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**CARIBBEAN FOOD
CROPS SOCIETY**

48

**Forty-eight
Annual Meeting 2012**

**Playa del Carmen, Mexico
Vol. XLVIII**

PROCEEDINGS
OF THE
48th ANNUAL MEETING

Caribbean Food Crops Society
48th Annual Meeting
May 20th – 26th 2012

Hotel Barceló Riviera Maya
Playa del Carmen, Mexico

*“Education, Productivity, Rural Development, and Commercialization
in the XXI Century”*

Edited
by
Wanda I. Lugo and Wilfredo Colón

Published by the Caribbean Food Crops Society

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ISSN 95-07-0410

Copies of this publication may be obtained from:

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P.O. Box 40108
San Juan, Puerto Rico 00940

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REPOSITIONING TRADITIONAL STAPLES (ROOTS AND TUBERS) IN THE FOOD BASKET OF THE CARIBBEAN: A CASE STUDY FOR CARDI

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INTRODUCTION

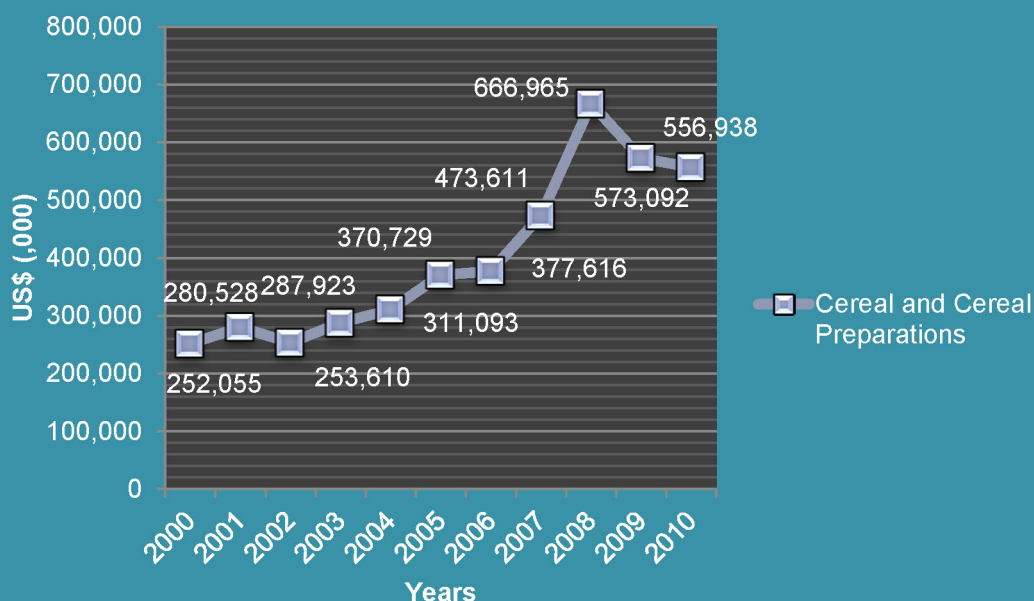
Roots and tubers are described as plants yielding starchy roots, tubers, rhizomes, corms and stems which are used mainly for food, livestock feed and also for manufacturing into starch, alcohol and fermented beverages (FAO, 1994). There are more than 30 species of roots and tubers grown worldwide. However, only a few make an important contribution to world food production, global food and nutrition security, income generation, and poverty alleviation. The most important crops in this group are cassava (*Manihot esculenta* Krantz), sweet potato (*Ipomoea batatas*), yams (*Dioscorea* spp.), and the aroids (*Collocasia esculenta* and the *Xanthosomas*). These are considered major staples and produce large quantities of dietary energy for significant populations in the developing world. Cassava is reportedly the most important in the group and the most important source of calories in the tropics after rice and maize (FAO, 1998).

Roots and tubers are basic food sources but they also function as sources of income in many countries and are therefore important for rural livelihoods. The crops are mainly produced by small farmers using traditional labour intensive methods of production, resulting in low levels of productivity and sub-optimal yields which limit profit margins.

The agricultural sector in the Caribbean Region is influenced by global factors, particularly the rise in price of imported staples and their reduced availability. Carmichael et al. (2009) reported that although CARICOM's food security may not be compromised by a lack of food availability, there are issues of concern related to trends of declining food production and increasing imports (and the related expenditure of scarce foreign exchange). The CARICOM Region imported more than US \$5 billion in cereal and cereal products in 2010 (Figure 1). The consumption of roots and tubers is affected by dietary preferences, urbanization trends and relatively cheaper alternative starches e.g. grains and cereals. Carmichael et al. (2009), also reported a reduction in the production of staples over the past decade, particularly as the demand for wheat and wheat-based products increased because of the change in consumer preferences. Roots and tubers, in spite of their superior nutritional qualities as complex carbohydrates, are being replaced by processed refined carbohydrates which are easier to prepare and use. This trend, which continues, has serious implications for the availability of basic staples in the face of both the rising prices of imported wheat and wheat-based products and the cost associated with importation. These costs also include the issue of food miles and low carbon food production and delivery considerations.

Roots and tubers have been identified by decision makers as an integral component for food security/sovereignty for the Region. CARICOM signaled its desire to reduce food imports and several Caribbean countries also established similar national targets.

VALUE OF CARICOM'S ALL COUNTRIES IMPORTS BY SITC DIVISION 04: 2000-2010



FAOSTAT | © FAO Statistics Division 2012 | 20 March 2012

Figure 1. Value of CARICOM imports for cereals and cereal preparations 2000-2010.

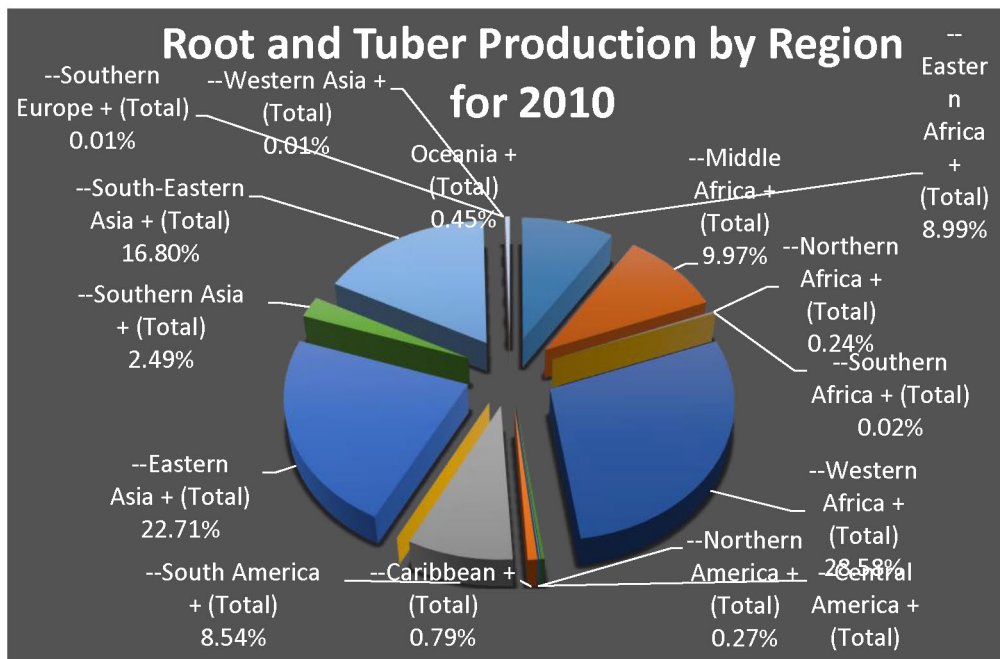
OBJECTIVES

The objectives of this paper are to:

- Discuss the status of the world root and tuber industry
- Conduct a comparative review of the regional industry
- Discuss the CARDI Roots and Tubers Programme and its major achievements
- Make recommendations for repositioning the industry towards greater sustainability, particularly economic competitiveness

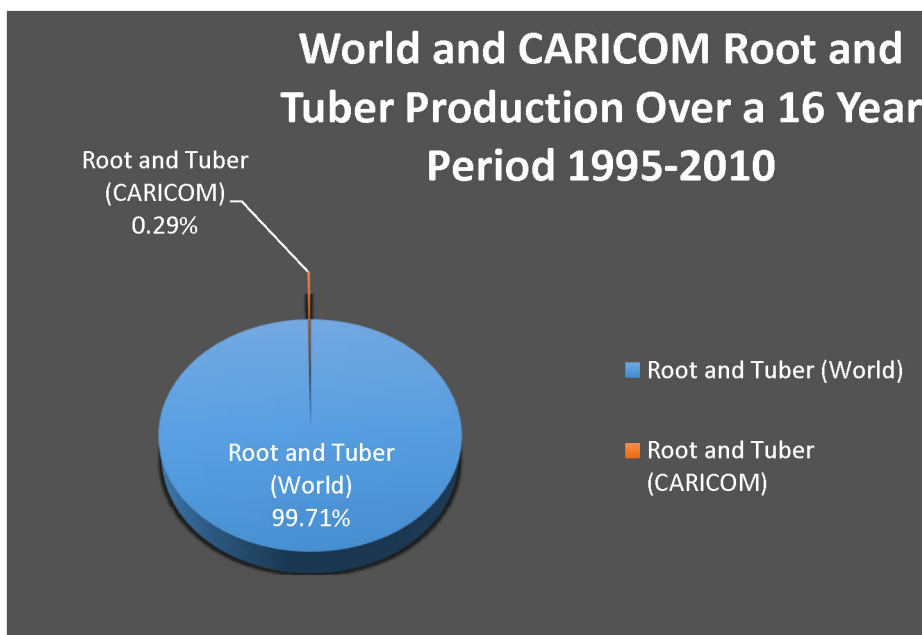
Current status of roots and tubers

Roots and tubers are a major source of food in many developing countries. However, levels of production and use vary between countries and regions. Almost 36 million hectares of land in developing countries are reportedly planted in these crops (FAO, 1997). Asia is the main producing region (Figure 2) followed by Africa and Latin America. China is the most important sweet potato producer (90% of global production); Nigeria is the main producer of yams, and Brazil produces the most cassava. Small farmers in China, who have traditionally cultivated sweet potato for human consumption, now process roughly half of their annual harvest of 118 million mt (1995-97 value) into animal feed (Scott et al., 2000). On a 16-year (1995-2010) average, CARICOM produced only 0.29% of the world's production of roots and tubers (Figure 2). A slight increase was seen in 2010 to 0.38%.



FAOSTAT | © FAO Statistics Division 2012 | 20 March 2012

Figure 2: World root and tuber production (Source FAO).



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Figure 3. World and CARICOM root and tuber crop production.

Internationally, several organizations have made significant contributions to roots and tubers development. Foremost among these are the Consultative Group on International Agricultural Research (CGIAR) Centers: the International Centre for Tropical Agriculture (CIAT) and the International Potato Centre (CIP), which have world germplasm collections of cassava and sweet potato, respectively, and the International Institute for Tropical Research (IITA) located in Nigeria which services the research needs of farmers in Africa. Both the *Instituto de Investigaciones de Viandas Tropicales* (INIVIT) and the *Instituto Dominicano de Investigaciones Agropecuarias y Forestales* (IDIAF) focus on all the targeted root and tuber crops in this paper and cater their research specifically to the needs of farmers in Cuba and the Dominican Republic. The National Agricultural Research Center for Kyushu Okinawa Region (KONARC) in Japan, conducts research on sweet potato, where breeding new varieties is a priority activity. The Latin America and Caribbean Consortium to support Cassava Research and Development (CLAYUCA) in Colombia is now a well established and functional organization engaged in supporting cassava development in the region and beyond. CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement) is a French research centre working with developing countries to tackle international agricultural and development issues and is known for its work on yams. The functional areas for the various Institutions are shown in Table 1.

Table 1. Institutions and their research focus

Institution	Cassava	Sweet Potato	Yams	Aroids
CIAT	X			
CIP		X		
IITA	X	X	X	X
INIVIT	X	X	X	X
IDIAF	X	X	X	X
KONARC		X		
CLAYUCA	X	X		
CIRAD			X	

In the CARICOM Region, roots and tubers (cassava, sweet potato, yams and aroids) have been produced for centuries mainly by small farmers. There is significant germplasm in each country which is produced mostly for human consumption. There is some degree of income generated through Intra-regional and international trade. There is also limited value addition. The changing global environment, particularly the unavailability of imported cereals, has resulted in the increasing importance of roots and tubers for food and fuel.

Roots and Tubers Programme in CARDI

As outlined in its Medium Term Plan, CARDI's work in roots and tubers is guided by its mandate for the Research and Development of these commodities given in the Regional Transformation Programme for Agriculture (RTP) of 1996. Industry development would take the value chain approach where all stakeholders are involved in the process as shown by the Commodity Development Chain below (Figure 3).

CARDI embraces the ‘New Agriculture’ concept recognised by CARICOM Heads of Government, where industry development spans the entire value chain, is market-oriented and acknowledges the importance of linkages with other productive sectors. This industry development is also influenced by appropriate technological processes and measures.

Commodity Development Chain

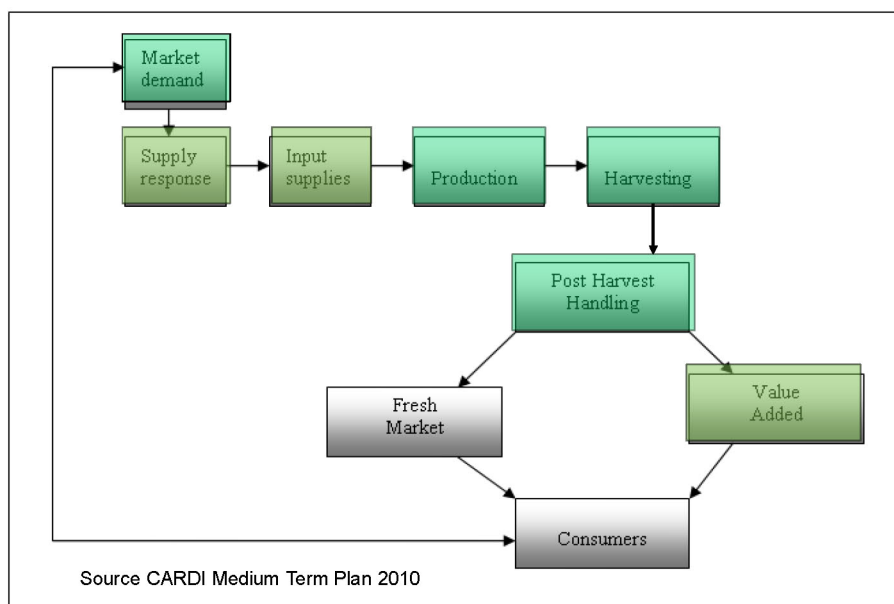


Figure 3. Commodity Development chain

The objective of the Roots and Tubers Programme in CARDI is “To support the development of a commercially viable and sustainable regional root and tuber crop industry that facilitates the improvement of livelihoods and overall food and nutrition security/sovereignty”. This objective would enable the institute to contribute to the development of roots and tubers industries through the development of fresh production and value-added technology. Over the years, the Institute has been involved in various aspects of research and development in respect to roots and tubers. The major achievements are reported here under.

Germplasm introduction, evaluation, and conservation

CARDI’s work in cassava dates back to the 1980s in the Barbados Unit. New accessions from CIAT were introduced and evaluated for use in the production of animal feed. Planting material of the selected varieties was multiplied and the production technology transferred to farmers.

Again in the 1980s, white yam (*Dioscorea alata*) was introduced from INRA and evaluated for yield and tolerance to anthracnose. During this period, there was also a virus-tested yam multiplication project through tissue culture. This was centered in Barbados and planting material was distributed to 12 countries.

In 2003, improved cassava varieties were again introduced from CIAT and evaluated at the CARDI Unit in St. Vincent and the Grenadines. The selected high yielding varieties are multiplied in vitro and distributed to farmers in the Region.

CARDI collaborated with CIP (2003-2010) to obtain appropriate varieties of sweet potato for introduction and evaluation as to their suitability for fresh consumption and processing into value added products. Several of these are currently being evaluated across the Region.

The Institute is currently collaborating with the Secretariat of the Pacific Community (SPC) on a European Union-funded project to introduce, breed and evaluate aroids (dasheen, tannia), which would be adapted for climatic changes and new commercial uses.

Germplasm collections in gene banks, mainly of sweet potato, can be found in several CARDI Units. In addition, the Institute is collaborating with the Ministry of Agriculture in St Vincent and the Grenadines for the storage of cassava, sweet potato and aroid planting material at its tissue culture laboratory.

During the period 1982-86, the Institute executed a project funded by the European Development Fund on the genetic improvement of aroids in Dominica, Trinidad and Tobago, Grenada, St Lucia, and St Vincent and the Grenadines. The goal was to identify superior clones based on yield, disease tolerance /resistance and adaptability.

Under the Caribbean Plant Genetic Resources Network (CAPGERNET), CARDI is collaborating with the Ministries of Agriculture to regenerate, conserve, multiply, and disseminate landraces of sweet potato (Trinidad and Tobago), and cassava (Guyana).

Improved production and productivity

CARDI Units are involved in the demonstration of improved technologies for root and tuber production. Technology has been transferred through seminars, workshops, field days, publications. Several fact sheets produced by the Institute's scientists have been used by farmers and extension agents in crop production. The most recent publications include a sweet potato technical manual and a cassava technical bulletin.

Sweet potato varieties for local and export markets have been characterized in Jamaica, St. Vincent and the Grenadines, and St Kitts and Nevis. In addition, suitability of varieties for various Agro Ecological Zones (AEZ) has been determined in Jamaica and Antigua.

Among the post harvest characteristics determined has been curing technologies to extend the shelf life of sweet potato in Jamaica. It was also established that the cyanide levels (0.34 – 1.72 mg/kg) of six introduced high yielding cassava varieties (after processing) are within FAO/WHO CODEX permissible levels of 10 mg/kg.

Integrated Pest Management

The integrated pest management in sweet potato was one of the more successful projects undertaken by the Institute. This multi-country project was done in association with Virginia

Technical Institute and was executed from the CARDI Jamaica office. Results included the development of control measures for *Cylas formicarius* and *Phyllophaga* spp, two main sweet potato pests, in the Region. The adoption of this technology led to increased production and export of sweet potato in St Vincent and the Grenadines and Jamaica. Pesticide residue analysis showed that the treatment enabled compliance with food safety regulations.

Value addition initiatives

Under a CARICOM/Japan project, 34 regional sweet potato varieties were evaluated for their suitability for processing into flour, paste, juice and fries. The germplasm came from Jamaica, St. Vincent and the Grenadines, St. Lucia, St. Kitts and Nevis, Trinidad and Tobago and Barbados. At the Food Science laboratory, University of the West Indies, St. Augustine, they were analysed for brix and dry matter percentages: low brix gives the products a better colour and a low to medium dry matter content is desirable for fries and chips.

In collaboration with the University of the West Indies, CARDI was able to evaluate 21 sweet potato varieties from St Vincent and the Grenadines. Complete proximate analyses were done of the flours and starches produced from the varieties. The information gathered will be used in determining processing suitability.

The Scientific Research Council (SRC) in Jamaica was contracted by CARDI to evaluate the processing capability for the ten most popular sweet potato varieties on that island. The resulting information was made available to the marketers and processors.

In Montserrat, training in cassava value addition exposed participants to making the traditional cassava bread and other new products (pizza, quiche). The acquisition of processing equipment by the Ministry of Agriculture prompted the Institute to initiate the training session to ensure sustainability of the cassava industry on that island.

In addition, CARDI conducted an evaluation of introduced cassava varieties in St Vincent and the Grenadines to determine their suitability for processing into farine—the preferred cassava product. This research resulted in the selection of six varieties introduced for further production.

Capacity building

Apart from several training workshops organized by CARDI scientists, the Institute has been collaborating with regional and international organizations to train farmers and technicians in root and tuber technologies throughout the value chain. Under the CARDI Caribbean Food Corporation (CFC) project, farmers and officers from Barbados, Dominica, Jamaica, St. Vincent and the Grenadines, and Trinidad and Tobago were exposed to cassava micro-propagation, production and processing practices at CLAYUCA in Colombia. The root and tuber farmers of St Kitts and Nevis also benefitted from a collaborative project between CARDI and the Florida Association for Volunteer Action in the Caribbean and the Americas (FAVACA) through training in pest management.

Collaborative Linkages

In keeping with its value chain approach, the Institute convened a workshop for sweet potato stakeholders in St. Vincent and the Grenadines in 2006. Participants included farmers, agro-processors, extension officers, policy makers and researchers from various institutions, agencies, Ministries of Agriculture, Farmers' Groups in the Bahamas, Barbados, Guyana, Jamaica, St. Vincent and the Grenadines, and Trinidad and Tobago. The aim was to formulate a regional sweet potato work programme.

The Institute also recognizes the value of its partners in its efforts to develop the root and tuber industry. Strategic alliances have been forged with regional entities, e.g. Barbados Agricultural Development and Marketing Corporation (BADMC), the SRC (Jamaica), the University of the West Indies (UWI) St. Augustine Campus and the Trinidad and Tobago Agribusiness Association (TTABA), which are all involved in product development. CARDI has also been collaborating with CLAYUCA, CIP and CIAT for improved germplasm and training. Under the CFC project, the Ministries of Agriculture, Farmers' Groups and NGOs in the project islands of Barbados, Dominica, Haiti, Jamaica, St Vincent and the Grenadines, Trinidad and Tobago have partnered with CARDI for the successful implementation of the project entitled, *“Increased Production of Root and Tuber Crops in the Caribbean through the Introduction of Improved Marketing and Production Technologies”*.

Strategic repositioning of roots and tubers in the agriculture sector of the region

“One key to successful strategic repositioning of a technology or commodity is recognizing that success involves innovative change and requires advocacy, capacity building and marketing” (Onyango, 2011). As explained by the author, advocacy involves selecting the correct strategic partners. In this regard, the Institute has established important strategic alliances with national, regional and international organizations. The emphasis placed on strengthening farmers' groups and industry clusters within current projects is part of this process of building multi stakeholder platforms that facilitate innovation. As a consequence, the major stakeholders will be sensitized as to the importance and potential of roots and tubers to the Region's food and nutrition security needs and the potential for providing an acceptable financial return for the agripreneurs involved.

Since improving the competence of the players along the value chain is pivotal to sustainable development of the industry, CARDI is working to build the capacity of technicians, producers, processors and marketers. This emphasis on human resource development will facilitate research, technology transfer, and fuel the innovation process. For example, it is recognized that there is an increasing role for plant breeders to assist in the development of climate-ready plants, given the imperatives of efficient plant genetic resources conservation, and management in the context of climate variability and change. The vital role of the policy makers in the repositioning process has been noted and, indeed, appropriate measures are being developed to engage the region's decision makers in the science policy dialogue. Their contribution to advocacy and promotion is indispensable.

Onyango (2011) also notes, “The first step in promoting any crop is the provision of quality seed”. Recognising this, CARDI, through the CFC project, has focused on the production and distribution

of high quality planting materials of roots and tubers. Sustainability is ensured by the construction of plant propagating facilities in the targeted project countries. The project being implemented under the CARICOM/Japan agreement also targets the production of clean planting material for distribution to farmers.

Product development, value addition and processing are all important in the value chain and subsequently the repositioning process. As consumers are encouraged to transition from imported grains and cereals and consume more traditional staples for health and wellness reasons as well as the attainment of food and nutrition security, there will be a growing demand for processed products from these traditional staples. This increased demand for processed products will therefore require the industry to diversify the range of products available.

The marketing of fresh and processed products could greatly affect the repositioning of the roots and tubers highlighted in this paper. A lack of market access would negatively impinge on industry development. The policy decision to achieve 25% of food and nutrition security, and the selection of roots and tubers as a major supplier of starch, should address the question of market availability and accessibility.

CONCLUSIONS

The Caribbean Agricultural Research and Development Institute, as the only agricultural Research and Development Institute in the CARICOM Region, and given the importance that roots and tubers play and would continue to play in the lives of the region's people, is taking up the responsibility for leading the process of repositioning the industry.

Scott et al. (2000) noted that cassava, sweet potato, and yam will remain important commodities in the coming years, particularly in many of those poorer regions and countries that merit broader international support in their efforts to increase food production, reduce rural poverty, and improve food security while protecting the environment.

The successful involvement of the private sector in research and development has been demonstrated by CLAYUCA (Ospina, 2000). This role should not be underestimated and needs to be further tapped to exploit the substantial research and development capacity and extensive supply chains, infrastructure development and market penetration which this sector can access. By *working together*, one of CARDI's strategic pillars, these stakeholders can contribute more effectively towards the goals and objectives of the repositioning process.

The availability of molecular tools would provide the opportunity for the development of more suitable varieties for the changing environment and with acceptable production, productivity and consumer characteristics for the emerging challenges particularly in terms of climate change, increasing pest pressures, and rapidly declining soil fertility.

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