and malnutrition, especially as related to high food costs and the high food import bill;
- High levels of poverty that range from a low of 9.3 percent in the Bahamas to 41.3 percent in Guyana and to a high of 77.0 percent in Haiti;
- A rapid dietary/nutritional and epidemiological transition, resulting from changing food consumption patterns that contribute to increased levels of non-communicable diseases such as obesity, diabetes, hypertension, stroke, heart diseases and cancer;
- Underdeveloped agriculture and food systems.;
- Inadequate rural area and territorial development strategic approaches;
- High exposure to risks and limited resilience capacity; and
- Weak Public Policy and Governance.

Confronted with these challenges, Caribbean governments have sought to identify alternative local commodities which can contribute to reducing the high food import bill and increasing the consumption of healthy alternatives in the diet. They have further specified that these alternative commodities should be well suited to the Caribbean conditions, provide a reasonable income for rural farmers as well as meet their nutritional needs and should not pose too many difficulties for Caribbean farmers to produce. In this context, cassava has been identified as one such crop with great potential, because it has the required attributes.

Cassava already has a production base in almost all countries of the region and has significant potential as a multipurpose crop. The multi-faceted nature of cassava products offers unique opportunities and excellent market potential. It is adapted to a wide range of environments and soil types, making it an ideal crop for expansion on marginal and sub-marginal lands.

However, the development of the cassava industry in the Caribbean faces several obstacles, including:

- Lack of favourable policy environment to stimulate farmers and other stakeholders to promote production, utilization and marketing of cassava as both a food crop and a commercial crop has hampered its production and utilization of cassava in the food, animal feed, pharmaceutical and paper industries
- Lack of access to healthy and improved planting material
- Lack of research-extension packages to address other technological challenges often leading to a shift to other crops such as sweet potatoes
- Inadequate technology transfer to spur production both horizontally and vertically and value addition to broaden and activate market channels
- Cassava safety as a result of cyanide content in some parts of the country
- Image problem due to perception that cassava is a poor man's food
- Rapid post harvest deterioration under normal conditions
- Inadequate awareness on appropriate processing knowledge and entrepreneurship
- Low production levels that do not sustain the demand for both food and industrial use
- Marketing Constraints such as marketing information and intelligence lack of grades and standards

- Low returns to investment by farmers due to long marketing chain
- Poor farmers organization
- Lack of credit.

The lack of appropriate public policies has been identified as one of the major constraints hindering the production, utilization and commercialization of cassava and cassava-based products in region. Several formal and informal forums have concluded that with appropriate policies and quality standards, cassava could be easily be transformed from "a poor man's food" into a commercial commodity for sustainable food security, poverty alleviation and income generation through production, utilization, marketing and trade of cassava and cassava-based products.

Therefore the development of a policy incentive framework is expected to provide a policy and institutional environment that is conducive to increasing cassava production and productivity, promoting investment and encouraging private sector involvement in cassava enterprises and agribusinesses. Such a policy incentive framework should contain provisions that will:

- Ensure greater efficiency in the structure and institutional management of the cassava industry through well defined roles of regulatory and promotional bodies and enhancing collaboration between key players in the industry;
- Establish clear policy incentives for production, processing, utilization and marketing of cassava and cassava-based products; and
- Ensure food security, improve farmer's/processor's income, create employment and attract private sector participation in the industry.

In the context of its nature and scope, the policy should address key issues derived from the challenges faced by the cassava industry, to include elements and objectives of:

a) **Effective Governance policies to** support the establishment of a national and regional coordinating mechanisms for the cassava industry, as they relate**:**
   - Information management
   - Monitoring the implementation of approved policies
   - Formulating National Development Plan;
   - Mobilizing resources for implementation of Plan
   - Advising government on status of industry

b) **Investment Incentives** as they relate to:
   - Pioneer Status
   - Investment Tax Allowance
   - Incentives for New Projects
   - Incentives for Existing Companies which Reinvest
   - Cross-border Investment, with emphasis on the establishment of transparent institutional framework and risk management mechanisms to facilitate cross-border as they relate to land, financing, foreign exchange and repatriation of profits

- **Financial Policy** to support the mobilization and utilization of resources along the cassava value chain.

c) **Trade/Import Policy** to focus on:

- Import duties waiver on capital goods imported and duty-free imports of spare
- Exemption from custom duties or import taxes on raw materials
- Anti-dumping of cheap/subsidized cassava and cassava-based products
- Improved mechanisms and systems to facilitate the movement of planting materials and products

d) **Research and Development Policy,** focusing on issues such as:

- Development and implementation of a refocused and revitalized R&D programme with agronomic management practices, new high yielding and disease and pest resistant varieties for various market segment
- Institutional support to CARDI and other relevant R&D bodies to conduct prioritized cassava research
- Strengthening and improving linkages between research, extension and cassava producers
- Encouragement of and support to for research on value addition and post harvest handling
- Encouragement of private sector support for and research on cassava and cassava products.

e) **Processing,** with a focus on policy interventions to:

- Encourage the processing of various cassava-based products
- Allow for minimum levels of substitution of wheat with cassava flour for bread and other baked products and confectionaries
- Allow the use of cassava-based starch in the manufacture of products such as beverages, textiles, adhesives, confectionary, pharmaceutical products, paper, glucose syrup and alcoholic products
- Facilitate the development of quality standards for all products
- Make it mandatory for all feed millers to include a minimum percentage of cassava chips as one of their raw material
- Provide tax incentives to millers utilizing cassava as a raw material, in form of tax relief
- Foster collaboration with the Bureau of Standards in their reviews, formulation and implementation of standards of quality, labeling, packaging and marketing of cassava and cassava-based products
- Encourage the industry to purchase and install modern processing plants through tax incentives and exemptions.

f) **Effective and Efficient Marketing** policy interventions to:

- Promote market information systems that help the growers, traders and processors in

increasing the efficiency of the cassava marketing, minimizing transaction costs and enhancing transparencies

- Support the establishment of Cassava Produce Marketing Associations
- Support efforts in marketing new cassava-based products to overcome stigma from the consumers through increased budgetary allocation
- Enhance competitiveness of cassava-based product in the markets especially where there is stiff competition from other raw materials such as wheat and maize
- Encourage constant supply of cassava-based raw materials.

g) **Utilization/Consumption** policy interventions to:

- Promote greater incorporation of cassava in animal feeds through mandatory provisions by law
- Support mandatory introduction of minimum quantity of cassava in school meals program
- Promote the use of cassava in other food products
- Create awareness among the potential consumers on importance of cassava-based products
- Provide incentives to consumers of cassava-based product in form of favourable tax regime

The expected outputs of these policy elements and objectives are thus the:

- Establishment of an institutional and legal framework;
- Establishment of Cassava Farmers' Associations in different countries within the region;
- Introduction of high yielding quality planting materials that are resistant to cassava diseases and pests;
- Enhancement of institutional budgetary reform to accommodate cassava as an important food and cash crop;
- Creation of sustainable research on production, utilization, marketing and new product development;
- Establishment of an Apex Body that will promote, coordinate and regulate the cassava industry;
- Development and harmonisation of standards of cassava and cassava-based products; and
- Provision of appropriate incentive to the producers and end users of cassava and cassava-based products.

It must be recognized that there are several policy instruments in place that are relevant to the development of the cassava industry. Therefore, critical to the process of establishing an environment conductive to the development of a sustainable cassava industry in the Caribbean is the need to:

- Review current policy incentive frameworks for the development of the food and agriculture sector in five selected countries, and in particular there relevance to the development of the cassava industry in those countries; and

- Establish gaps/deficiencies in the existing policy incentives frameworks, including those specific policy instruments that could impact significantly on the development of the cassava industry.

There are several investment incentives associated with obtaining pioneer status in the cassava industry and this includes exemption from taxes for five years, deduction of accumulated losses incurred from the post pioneer income and a waiver on import duties of raw materials. There is also an Investment Tax Allowance on qualifying capital expenditure incurred during five years on the clearing and preparation of lands, planting of crops, provision of plant and machinery, construction of feeder roads, construction or purchase of buildings, and structural improvements. In terms of incentives for new projects, tax incentives are given to both companies which invest in a subsidiary company engaged in cassava production/processing and its subsidiary. Tax deductions are equivalent to the amount invested. There is also, for a subsidiary company, full tax exemption on statutory income for 10 years. Losses incurred during the exemption period are allowed to be brought forward after the exemption period. As it pertains to cross-border investment, the intention is to establish a transparent institutional framework and risk management mechanisms to facilitate cross-border investments in areas related to land, financing, foreign exchange and repatriation of profits. An existing company which reinvests qualifies for the same incentives for a period of 5 years.

For the purpose of trade/import policy, incentives include a double deduction on freight rates for the export of cassava products, waiver of import duties on capital goods imported, duty-free imports of spare parts up to 15 per cent of capital goods imported and exemption from custom duties or import taxes on raw materials. Meanwhile, in the area of research and extension, the objectives are to establish a self-sustainable Cassava Research and Development Fund (CRDF), to develop and implement a refocused and revitalized research and development program with agronomic management practices, new high yielding and disease and pest resistant varieties for various market segments. Additionally, there is the need to provide institutional support to CARDI and other relevant research and development outfits to conduct prioritized cassava research, as well as to encourage private sector research on cassava and cassava-based products. Other intentions are to:

1. Encourage and support research on value addition and post-harvest handling;
2. Improve the flow of information on cassava production and use to farmers;
3. Improve skills among the extension workers involved in cassava production;
4. Establish collaboration with renowned international institutions involved in cassava research and development; and
5. Institutionalize the farm field school methodology to strengthen linkages between research, extension and farmers.

Marketing policy intervention is geared towards the promotion of market information systems that help the growers, traders and processors in increasing the efficiency of cassava marketing, minimizing transaction costs and enhancing transparencies. They also aim to support the establishment of a Cassava Growers' Association, and to increase the efforts in marketing new cassava-based products, in order to overcome stigma from the consumers through increased budgetary allocation. These interventions should be successful in enhancing the competitiveness of cassava-based products in the market especially where there is stiff competition from other raw materials such as wheat and maize, as well as encourage a constant supply of cassava-based raw materials.

Processing policy interventions on the other hand entail the introduction of tax exemptions to encourage the processing of various cassava-based products, and through an act of parliament, a National Policy to allow minimum levels of substitution of wheat with cassava flour for bread

and other baked products, as well as confectionaries. Quality standards are to be developed for all products. This will make it mandatory for all feed millers to include a minimum percentage of cassava chips as one of their raw materials, and provide tax incentives to millers utilizing cassava as a raw material, in the form of tax relief. There will be collaboration with the Bureau of Standards in the review, formulation and implementation of standards of quality, labelling, packaging and marketing of cassava and cassava-based products. Additionally, the industry will be encouraged to purchase and install modern processing plants through tax incentives and exemptions.

Utilisation and consumption policies should be geared towards the promotion of greater incorporation of cassava in animal feeds through voluntary agreements, mandatory introduction of minimum quantity of cassava in school meal programmes, and the promotion of the use of cassava in other food products. Awareness also needs to be created among the potential consumers on importance of cassava-based products, while providing to them incentives for consumption in the form of a favourable tax regime. Finally, regarding a financial policy for the cassava industry, the thrust should be towards the establishment of a Cassava Industry Development Fund as a special window within the CARICOM Development Fund.


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Session 5

Way Forward Collaboration and Actions

(Group Discussions & Reporting)

Session Chair

Ms. Jean Lowry

Inter-American Institute for Cooperation on Agriculture (IICA)

Group 1: Road Map for Production Approaches – Small Scale and Large Scale

Production constraints across the region include the following:

1. Quality and quantity of planting material;
2. High costs of input;
3. Lack of knowledge or information;
4. Training and Extension; and
5. Availability of Labour.

These however can be addressed in various ways. The establishment of mass propagation facilities in each country, along with the establishment of a regional certification and distribution system can aid in addressing the constraints associated with the quality and quantity of planting material. The adaptation of sustainable and efficient agronomic practices (more locally produced inputs); along with shared service acquisition through private sector partnerships can reduce input costs. Meanwhile, industry driven research and development, greater collaboration to source funding, and increased networking between researchers and industry stakeholders (industry driven research) will alleviate the information sharing challenges.

Capacity building of extension officers and farmers will help increase the cadre of extension farmers and will in turn alleviate the issue faced which relate to training and extension. Mechanization and movement of labour can also help reduce the challenges related to the availability of labour.

Group 2: Road Map for Processing Approaches – Small Scale and Large Scale

In terms of processing within the cassava industry, existing constraints include the absence of quality control standards both as it relates to grading and food safety. The lack of research and development capacity to handle the technical, business model and scientific needs of the industry, for example the limited amount of appropriate machinery for processing are also challenges. Processing challenges also include issues related to the supply chain, such as labour, market intelligence, demand and price planning, post-harvest logistics, costs of raw materials, labour and machinery, as well as financial support.

In efforts to address the challenges outlined, various strategies can be employed through assistance from different entities (**Figure 5.1**). In terms of quality control, standards can be incorporation from across the field. Effective market communication based on product requirements and price can be used to address the issue of grading and protocols set for use in the field and in the factory to address the issues related to food safety. In order to identify which machinery is appropriate for processing, information needs to be obtained on how much can be produced per day, and machinery design based on true output and market demand. Research and development is also needed to assist in the innovative marketing of new products.

In addressing the existing labour challenges, there is a CARICOM agreement in place which facilitates skill labour movement across the region. Stakeholders should continually invest in marketing intelligence which should be made available to small and medium farmers. Markets and processes should be fully developed, that is, machines in place, tested, and ready for production, before engaging farmers in production.

In terms of pricing, if farmers are engaged in the processing and are also partners and or investors, they will be more willing to accept low prices for their product. In order to reduce losses and wastage, there should be efforts to minimize delays within the field (harvesting period - pruning, curing, packaging, field grading), as well as from the field to the processing plants and markets

(transportation, quality and time). Support from institutions, along with subsidies and other incentives could also help to cut costs in the acquisition of raw material, labour and machinery. Finally, the provision of low interest loans, credit facilitation, and grants will help relieve some of the financial pressure associated with the cassava industry.

Table 5.1. Organisations and Institutions Involved in the Strategic Vision for Processing within the Cassava Industry – Small and Large Scale

Organizations that facilitate the process	Organizations and Institutions that could offer innovation options and support services to the agro-industrial cassava chain	Private Sector Organizations that demand innovation and support services from the agro-industrial cassava chain
Ministry of Agriculture- Suriname	Institute for Food and Management (IFM) - Suriname	Pinnacle Feeds (Barbados)
CELOS (Suriname)	CELOS (Suriname)	Red Stripe (Jamaica)
Institute for Food and Management (IFM) - Suriname	UWI – Mona (Jamaica)	PCI Rojas (Costa Rica)
UWI – Mona (Jamaica)	UWI – St Augustine (Trinidad and Tobago)	Pinnacle Feeds (Barbados)
UWI – St Augustine (Trinidad and Tobago)	BADMC - Barbados	
Ministry of Food Production - Trinidad and Tobago	CLAYUCA	
FAO		
CLAYUCA		

Group 3: Road Map for Marketing – National, Regional and Global

The first constraint identified within the region in the area of marketing and promotion is the existing information gap regarding the nature of the demand for cassava products – mainly the 'who', 'why', 'where' and 'when'. The proposed solution for this constraint is to conduct market research by country and market segment (domestic and export markets). Another constraint is the lack of evidence-based information to support the health and animal productivity claims made about cassava and cassava products. This can be remedied by conducting research on the various products and consuming populations (literature and chemical analyses of the various varieties).

Another constraint identified is the stigma attached to cassava as 'poor people food', and this can only be addressed by shifting the focus of cassava to the products' benefits. Inadequate product range is another issue, which may be addressed through innovative product development strategies including a regional product development centre linked to the various universities. In addition there is the need for a competitive pricing strategy, which can be determined by assessing the current cost of production, margins, and efficiencies along the chain. Cost reduction can be achieved by increasing productivity and efficiency along the value chain, as well as careful positioning and innovative promotion of targeted production in targeted market segments. The last constraint identified is inadequate business/market service support which can be addressed by establishing/strengthening business/market support strategies.

As it relates to resource mobilization there is the need to link the characteristics and attributes of cassava to relevant global funding sources, engage the major industry players in providing development funds to remove identified marketing constraints, as well as putting in place relevant government policies for resources to support industry development initiatives.

Group 4: Road Map for Policy and Research

The countries within the region can be considered as one single productive space. Heads of Governments have called for development in various sectors to address the current state of economic decline within the region. Member states have identified agriculture as one of the key sectors which possesses the potential to bring about economic change. Currently the region imports roughly US$4.3 billion worth of food each year, of which US$400 million is spent on wheat and corn imports. As such, the cassava industry has been identified as a key agricultural sub-sector to promote agro-industrial development through the various interagency groups on agriculture. Some of these groups include Caribbean Agricultural Research & Development Institute (CARDI), the Food and Agriculture Organization of the United Nations (FAO), Inter-American Institute for Cooperation on Agriculture (IICA), Caribbean Farmers Network (CaFAN), the University of the West Indies (UWI), Caribbean Agribusiness Association (CABA), the Organisation of Eastern Caribbean States (OECS) and the Caribbean Community (CARICOM).

The environment required for the cassava industry to move forward was discussed, using as an example, the Trinidad and Tobago experience. The likely solutions to address the existing institutional issues include the formation of a formal regional stakeholder body which is recognised by the Council for Trade and Economic Development (COTED) as an umbrella body for other existing national bodies. Also research and development is required, along with the development of food safety standards, health and nutrition information and standards, marketing strategies, the establishment of rural development policies and land policies, along with relevant finance and business plans.

Recommendations include the provision of incentives to facilitate the scaling up of cassava production. This could include the enactment of a cess on wheat imports, the provision of investment packages based on existing and required policies for small and large investors, scaled incentives on targeted outputs being met, for example land rental, the investment of taxes in agribusiness and an appropriate legislative and regulatory framework to address the needs of the industry. Risk mitigation strategies could also prove useful, especially as it pertains to addressing climate change, pests and diseases.

Summarily, as it relates to moving the cassava industry forward, there are five key policy areas that need to be addressed:

1. Legal and regulatory framework which will in turn lead to a common cassava policy;
2. Health and food safety including issues related to perishability and cyanide content;
3. Private sector participation;
4. Productivity and competitiveness; and the
5. Review of existing national and regional policy for an integrated policy framework.

Discussion

Questions/Comments	Responses
Regarding marketing, the impression was given that there was as much interest in the export market as the regional markets. In this first phase of the development of the cassava industry, the aim should be to see how much can be achieved regionally, as opposed to trying to focus on importers in the USA for example. The best move would be to market the product regionally for the next few years initially, rather than targeting products in the US market. Efforts should be geared towards competing with products placed on local markets by the US.	It is not a good idea to exclude the collaborative efforts of markets within the region. The question does however need to be asked: 'Do we need to be focusing on exports at all?' In Jamaica for example, the production of bammy is an export oriented initiative. For short term potential however, it is practical to focus interests within the region. It is not a matter of this or that. There is no luxury of taking things in stages since the Caribbean economy is facing a serious economic crisis. The reality is that developing an internal market and then transitioning it into an export market will prove extremely difficult. Notwithstanding, an export experience may also help some of the local and regional marketing issues.
It has been noted that there has been a lot of investment into product development, however there is merit in looking at products that already exist. These products need to be properly marketed and commercialized.	-
There are some processors in the region which are fighting to upgrade their products in order to meet international standards. It is therefore not bad to look at the domestic market first. It is critical however to ensure that locally marketed products meet international standards since even when marketed locally, products are competing with overseas products, in the local market.	-
While the primary consumers are the industry, the final consumers are the people within the region and the rest of the world. It is critical to meet the need of the consumer. In order to meet the demand of putting cassava in products, this will require a high productive capacity and will include getting consistent and high quality product to meet the demand and protect the brand image within the market. A good strategy would therefore be to act small and think big.	Implications of legislative changes and the development of the industry should be framed to meet the evolutionary changes of the cassava industry.
Products need to be branded and be consistent as it relates to quality. These efforts also require significant investment in the areas of branding, marketing and production. In approaching CARICOM for example, it is better to find buyers and have them aid in driving the arrangement through CARICOM.	Product development goes beyond just the process of making a project. The Caribbean for example is driven by television to a large extent. The region now eats what everybody else eats. These are some of the things which drive demand and markets.

Questions/Comments	Responses
We shouldn't be afraid of products coming from overseas to challenge local products. These challenges should be embraced as the end result is usually the creation of higher standard products. Additionally, the regional culture which shows a lack of trust for locally made products requires a culture change. People need to be proud of their own products.	Efforts should be concentrated on promoting the use of cassava, and encouraging investment and commitment. This is with the aim to increase and address domestic and regional demand. This also includes domestic products which are exported.
Sales are based on a certain amount of production and as such it is critical to focus on the market and the structure of the business. Too many times, industries are built upon the work of small producers, which in some cases may not be able to meet demands.	It is critical to identify at which level challenges occur. Is it at the level of the producer, during manufacturing, the marketing, or the consumer? Each of these issues needs to be specifically addressed.
Agro-business models are required at each country level. Cassava production may not be profitable for farmers for specific types of products. A solution could be to make farmers part-owners of the process. Distinctions also need to be made in terms of 'food-grade' cassava, which may be different from cassava used for different purposes. The strategy of attempting to solve all problems at once will not prove successful. Production costs for persons farming one acre of cassava versus 100 acres of cassava is entirely different.	In terms of marketing information systems and production, the timing of production and production forecasting is critical, and this has proven to be a difficult exercise. These initiatives should be included in the development of a cassava information system in order to identify the specific projected supply, taking into consideration weather and other factors.
As a local industry, the information given to the public should not conflict with the reality as this will create a problem. For example, promoting cassava consumption when the available supply is limited.	In some regions, even though the crop is produced, there is uncertainty as to what to do with the product. It has been found to be more successful when the process is owned by the farmers. Notwithstanding, in terms of exporting, there is a difficulty in addressing the traceability of the product. An established system could therefore facilitate the process of traceability, which can aid in maintaining quality standards. Waste management is another factor, since the more that is produced, the more that will be wasted. This is a major factor to take into account.
Locally branded products are a good idea – specifically having locals be directly invested and participating in the value chain. The key is to include the small holder.	-

Session 6

Closing Session

Session Chair

Dr. Deep Ford

Food and Agriculture Organization of the United Nations (FAO)

Way Forward

Suriname

In moving forward, a good strategy would be the formation of a body designated to the development of the cassava industry with representatives from the Ministry of Agriculture, a research body - for example a regional university, farmers' organisations, large farmers marketing organisations, processors, financial institutions and non-governmental organisations (NGO's).

An analysis of the cassava agro-productive chain reveals the various ways in which cassava can be marketed. Cassava can be marketed as a local produce on the fresh market, as well as a frozen product. The product can be used for the production of feeds (maize substitution), as well as processed into cassava flour. There are several problems and constraints associated with this however; these include access to markets (distance and quality), product improvement, lack of technology, limited availability of technical data on cassava varieties, limited availability of knowledge on sustainable farming systems, and lack of funding. In terms of competitiveness along the value chain in Suriname, other challenges include lack of government support of agricultural policy and improving productivity per hectare. There is however land and infrastructure available, as well as a processing plant already in place. Technical support is also available through the Food and Agriculture Organization of the United Nations (FAO) and Inter-American Institute for Cooperation on Agriculture (IICA).

Discussion

Questions/Comments	Responses
You have trained several thousand farmers so far. How many of these are old farmers and how many are new?	Most of them are not young people. Young people are not motivated to enter into farming. The main complaints are a lack of governmental support. There is a lack of motivation also due to level of sacrifice required to be a farmer, for example, the amount of farming land that existed has also reduced significantly, as these lands have now been used for building houses as opposed to cultivation.
There is a lot of frustration and demotivation due to an unwillingness to enter into a contract with farmers. Additionally, the factory was ill equipped, there was poor/wrong choice of equipment, start-up was slow, and there was not enough energy available to run the factory in that area. Start-up has also been slower than the farmers had initially anticipated. Tension also exists between producers and farmers.	-

Barbados

In Barbados, there are currently 206 acres of cassava planted, in plot sizes of approximately 0.5 – 10 hectare plots. The average yield is 20 tons per hectare. Cultivars include sixty (60) varieties imported from Columbia and four (4) varieties brought in by the Caribbean Agricultural Research & Development Institute (CARDI). Some of the local varieties are however uncharacterized. Current production costs are unknown in Barbados, and that is a gap which needs to be filled. The present farm gate price is stable at $2.00BD per kilogram. A preliminary analysis therefore needs to be done. Current markets include two grades of flour which are sold to supermarkets, fresh grated cassava which is sold to bakeries and supermarkets, frozen grated cassava, and dried cassava chips.

Currently, the problems associated with the cassava industry in Barbados include pests and diseases, the need for variety evaluation and market surveys, praedial larceny, limited extension support, harvesting and training challenges. In terms of competitive potential, energy costs relative to production costs are excessively high. There is also the challenge of matching equipment to the respective operations, and scale of production.

Potential markets include various institutions, for example, through various school feeding programmes and in geriatric homes, health food stores, supermarkets, bakeries, restaurants and hotels. The common objective is therefore to tap into these various markets and to develop a comprehensive plan for managing the germplasm. In order to develop a structured cassava industry that will reduce the food import bill and improve the health of Barbadians, it will be important to prioritize agriculture, study the production costs at various levels, conduct extensive market surveys, while carrying out numerous public education campaigns on cassava and cassava based products. Additionally, there is a pilot programme geared towards integrating farmers into the value chain. From the pilot project, the opinions of farmers (**Figure 6.2**) and technical personnel (**Figure 6.3**) were sought

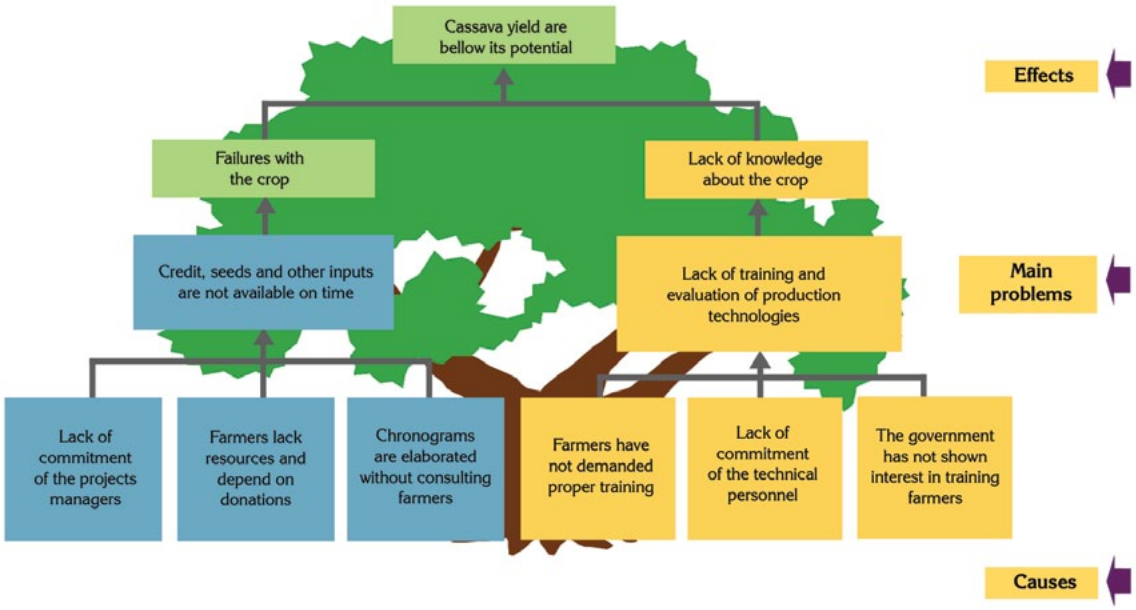

Figure 6.1. Analysis of Cassava Production Problems in the Pilot Project Site - Opinions of Farmers

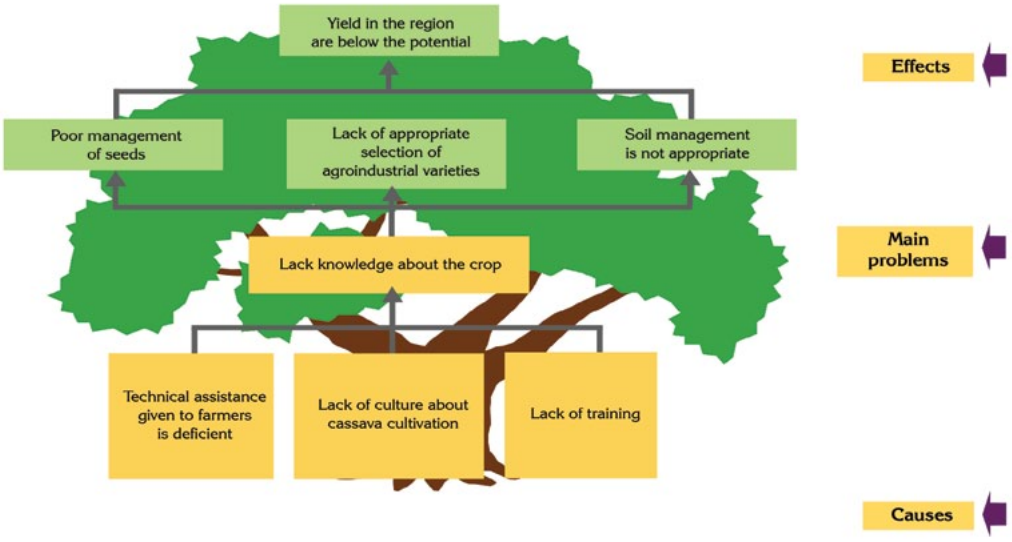

Figure 6.2. Analysis of Cassava Production Problems in the Pilot Project Site - Opinions of Technical Personnel

Discussion

Questions/Comments	Responses
Are there issues with the age of persons doing agriculture in Barbados? What is the root of the problem and what are some of the possible solutions?	They need to be better engaged, for example, in this discussion which involves opportunity for business and a career. Discussions of this nature – agriculture as a business- especially from people who have the knowledge and insight is also a factor. Public education campaigns can also prove profitable.
After reduced interest in cassava, there was a reduction in acreage and resultantly consumption. The intent was to provide direct support, but funds were limited. There were difficulties in terms of how to proceed and provide support in the form of a policy commitment and the availability of funds to support the initiative.	Interest in cassava is directly linked to cassava consumption. This needs to be supported by sound and strategic policies.
Have there been any projections of the acreage which the government would like to dedicate to this crop?	Markets for the flour were explored, as well as markets for the feed. There was a vision of about 3,000 acres of cassava in Barbados.
From which perspective is a pilot programme for the integration of small farmers into the process?	A suggestion was made for farmers to be trained in a farmer field school setting where they would be shown how to create value from the product, as well as aided in the development of different business models to support the cassava value chain. The possibility for a farmer's cooperative to be tied into the factory was also envisioned – this would be operated by way of a private-public partnership.

Questions/Comments	Responses
The actual programme was started in 2008, and it was expected that there would be a lot more private sector participation. This was in fact the intention of the initiative. Notwithstanding, the initiative lacks vision, and there is the absence of a private sector playing a leading role. This has limited its ability to move at an acceptable speed.	Additionally approaches can be tested, for example allowing farmers to control all three segments of the chain – production, processing and marketing.

Jamaica

In Jamaica, the objective is to develop the capacities of the farmers to improve the management practices and the profitability of the cassava crop. The value chain is depicted in **Figure 6.3** Specific activities involved in achieving this objective include:

1. Developing a master training and technical assistance plan;
2. Developing mass propagation facilities;
3. Establishing shared services and acquisition facilities;
4. Developing low technology equipment for mechanisation;
5. Mechanisation;
6. Conducting trials with active participation of farmers to evaluate the different options available for cassava crop management;
7. Developing a cassava planting chronogram between farmers groups and support institutions that facilitates identification and timely processing of credit and inputs requirements; and
8. Training and formation of technical assistance personnel.

The other main objective for the cassava industry in Jamaica relates to commercialization. It involves the exploration of the different markets (fresh cassava for different markets, wax-coated fresh cassava for human consumption, dry cassava chips for animal feeding, cassava leaves, cassava flour, and cassava silage), and conduct pilot trials with each technology. Here the specific activities involve the following:

1. Hands-on training period for farmers and technical personnel in cassava processing plants that use natural drying technology;
2. Formation of groups with farmers and technical personnel, to conduct study-tours and visits to the market options selected as those with more potential, in order to obtain additional information and conduct a more in-depth analysis of each potential market;
3. Evaluate technological and marketing options with farmer participation on cassava leaves, cassava flour, cassava silage as well as animal balanced feeds; and
4. Propose pilot projects with the market options chosen.

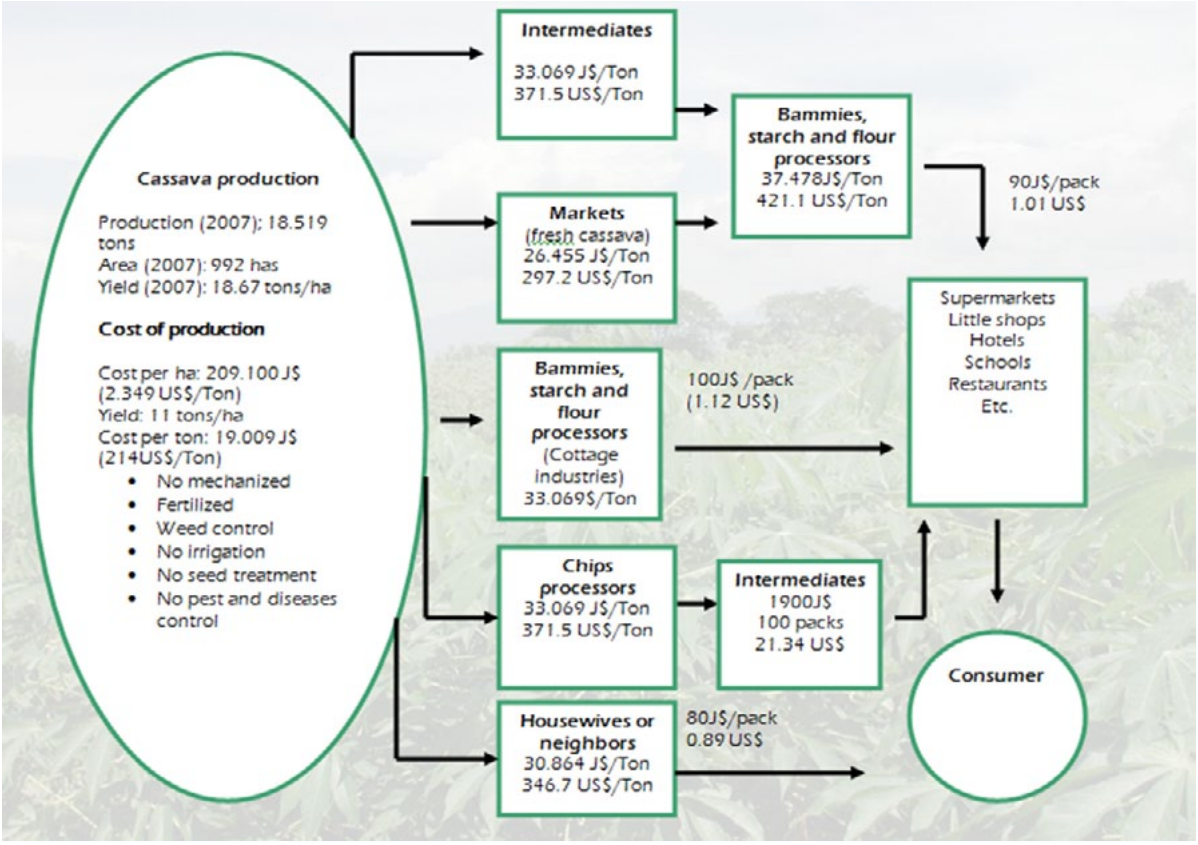

Figure 6.3. Cassava Chain in Jamaica (2009).

Discussion

Questions/Comments	Responses
Are there issues with the age of persons doing agriculture in Jamaica? What is the root of the problem and what are some of the possible solutions?	For cocoa for example, the average age of farmers was 69. So the same issue exists in Jamaica. One of the strategies employed by Red Stripe is to train 18- 25 year olds. To date, 40 persons are being trained to be the next generation of farmers to be trained, certified and keep the farming going for the next 20-25 years. The intention is also to have persons involved in farming from as early as Grade 7 CARDI is also leading a process to set up demo plots in Jamaica, set up technology packages and training in extension programmes. These are all strategies being explored in terms of implementation. The Ministry of agriculture is also involved and the initiative is a partnership among all the players.
When will these initiatives be enacted?	By June the initiative will be operational including a pilot plan, new building and relevant support systems. A factory has also been constructed for the brew to be marketed in September.
How do you address the issue of small plots and what mechanism is in place to increase production?	A two-tiered strategy is required to include small farmers. A lot of flat land still exists and these will be utilised in order to meet the needs of the agro economic system.
Are these lands former cane lands?	Some, not all. Some are former bauxite and alumina lands which are being reclaimed.

Organisation of Eastern Caribbean States (OECS) Countries (Grenada, St. Vincent, St. Lucia & Dominica)

This group is made up of the islands of Grenada, St. Vincent and the Grenadines, St. Lucia and Dominica. In these countries, cassava will function as a complementary commodity to the banana industry which will allow for the development of value added products which will in turn contribute to foreign exchange, poverty reduction, livelihoods and food security in a sustainable manner. This is consistent with the OECS development plan of action. Within the plan of action the specific objectives are:

1. Marketing and promotion among the public and private sector to create awareness on the importance of the cassava industry to get their acceptance;
2. Engaging in the necessary research and development for technical and agri-business development of the industry;
3. Conducting an industry assessment to determine the industry national demand;
4. Identifying the appropriate Business model ;
5. Developing an industry plan with the involvement of all the stakeholders; and
6. Forming a national task force that will drive the industry.

In achieving this end, the various groups of stakeholders which may play a role are displayed in **Table 6.1**.

Table 6.1. Organisations and Institutions Involved in the Strategic Vision of the Cassava Industry for the Organisation of Eastern Caribbean States (OECS)

Organizations that facilitate the process	Organizations and Institutions that could offer innovation options and support services to the agro-industrial cassava chain	Private Sector Organizations that demand innovation and support services from the agro-industrial cassava chain
Ministry of Agriculture	Agricultural Research Agencies	Farmers Organizations/ producer groups
Agricultural Research Agencies (CARDI etc.)	Technology Transfer Agencies	Private Sector Companies (micro, medium and Large operators)
Chinese Technical Mission	Universities	Farm families and farmers
Taiwan Technical Mission	Government Ministry	Agro- processors
UWI	Banks	
Technology Transfer Agencies	Credit unions, NDFD, OECS Secretariat	
FAO	FAO	
OECS task force	IICA	
CARIRI	CIAT	
BOS - CROSQ	CLAYUCA	
IICA		
CLAYUCA		

Within the OECS, the current area of land under cassava production is less than 200 acres. The cost of production is on average EC$8,500.00 per acre, with a yield of 20,000 tons per acre. Average costs are estimated at US$244.00 or EC$660.00. Existing constraints to production include:

1. Lack of mechanization;
2. Inadequate fertilizers;
3. Poor weed control;
4. No irrigation;
5. Limited seed treatment;
6. Pest and disease control; and
7. Bitter and sweet varieties being planted together.

Market segmentation along the value chain is the same for the OECS as in Jamaica. Here fresh markets account for 15 per cent, farine and cassava bread account for 80 per cent and cassava chips and starch are responsible for the remaining 15 per cent of the market. Existing cassava products being produced by the OECS include fresh cassava roots, peeled root chips, peeled and vacuum packed cassava, farine, bammie/cassava and cassava pone. New products to be explored are cassava flour, cassava chips for animal feed, cassava logs, cassava cereal and khurma. There is also a desire within the OECS to explore the use of cassava leaves for feeding small ruminants, and the wax coating of cassava tubers for export markets.

Discussion

Questions/Comments	Responses
How come the yield is so high?	It may be due to the nature of the indigenous varieties, as well as the rainfall. Improved varieties produced 40,000–60,000 pounds per acre, making the yield of these improved varieties almost 3 times higher in some cases.
For all the products being proposed, the volume of production may need to be increased. Is land available?	Challenges in doing this include the competitiveness of the banana industry since the removal of the preferential market, including price constraints. This has forced many farmers to either abandon lands or shift into other commodities. Other issues with bananas include moko and black sigatoka diseases for example; have caused farmers to leave the banana industry. It is however unsure as to whether cassava could replace bananas, and instead of referring to it as a replacement crop, it could be considered to be more of a complementary crop.
In the process of looking at export increase, have you looked at Guadeloupe, Martinique and indirect trade?	This has been explored and trial shipment is to be explored soon.
Are there any categorisations of the cassava varieties within the OECS?	Some work was done in St Kitts and Trinidad.

Trinidad and Tobago

Trinidad & Tobago has been working towards improving their cassava industry since 2006. Some of the lands required for the development of the industry have already been acquired, and the commodities chosen for marketing are those which absorb most of the cassava produced, which is flour. Several issues are however involved in putting together a viable cassava industry development plan. These include the conduct of a situational analysis of the cassava industry, along with a baseline study on the production and supply of cassava, and a consumer survey.

Price support for the industry will be required in the form of an initial capital investment, as well as the mandate for institutional buyers to use a certain percent of cassava product in their systems. Special incentives can be offered to farmers and bakers, along with promotions through various ministries and institutions. Issues in processing relate to investments, capacity building, technology acquisition, machinery and food safety protocols. Production issues in Trinidad and Tobago involve the availability of planting material and good agronomic practices. Meanwhile, harvesting challenges relate to mechanization, the use of private harvesting services, and the traceability of cassava products. Additionally, there are waste management issues related to the disposal of waste products from cassava manufacturing.

Table 6.2. Organisations and Institutions Involved in the Strategic Vision of the Cassava Industry for Trinidad and Tobago

Organisations that facilitate the process	Organisations and Institutions that could offer innovation options and support services to the agro-industrial cassava chain	Private Sector Organisations that demand innovation and support services from the agro-industrial cassava chain
NAMDEVCO	UWI	NAMDEVCO
Ministry of Food Production – Trinidad and Tobago	CARDI	Bakeries
UWI – St Augustine (Trinidad and Tobago)	THA	NFM Mills
CARDI	UWI – St Augustine (Trinidad and Tobago)	TTABA/CABA
IICA	CLAYUCA	Food Processors
FAO		
CLAYUCA		

Discussion

Questions/Comments	Responses
Listening to the member states, it all sounds positive and there is a lot of interest and enthusiasm which needs to be pooled so that the interests can be kept alive. In terms of the member states the interest was more inward, and this will require policy support at a national level. This will also require buy-in at the political level. What can be done between now and October to bring something to the ministers at the agricultural ministers meeting, which is usually followed by a higher level meeting? Is it possible to set some timelines in order to have something brought to the fore at these high level meetings, which should include a demonstration of the potential, yields and successes associated with cassava production. What is on the ground working currently? What are the major projects with funds to support industries? How can we make cassava work?	-
Marketing needs to be very specific and accompanied by public education programmes.	-

Closing Remarks

Deep Ford

The time for cassava has come and we should all work together to move this product and the industry ahead. Resources are available and collaboration will be facilitated in order to achieve success. Given the plethora of commodities, there needs to be emphasis on which products are to be championed. The value added by this conference is the formation of alliances which will contribute to the development of the cassava industry not only in each country, but also across the region.

A lot of information has been shared in this conference regarding the production, harvesting and processing of cassava. Machinery was introduced which could increase productivity at all of these levels. A lot of recommendations have also been made and I am confident that these will be pursued at the national level. They pertain specifically to the area of training and policy. Training to increase production and processing, policy to provide regulations and incentives for a cassava industry that produces products that meet all the necessary food safety standards. Trade policy is another area which will require additional work and exploration, especially as this pertains to imports. The regional cassava working group that FAO chairs should be used to ensure that the communication continues and includes monthly updates on the state of the cassava industry across the region. With this conference there is now a general appreciation for what is taking place in the cassava industry across the region and we leave with a lot of hope related to the opportunity presented by cassava.

Additionally, as we go forward, there will be the building of a formally recognised stakeholder lobby, for example, a cassava association which is to be formalised to lobby on behalf of the cassava industry across the region. The demand being targeted needs to be better understood in terms of yield, processing opportunities and consumer interests. Some brief fact sheets could be developed in order to speak to these aspects of the value chain. The food import bill for each country should be analysed and targets and phasing for replacing some imports with cassava should be clearly established. A common cassava policy also needs to be developed along with a plan for how it will be tabled and implemented across CARICOM. Practical production costs also need to be addressed, including management systems and profiles which outline possible returns on investments. Support is also required from research and development institutes. The issue of aging farmers is also something that needs to be addressed – particularly strategies which can be adopted in order to bring youth into the sector. There needs to be a programme that somehow excites youth to get into the production of cassava.

Let me close by saying that we greatly appreciate all the work done by the different organisations, agencies and countries in promoting the arguments for increased focus on cassava. Special thanks are to be extended to the UWI Cave Hill Campus representatives, collaborators in the administrative processes for this conference, to the Inter-American Institute for Cooperation on Agriculture (IICA) and the Caribbean Agricultural Research & Development Institute (CARDI) for their technical contributions. I also want to recognize the farmers, processors, policy makers, academics and all others who have contributed to making this conference a success. As we go forward governance at all levels will be essential and we look forward to all leaders playing their part.

Finally, thanks to all FAO colleagues who worked very hard in making this Conference a reality. In this regard, I would like to single out Dr Vyjayanthi Lopez, our regional plant production and protection specialist for leading the efforts and working tirelessly on all the technical and administrative aspects needed to be addressed in a conference such as this one. Best wishes for a safe trip home is extended to all those travelling back to their respective countries across the region.

Annex

AGENDA Regional Conference - Cassava in the Caribbean and Latin America

The University of the West Indies – Cave Hill, Barbados. 12-14 February 2014

DAY 1 – 10 February 2014		
0800 – 8300	Registration	FAO / UWI
	Opening Session	
0830 – 0845	Dr. J R Deep Ford, Coordinator - Caribbean Sub-Region, Food and Agriculture Organization (FAO)	Welcome remarks
0845 – 0900	Ms. Nisa Surujbally, CARICOM Secretariat.	Welcome remarks
0900 – 0910	Dr. Cyril Roberts, Caribbean Agricultural Research and Development Institute (CARDI)	Welcome remarks
0910 – 0920	Ms. Jean Lowry, Inter-American Institute for Cooperation on Agriculture (IICA)	Welcome remarks
0920 – 0940	Professor Sir Hilary Beckles, Pro Vice-Chancellor of the University of the West Indies (UWI) and Principal of the Cave Hill Campus	Welcome remarks and launch of the UWI Campus Centre for Food Security and Entrepreneurship
1030 – 1100	Coffee break and display of cassava products	
	Session 1: State of Cassava in the Region	Chairperson: Nisa Surujbally, CARICOM Secretariat
1100 – 1120	Why Cassava Industry Now?	Deep Ford, SLC
1120 – 1140	Global marketing trends	Adam Prakash, FAO
1140 – 1210	State of Cassava in Latin America	Bernardo Ospina, CLAYUCA
1210 – 1240	State of Cassava in the Caribbean	CARDI
1240 – 1300	Constraints and Challenges – Caribbean perspectives	Vincent Little and Vyju Lopez, FAO
1300 – 1330	Discussion on State of Cassava in the Region	
1330 – 1500	Lunch	
	Session 2: Sustainable Intensification of Production	Chairperson: Mr. Leslie Brereton, Ministry of Agriculture, Barbados
1500 – 1515	Grower perspectives: CAFAN	CAFAN Representative
1515 – 1530	Cassava Global and Regional Production Systems and relevance to the Caribbean and Latin America	MakikoTaguchi and Alberto Pantoja, FAO
1530 – 1550	Land and water availability for sustainable cassava production	Lystra Fletcher Paul and Jan Van Wembeke, FAO
1550 – 1610	Mechanization for commercial and family farming cassava production	Josef Kienzle, FAO

1610 – 1630	Post-harvest loss management along cassava value chain	Majeed Mohammed, UWI
1630 – 1650	Coffee break	
1650 – 1710	Feasibility study for sustainable cassava intensification in countries of LAC: economic and social aspects, successful experiences in LAC and recommendations.	Bernardo Ospina, CLAYUCA
1710 – 1800	Discussion on Sustainable Intensification of Production	
END OF DAY 1		

DAY 2 – 11 February		
0800 – 0830	Recap of Day 1	FAO
	Session 3: Demand for Cassava Products and Commercialization	Chairperson: Dr. Cyril Roberts, CARDI
0830 – 0850	Processing perspectives: small-scale producer	Adrian Kirton, Barbados
0850 – 0910	Cassava replacing wheat flour	Vassel Stewart, CABA
0910 – 0930	Cassava replacing corn in animal feed	Tito Diaz and Cedric Lazarus, FAO
0955 - 1015	Cassava replacing barley malt in beer	Damian Graham, DIAGEO, Jamaica
1 0 1 5 – 1035	Feasibility analysis: Cassava large scale production and industrialization, including Technological innovations	Bernado Ospina, CLAYUCA
1035 - 1105	Coffee break and display of cassava products	
1105 - 1125	Tobago Experiences with cassava development	Pathleen Titus, Tobago House of Assembly (THA)
1 1 2 5 - 1155	Costa Rica Experiences with cassava development	Rocio Valerio Rodriguez, PCI Rojas
1155 - 1300	Discussion on Demand for Cassava Products and Commercialization	
1300 – 1430	Lunch	
	Session 4: Cassava Policy, Marketing and Financing Issues	Chair: Dr. Angela Alleyne, UWI
1430 – 1450	Commercialization and marketing of cassava and cassava products: Challenges and Opportunities	Robert Reid, IICA
1450 –1510	Financing and Investment for Cassava Industry Development – Criteria and Opportunities	Luther St Ville, CDB
1510 – 1530	Policy Incentive Framework for Cassava Industry Development in the Caribbean	Vincent Little, FAO
1530 – 1600	Coffee break	

1600 – 1630	Discussion: Cassava Policy, Marketing and Financing Issues	
END OF DAY 2		

DAY 3 – 12 February 2014		
	Session 5: Way Forward – Collaboration and Actions	Chairperson: IICA
0800 – 1200	Group Work – country groups to develop National Action Plan / Road Map	
	Group 1: Barbados	
	Group 2: Jamaica	
	Group 3: Suriname	
	Group 4: Trinidad and Tobago	
	Group 5: OECS Countries	
1200 – 1330	Lunch	
1500 -1630	Presentation of Road Maps by Country Groups	
1630 - 1700	Coffee break	
	Session 6: Closing Session	Chair: Deep Ford, FAO
1700 - 1815	Way forward and next steps	
1815 - 1830	Closing of Workshop	FAO, UWI
END OF DAY 3		

Conference Attendees

Name			Country	Organisation
Mr.	Norville	Abraham	St. Vincent & the Grenadines	Government of St. Vincent and the Grenadines
Mr.	George	Alcee	St. Lucia	OECS Secretariat
Dr.	Angela	Alleyne	Barbados	UWI
Dr.	Chadwick	Anderson	Jamaica	University of the West Indies
Mrs.	Omaira	Avila Rostant	Trinidad and Tobago	Government of Trinidad and Tobago
Dr.	Ospina	Bernardo	Colombia	CLAYUCA
Dr.	Dennis	Blackman	Barbados	Ministry of Agriculture
Ambassador	Chelston	Braithwaite	Barbados	Government of Barbados
Mr.	Leslie	Brereton	Barbados	Ministry of Agriculture
Mrs.	Beverly	Darby Collins	Jamaica	Government of Jamaica
Dr.	Tito	Diaz	Chile	FAO
Mrs.	Lystra	Fletcher-Paul	Barbados	FAO
Ms.	Olivia	Franklyn	Barbados	Ministry of Agriculture
Mr.	Ganesh	Gangapersad	Trinidad and Tobago	NAMDEVCO
Mr.	Ian	Gibbs	Barbados	Ministry of Agriculture
Dr.	Humberto	Gomez	Trinidad and Tobago	IICA
Mr.	Damian	Graham	Jamaica	Red Stripe
Mr.	Hesdie	Grauwde	Italy	FAO
Mr.	Lesley	Greig	Italy	FAO Headquarters
Mr.	Nigel	Grimes	Trinidad and Tobago	Ministry of Agriculture, Trinidad and Tobago
Dr.	Winston	Harvey	Barbados	CASSE, Barbados
Mr.	Damien	Hinds	Barbados	IICA
Mr.	Michael	James	Barbados	Ministry of Agriculture
Mr.	Ludlow	Jones	Jamaica	Consultant
Mr.	Peter	Jones	Barbados	Consultant
Mr.	Josef	Kienzle	Barbados	FAO Headquarters
Mr.	Adrian	Kirton	Barbados	Consultant
Mr.	Vincent	La Corbiniere	St. Lucia	Government of St. Lucia
Ms.	Miranda	Laurent	Dominica	Government of Dominica
Dr.	Janet	Lawrence	Trinidad and Tobago	CARDI
Mr.	Cedric	Lazarus	Barbados	FAO
Dr.	Vincent	Little	Barbados	FAO
Dr.	Francis	Lopez	Barbados	UWI
Dr.	Vyjayanthi	Lopez	Barbados	FAO
Ms.	Jean	Lowry	Barbados	IICA
Mr.	Lincoln	Mark	Grenada	Government of Grenada
Mr.	Donovan	McLaren	Jamaica	CAFAN
Dr.	Majeed	Mohammed	Trinidad and Tobago	University of the West Indies

Mr.	Marcus	Mycoo	Trinidad and Tobago	Trinidad and Tobago
Mr.	Rudi	Nelom	Suriname	CELOS
Professor	Leonard	O'Garro	Barbados	University of the West Indies
Dr.	Alberto	Pantoja	Chile	FAO
Mr.	James	Paul	Barbados	Consultant
Dr.	Adam	Prakash	Italy	FAO
Mrs.	Mynie	Ramlal-Ousman	Trinidad and Tobago	Government of Trinidad and Tobago
Dr.	Robert	Reid	Trinidad and Tobago	IICA
Dr.	Cyril	Roberts	Barbados	CARDI
Mr.	Reuben	Robertson	St. Vincent & the Grenadines	FAO
Dr.	Dwight	Robinson	Jamaica	University of the West Indies
Ms.	Camille	Russell	Barbados	University of the West Indies
Mr.	Luther	St Ville	Barbados	Caribbean Development Bank
Mr.	Vassel	Stewart	Trinidad and Tobago	Caribbean Agri-Business Association
Mrs.	Nisa	Surujbally	Guyana	Caricom Secretariat
Ms.	Makiko	Taguchi	Italy	FAO Headquarters
Mr.	Reinier	Taus	Suriname	Institute Food management
Dr.	Morris	Taylor	Jamaica	CARDI
Dr.	Ian	Thompson	Jamaica	University of the West Indies
Ms.	Pathleen	Titus	Trinidad and Tobago	Tobago House of Assembly
Mrs.	Rocio	Valerio	Costa Rica	Costa Rica
Mr.	Ricardo	Vos	Suriname	Feed Mill, Suriname
Mr.	Paimoen	Wongsowikromo	Suriname	Government of Suriname
Mr.	Adrian	Yard	Barbados	Ministry of Agriculture

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