

Early Generation Seed Case Study

Cassava | Paraguay | CODIPSA

April 2018



Acronyms

CIAT | The International Center for Tropical Agriculture

CLAYUCA | Consorcio Latino Americano y del Caribe de Apoyo a la Investigación y Desarrollo de la Yuca (Latin American and Caribbean Consortium of Support for Cassava Research and Development)

CODIPSA | Compañía de Desarrollo y de Industrialización de Productos Primarios S.A (Company of Development and Industrialization of Primary Products S.A.)

EGS | Early Generation Seed

Embrapa | The Brazilian Agricultural Research Corporation

GAP | Good Agricultural Practices

SENAVE | Servicio Nacional de Calidad y Sanidad Vegetal y de Semillas (National Seed and Vegetable Quality and Sanitation Service)

Definitions

Breeder seed: Breeder seed is produced by or under the direction of the plant breeder who selected the variety. During breeder seed production, the breeder or an official representative of the breeder selects individual plants to harvest, based on the phenotype of the plants. Breeder seed is produced under the highest level of genetic control to ensure the seed is genetically pure and accurately represents the variety characteristics identified by the breeder during variety selection.

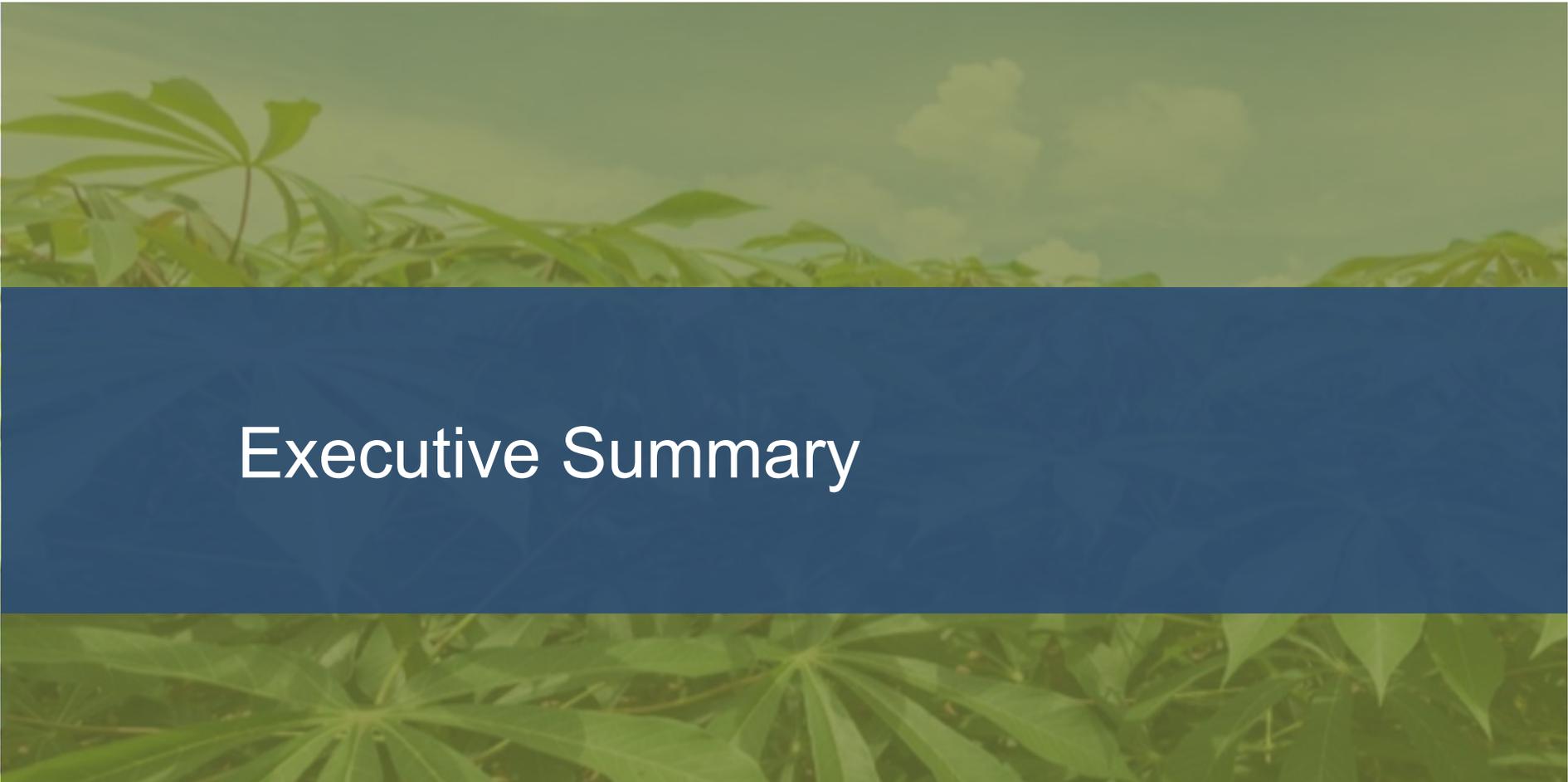
Basic seed (or Foundation seed): Basic seed is the descendent of breeder or pre-basic seed and is produced under conditions that ensure maintaining genetic purity and identity. When foundation seed is produced by an individual or organization other than the plant breeder, there must be a detailed and accurate description of the variety the foundation seed producer can use as a guide for eliminating impurities ("off types") during production.

Early generation seed: There is no scholarly definition of EGS which has attracted widespread usage in the literature. What the definitions in use share in common is a focus on breeder seed and basic seed but almost always in a context that is much wider and more complex than the mention of these two steps would imply.

Formal seed system: The formal seed system is a deliberately constructed system that involves a chain of activities leading to genetically improved products: certified seed of verified varieties. The chain starts with plant breeding or variety development program that includes a formal release and maintenance system. Guiding principles in the formal system are to maintain varietal identity and purity and to produce seed of optimal physical, physiological, and sanitary quality. Certified seed marketing and distribution take place through a limited number of officially recognized seed outlets, usually for financial sale. The central premise of the formal system is that there is a clear distinction between "seed" and "grain." This distinction is less clear in the informal system.

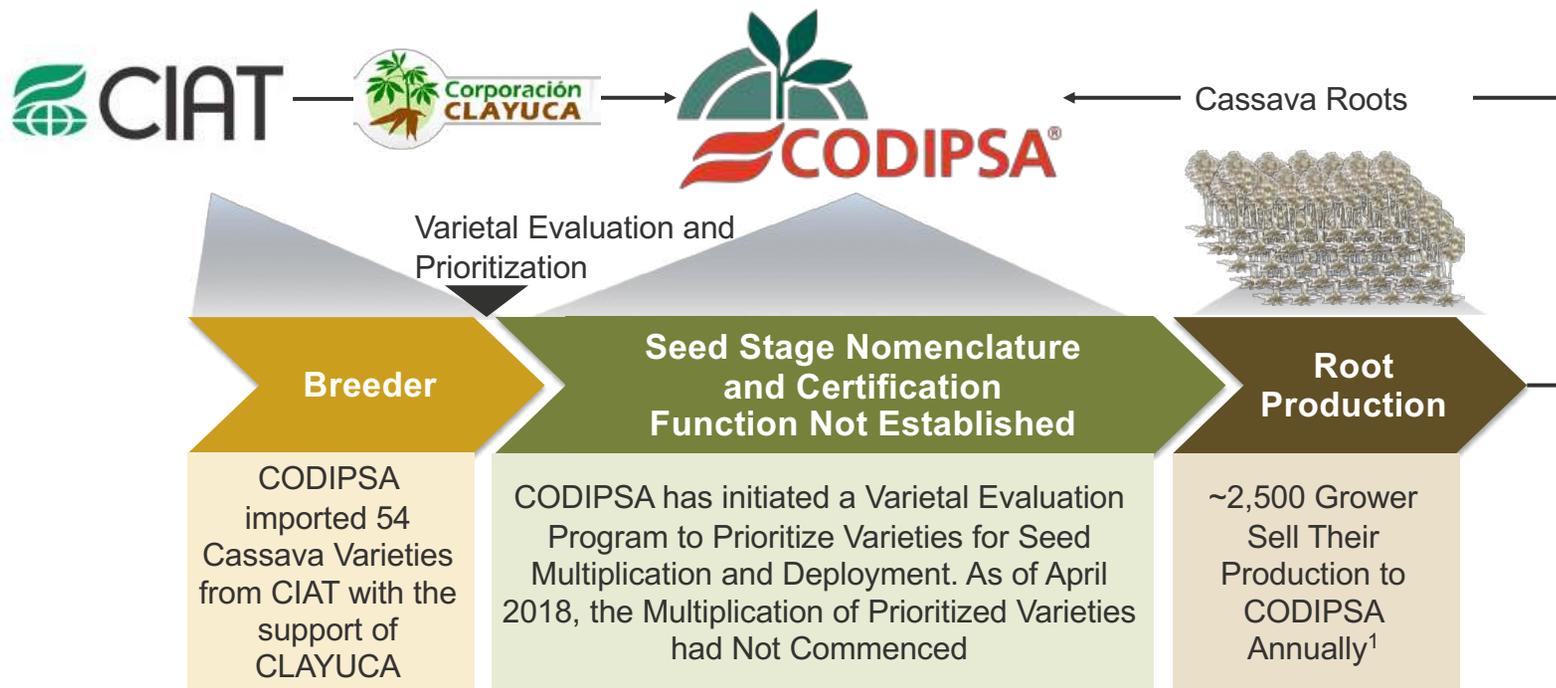
Informal seed system: The informal system also referred to as a local seed system, is based on farmer-saved seed or QDS. Varieties in the informal system may be variants of improved varieties originally sourced from the formal system, or they may be landrace varieties developed over time through farmer selection. There is less emphasis on variety identity, genetic purity, or quality seed. The same general steps or processes take place in the local system as in the formal sector (variety choice, variety testing, introduction, seed multiplication, selection, dissemination, and storage), but they take place as integral parts of farmers' production systems rather than as discrete activities. While some farmers treat "seed" as special, there is not always necessarily a distinction between "seed" and "grain." The steps do not flow in a linear sequence and are not always monitored or controlled by government policies and regulations. Rather, they are guided by local technical knowledge and standards and by local social structures and norms.

Improved versus landrace/local varieties: Improved varieties are the product of formal breeding programs that have gone through testing and a formal release process. A landrace is a local variety of a domesticated plant species which has developed over time largely through adaptation to the natural and cultural environment in which it is found. It differs from an improved variety which has been selectively bred to conform to a particular standard of characteristics.

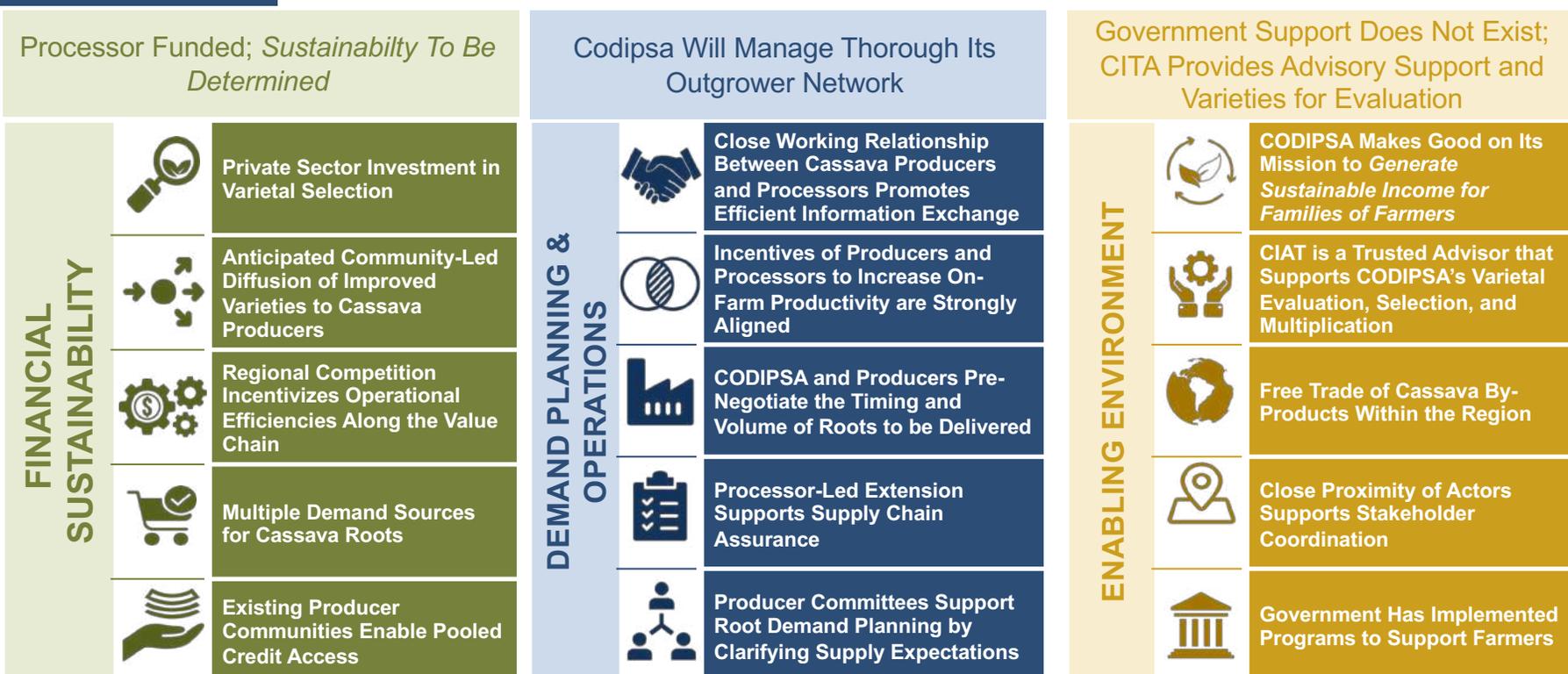


Executive Summary

Cassava Seed System is Processor-Led (CODIPSA) With Limited Public Sector Partnership



Summary of EGS System Building Blocks



Financial Sustainability

	<p>Private Sector Investment in Varietal Selection</p>	<p>CODIPSA is investing up to \$200,000 to establish a three step varietal evaluation program with the purpose of identifying and deploying stems of high yield (30 T/ha), high starch (27% dry matter content) varieties to the growers with which it sources cassava roots. CODIPSA has imported 54 cassava varieties from CIAT, and has evaluated those lines through step one (in vitro selection and importation) and step two (greenhouse multiplication). Step three (field trials) has commenced at CODIPSA managed trial sites, but has not started on growers' fields which is a requirement for varietal registration in Paraguay.</p>
	<p>Anticipated Community-Led Diffusion of Improved Varieties to Cassava Growers</p>	<p>CODIPSA is yet to formalize its cassava seed multiplication and deployment strategy, but will likely employ a model wherein it would select and provide lead growers with an initial quantity of improved planting material (stems) for cultivation. CODIPSA will likely coordinate with those lead growers to multiply and distribute that material to other growers. The key pro of community-led diffusion is cost, as infrastructure requirements and management expenses are low relative to a more intensely managed model wherein CODIPSA would maintain responsibility for EGS production and distribution. A key con is the lack of control that CODIPSA would have to (1) rapidly increase the availability and accessibility of improved seed, and to (2) regulate seed quality and genetic purity of the seed being multiplied and planted by growers.</p>
	<p>Regional Competition Incentivizes Operational Efficiencies Along the Value Chain</p>	<p>CODIPSA has limited supplier power in the global cassava starch market due to Thailand's dominant cost leadership position (\$50-\$60 per tonne). But in Latin America, CODIPSA is able to compete for market share with Paraguayan and Brazilian starch processors through pricing and brand differentiation. To maintain and grow market share, CODIPSA has invested in constructing modern processing facilities, and is focused on increasing agricultural productivity to increase grower revenues, processor root supply, and processing factory utilization, which will lower production costs per unit and enable CODIPSA to increase its competitiveness.</p>
	<p>Multiple Demand Sources for Cassava Roots</p>	<p>There is stable demand for cassava roots, with multiple processors trying to achieve processing efficiency and starch production targets. This market dynamic provides demand assurance to growers, who are making land resource allocation decisions. The maturation of Paraguay's cassava starch industry has led growers to consider cassava as a cash crop with the opportunity to sell production at relatively predictable prices.</p>
	<p>Existing Grower Communities Enable Pooled Credit Access</p>	<p>There was an established structure for growers to access credit for capital expenditures through the formation of grower committees. Under this arrangement, growers were able to secure loans through committees by pooling their assets in a shared bank account. And while this structure is no longer in place as a result of governmental policies that eliminated the private financing scheme, grower committees remain, and their relationship with starch processors continues to make them a better underwriting risk because reliable offtakers are in place.</p>

Demand Planning and Operations



Close Working Relationship Between Cassava Growers and Processors Promotes Efficient Information Exchange

Core to CODIPSA's mission is its support of smallholder growers. This ethic is epitomized by the close, trust-based relationships that CODIPSA's extension team maintains with cassava root growers. Extension team members have personal relationships with growers, and are familiar their production practices, including: area under cultivation, crops in rotation, input preferences, historical sales to CODIPSA, and current year production commitments to CODIPSA. This relationship is supported by the use of a digital application to track growers' performance against their production volume commitments (vouchers).



Incentives of Growers and Processors to Increase On-Farm Productivity are Strongly Aligned

The incentives of cassava root growers and CODIPSA to increase on-farm productivity are strongly aligned. CODIPSA benefits from higher productivity through increased root supply, which increases processing efficiency and reduces the unit-cost of production. And lower production costs enable CODIPSA to increase profits through higher volumes, higher unit-margins, or both. Growers benefit from a higher return on their hectares, which would lead to a virtuous cycle of higher yields → increased production → higher grower and processor incomes → increased grower adoption of improved varieties.



CODIPSA and Growers Pre-Negotiate the Timing and Volume of Roots to be Delivered

CODIPSA and growers determine the volume and timing of root supply delivery to the local processing factory in February. Once terms have been agreed to, CODIPSA issues a voucher to growers. When growers honor the terms of the voucher, CODIPSA pays them a bonus (10K Paraguayan guaraní). The formality of the voucher system promotes accountability, and allows CODIPSA to better manage the volume and timing of supply to each of its four factories.



Processor-Led Extension Supports Supply Chain Assurance

Growers make root production delivery commitments to CODIPSA, and CODIPSA's agricultural extension team is able to track and support growers' performance against their targets through its engagement with growers. CODIPSA is able to leverage production information received from its agricultural extension to update its root supply forecast throughout throughout the agricultural production cycle.



Grower Committees Support Root Demand Planning by Clarifying Supply Expectations

Growers ban together in committees to make production and marketing decisions that impact CODIPSA's supply planning and operations. For example: how much land should be dedicated to cassava cultivation? What production volume commitments should be made to CODIPSA? When and where should planting implements be deployed?

Enabling Environment



CODIPSA Makes Good on Its Mission to Generate Sustainable Income for Families of Growers

From its beginnings in 1998 until today, CODIPSA provides integral assistance to the grower in the technical, commercial, credit management and other areas of benefit. CODIPSA is solving for the lack of an enabling environment through the establishment of a private sector-led and funded initiative to increase agricultural productivity. As a for-profit social enterprise, CODIPSA is willing to support growers with agronomic extension in the absence of an effective public sector alternative.



CIAT is a Trusted Advisor that Supports CODIPSA's Varietal Evaluation, Selection, and Multiplication

CIAT has provided value-added advisory support to CODIPSA through its selection and importation of cultivars to Paraguay. CIAT continues to be a reference and technical advisor to CODIPSA on tissue culture management, greenhouse requirements, and field trial methodology. In other contexts, this advisory function would be provided by a national agricultural research institution; the direct linkage between CODIPSA and CIAT is a workaround



Free Trade of Cassava By-Products Within the Region

Paraguay's free trade agreement with key South American markets allows CODIPSA to be more competitive, because it does not have to incur or pass along export taxes to its buyers.



Close Proximity of Actors Supports Stakeholder Coordination

The co-location of cassava cultivation and processing plants in the eastern region of Paraguay reduces the risk of post-harvest loss and transportation costs, and it improves supply/demand coordination between CODIPSA and cassava growers. Additionally, Paraguay's border dynamics with Brazil are significant as companies can buy and sell stems and roots across the border.



Government Has Implemented Programs to Support Growers

The government of Paraguay has implemented select programs to support growers' livelihoods. For example, in the past, grower committees were able to access machinery and production intensification systems (greenhouses for vegetable crops).

Pain Points Associated with the Establishment of CODIPSA-Led Seed System

Financial Sustainability

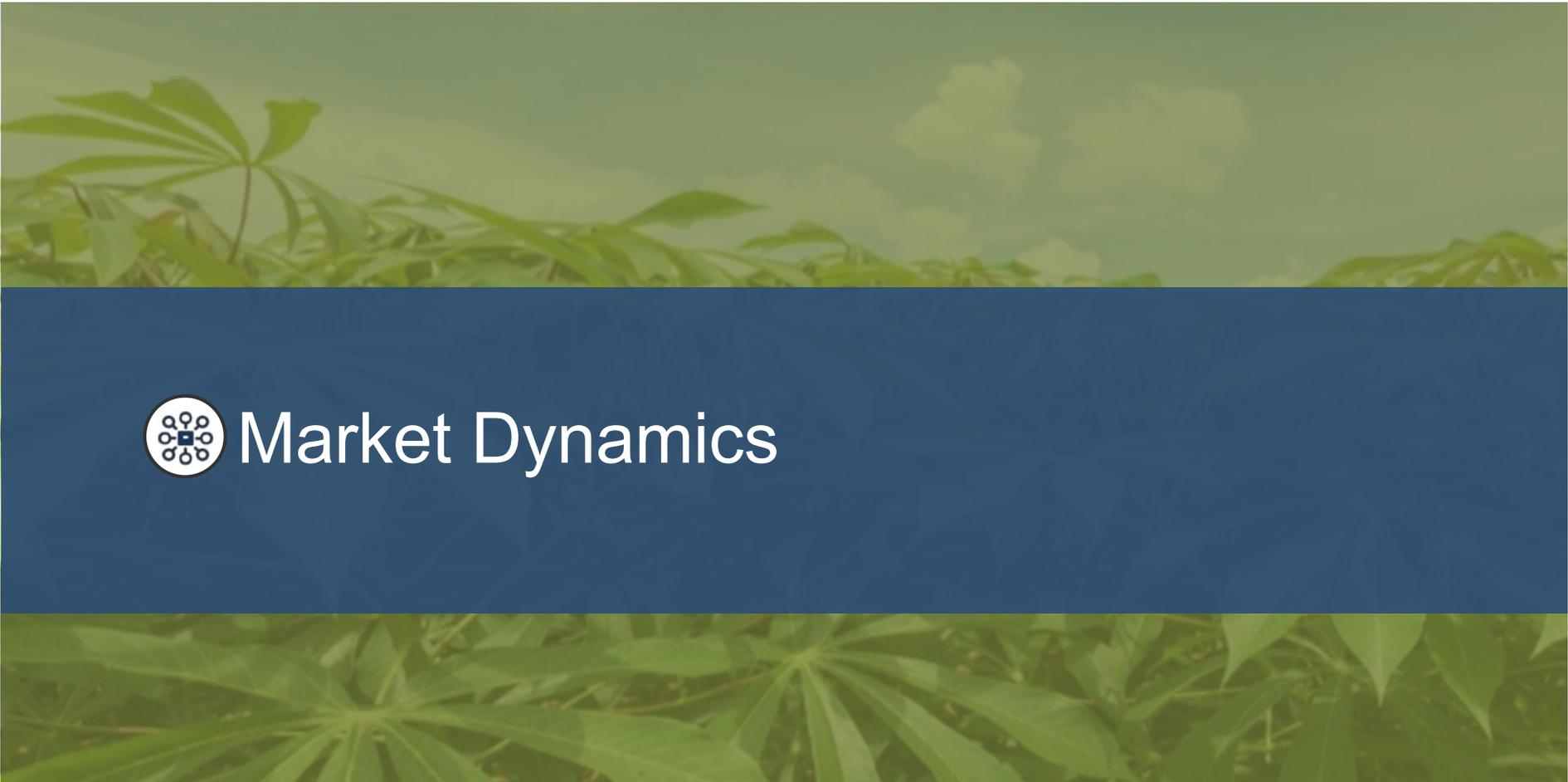
- Growers' willingness to pay for improved seed is unproven
- Governmental policies eliminated private sector credit for growers

Demand Planning & Operations

- Demand volatility for cassava starch due to global production system

Enabling Environment

- Public Sector is unwilling to fund varietal development, research, and selection
- Unclear regulatory pathway for varietal release (not even the native cassava varieties are registered in Paraguay)



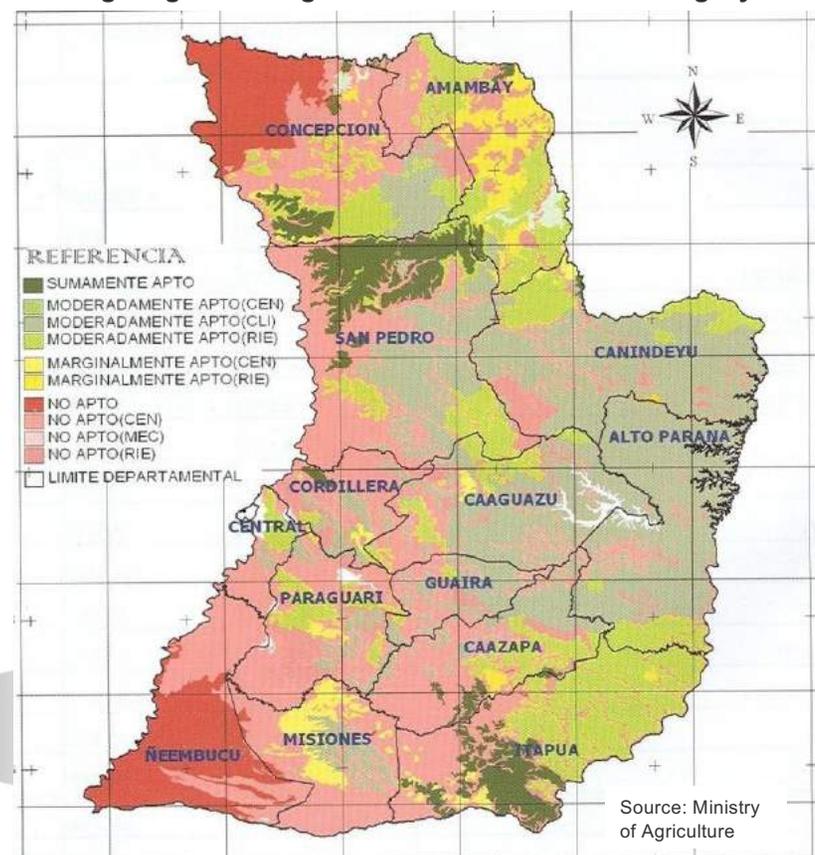
Market Dynamics

Paraguay Was Among the Top 20 World Producers of Cassava in 2016 (3.17 M Tonnes at a Yield of 17.4 T/ha)

#	Country	2016 Production Total (tonnes)	% of Total	Yield (hg/ha)
1	Nigeria	57,134,478	21%	91,254
2	Thailand	31,161,000	11%	213,165
3	Brazil	21,082,867	8%	149,922
4	Indonesia	20,744,674	7%	239,133
5	Ghana	17,798,217	6%	189,600
6	DRC	14,677,809	5%	81,483
7	Vietnam	11,045,184	4%	190,468
8	Cambodia	10,206,514	4%	263,302
9	Angola	9,981,245	4%	108,518
10	Mozambique	9,100,000	3%	90,791
11	Tanzania	5,575,304	2%	52,546
12	Cameroon	5,501,749	2%	146,849
13	Malawi	5,088,595	2%	220,230
14	China	4,794,262	2%	164,692
15	Sierra Leone	4,778,393	2%	120,851
16	India	4,554,000	2%	223,235
17	Benin	4,317,642	2%	156,687
18	Rwanda	3,537,566	1%	172,009
19	Côte d'Ivoire	3,210,614	1%	63,466
20	Paraguay	3,166,800	1%	174,000
21	All Others	29,645,655	11%	
	Total	277,102,568	100%	

SOURCE: FAOSTAT

Agrological Zoning of Cassava Production in Paraguay



Cassava's Production Value Relative to Other Agricultural Commodities in Paraguay

Cassava is the fourth most valuable agricultural commodity in Paraguay, but faces substitution risk from others commodities, including soybeans, maize, and rice when global starch prices are low

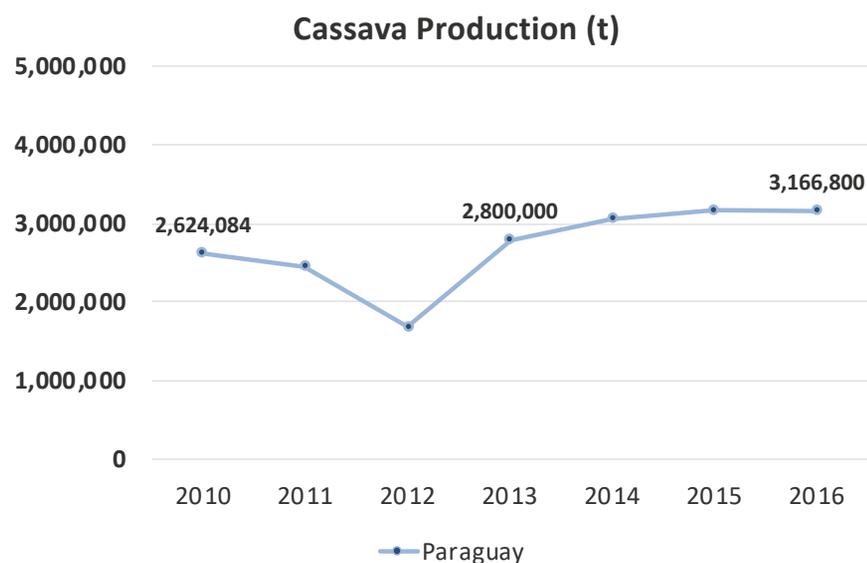
# Agricultural Commodity	Total Production Value	% of Total Value
1 Soybeans	\$2,736,083	45%
2 Meat indigenous, cattle	\$981,769	16%
3 Maize	\$453,328	7%
4 Cassava	\$319,657	5%
5 Meat indigenous, pig	\$260,190	4%
6 Rice, paddy	\$224,043	4%
7 Sugar cane	\$209,237	3%
8 Milk, whole fresh cow	\$163,832	3%
9 Wheat	\$132,537	2%
10 Eggs, hen, in shell	\$114,456	2%
11 Oranges	\$44,643	1%
12 Beans, dry	\$34,941	1%
13 Meat indigenous, chicken	\$33,555	1%
14 Rapeseed	\$31,241	1%
15 Sunflower seed	\$30,714	1%

Cassava is considered a low-value crop that is easy to grow

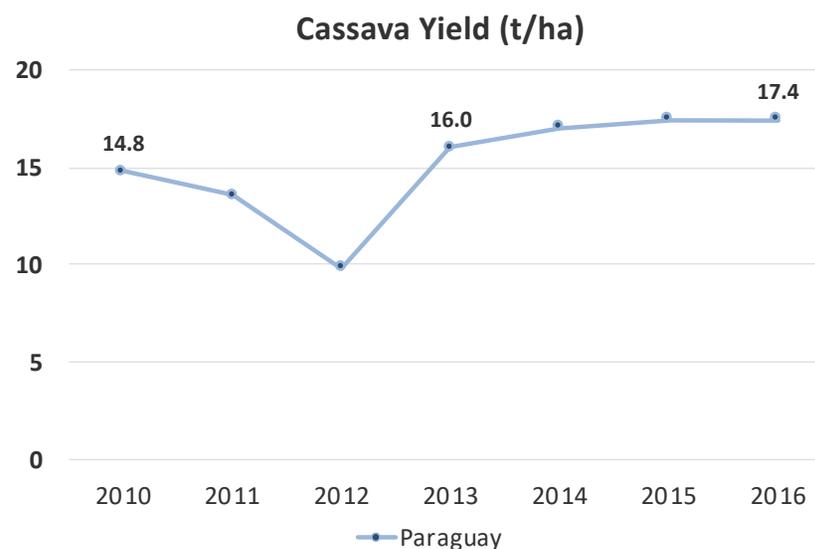
As global crop prices fluctuate, cassava growers, who have the capacity, can switch over to higher-value crops, decreasing the supply of cassava

Historically, consumers had options to purchase preferred varieties of cassava. However, currently there is scarce varietal distinction, which has decreased growers' opportunity to capture price premiums through product differentiation

Cassava Production Volumes and Yield Over Time



Paraguay's starch industry competes with Brazil, and experiences significant commodity price variability depending on the relative price competitiveness of its production

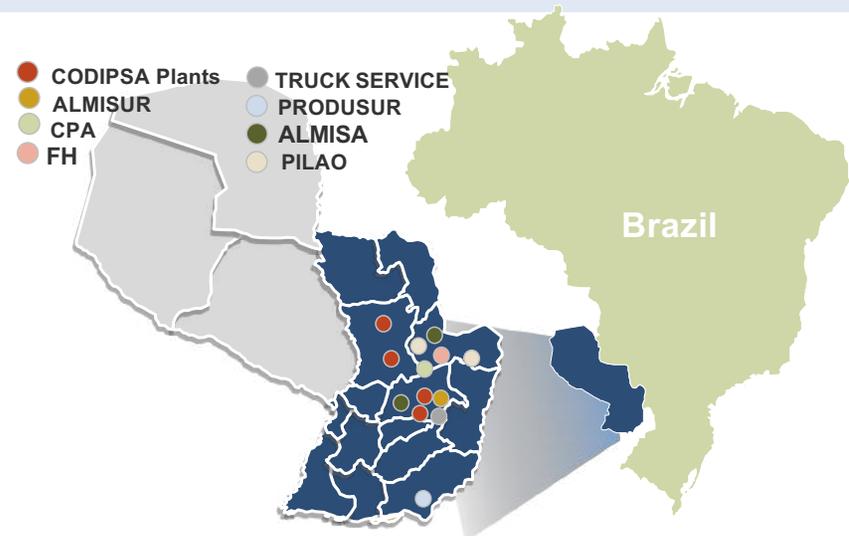


Cassava yields in Paraguay dropped in 2012, but quickly rebounded above former yields

Paraguay and Brazil Have Interconnected Cassava Industries Due to High Root Production Near the Border

Paraguay's Starch Production Plants Are Concentrated Near the Brazilian Border and Countries' Starch Prices Are Strongly Correlated

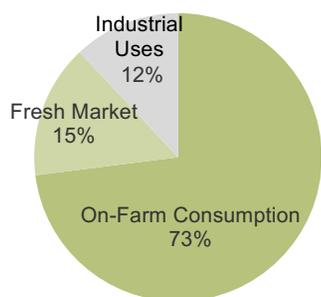
Starch Prices Received 2008-2017 (USD/T)



- Paraguay's border dynamics with Brazil are significant: companies can buy and sell stems and roots across the border, which means pricing in Paraguay is dependent on Brazil pricing, and a poor cassava season in Brazil could imply CODIPSA losing production to the Brazilian boarder
- Cassava production in Paraguay is concentrated in the eastern region along border with Brazil

Most Paraguayan Cassava is Consumed On-Farm; Key Export Markets Are Regional (i.e., Argentina, Brazil, and Bolivia)

Paraguayan Cassava End-Use Segments

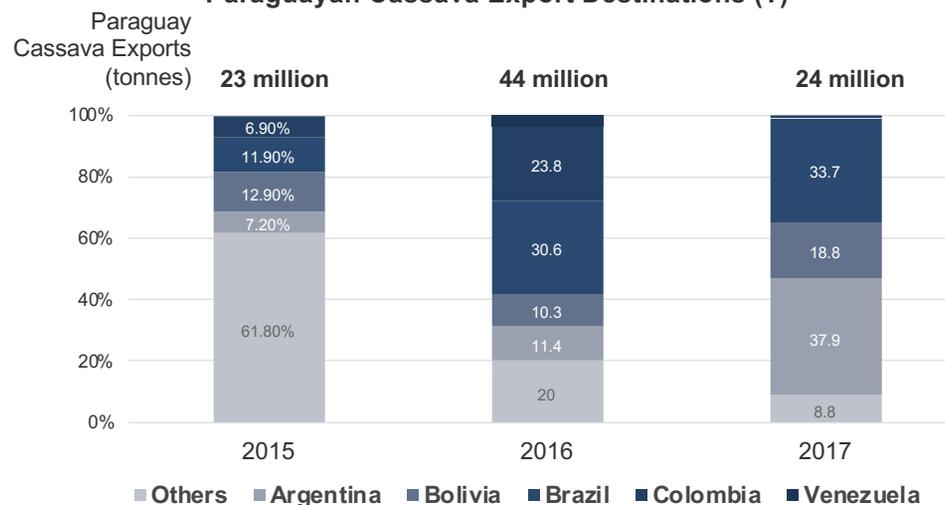


- Two starch processors manage 70% of Paraguay's installed cassava starch processing capacity
- One ethanol plant is fully built, but is not yet taking cassava
- The primary fresh, local markets are in Asunción and Luque

Industrial Uses of Cassava Include:

 Beer	 Animal Feed	  Primary Markets (80% Meat)	
 Chemical Ingredients	 Cosmetic Ingredients		
	 Paper/Cellulose	 Secondary Market (5% max of revenue)	
	 Textiles		

Paraguayan Cassava Export Destinations (T)

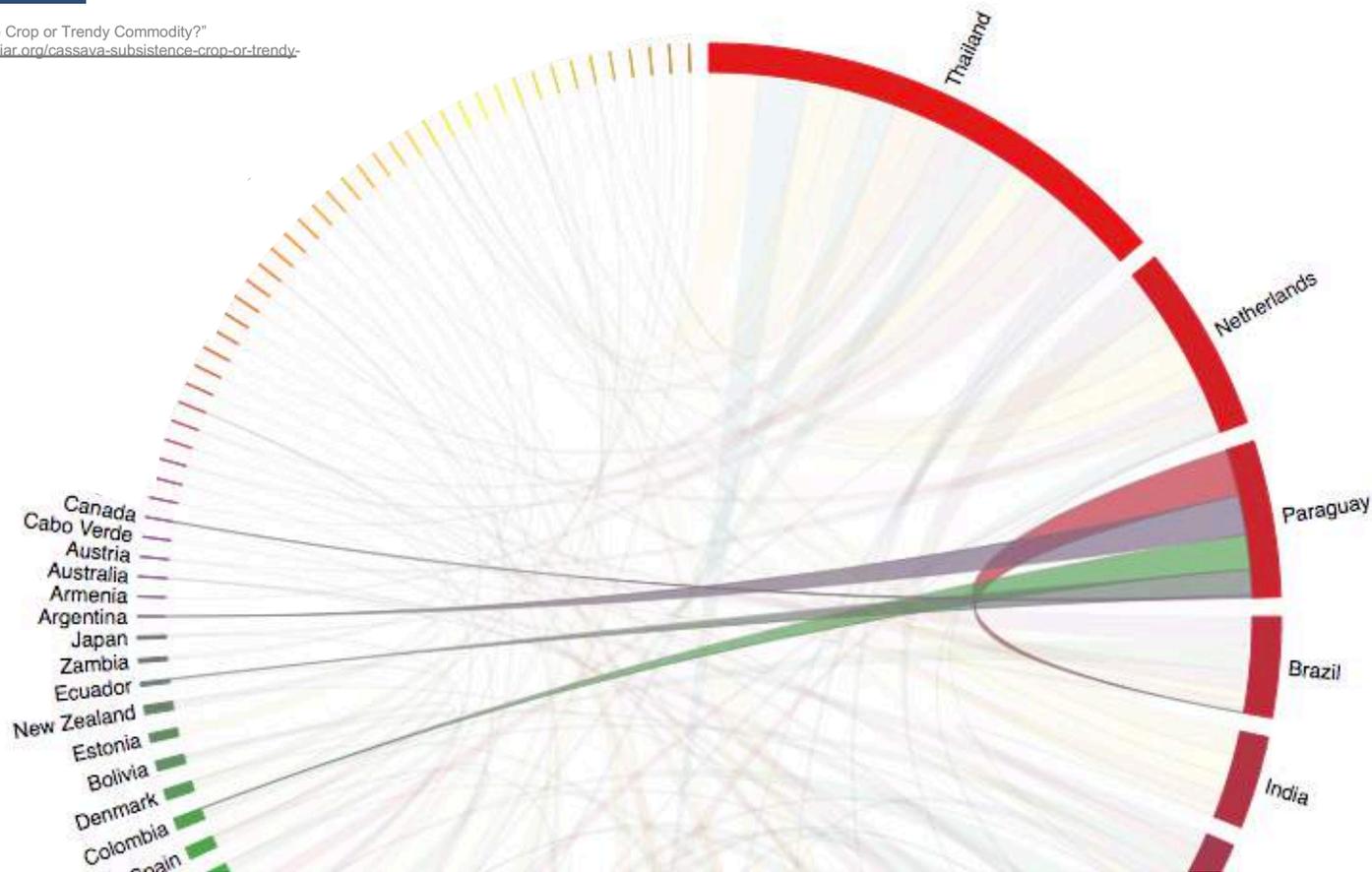


Paraguayan companies are unable to pass price premiums on to consumers due to competitive global market dynamics

When cassava is exported from Paraguay, it goes directly from the factory to Asunción, and then is shipped further from there

Paraguay's Dominant Export Markets are Regional, With the Exception of Canada

SOURCE: "Cassava: Subsistence Crop or Trendy Commodity?"
CIAT Blog link: <https://blog.ciat.cgiar.org/cassava-subsistence-crop-or-trendy-commodity/>





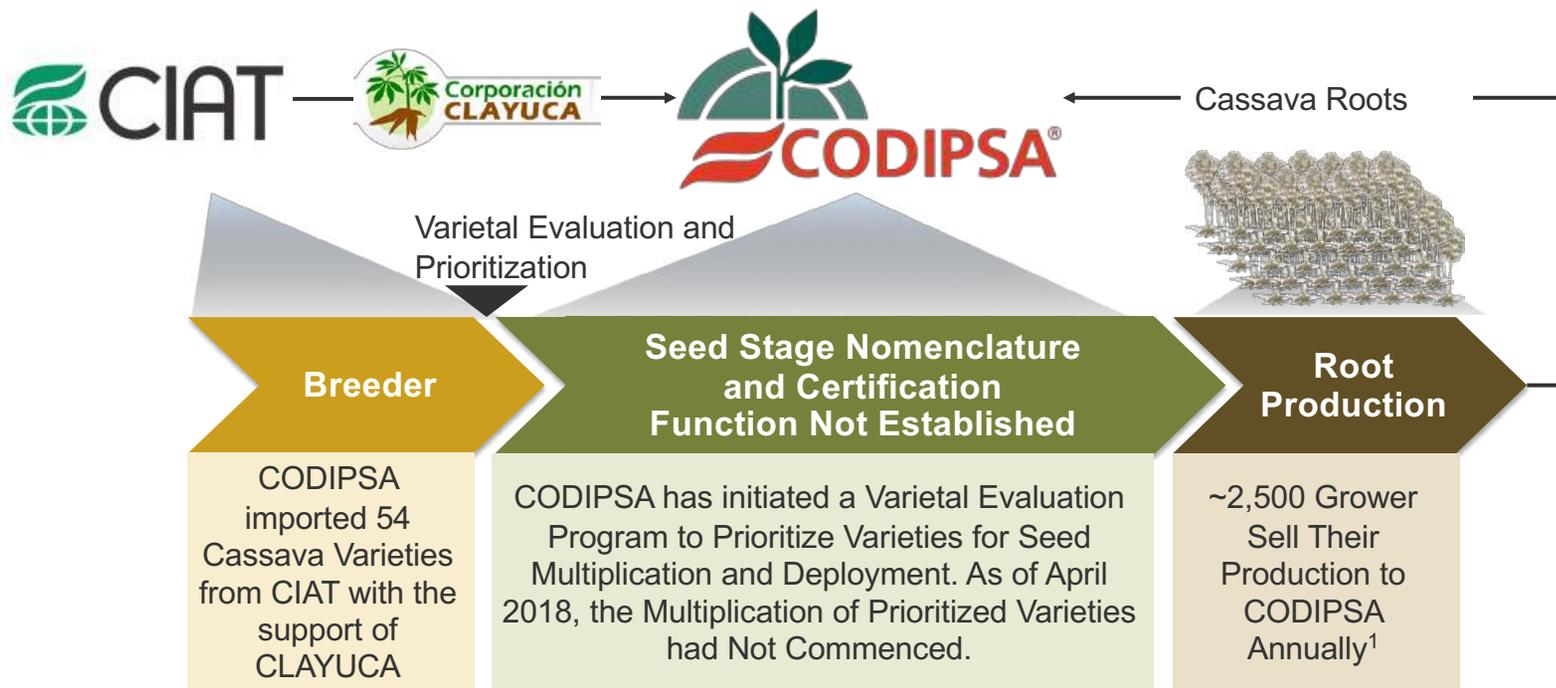
Leadership

LEADERSHIP

Organizational Value Chain Leadership Summary – BRAZIL

	A	B	C	D	E
ORGANIZATION	<p>CODIPSA</p> 	<p>CLAYUCA</p> 	<p>The International Center for Tropical Agriculture (CIAT)</p> 	<p>National Seed and Vegetable Quality and Sanitation Service (SENAVE)</p> 	<p>Grower Committees</p> 
VALUE CHAIN ROLE	<ul style="list-style-type: none"> • Cassava starch processing, packaging, marketing, and sale • Varietal selection and distribution • Technical support to growers 	<ul style="list-style-type: none"> • Support the transference of improved varieties from CIAT to CODIPSA for evaluation 	<ul style="list-style-type: none"> • Varietal development • Good agricultural practices on multiplication, cultivation, and post-harvest handling • Experimental trial design 	<ul style="list-style-type: none"> • Regulator of the Paraguayan seed systems, with a focus on soy and maize • Currently, there is no clear legislation for the cassava system or for other root and tuber crops 	<ul style="list-style-type: none"> • Grower committee members are growers who sell their cassava root production to CODIPSA and/or other buyers • The committees support grower aggregation, coordination, and advocacy
MAJOR FUNDING SOURCES	<ul style="list-style-type: none"> • Self-funded through starch processing operations 	<ul style="list-style-type: none"> • Funded through grants and consortium membership contributions 	<ul style="list-style-type: none"> • Grant funding 	<ul style="list-style-type: none"> • Government funded 	<ul style="list-style-type: none"> • Self-funded through farming operations
FINANCIAL SUSTAINABILITY	FINANCIALLY SUSTAINABLE	PUBLIC SECTOR FUNDED	PUBLIC SECTOR AND GRANT FUNDED	PUBLIC SECTOR FUNDED	FINANCIALLY SUSTAINABLE

Cassava Seed System is CODIPSA Led With Limited Partnership Support





WE ARE are a producer and marketer of starches and derivatives, focused on the global market, which contributes to the economic and social development of producers, and the strengthening of the agro-industry of Paraguay

VISION: To be the main exporter of cassava starch and derivatives in the American countries, recognized nationally and internationally for the quality of their products, oriented to the global market, which cooperates for the continuous improvement of the producers and agroindustry in Paraguay



OUR HISTORY

Codipsa was conceived as a business project with a social focus, constituting an alternative to generate sustainable income for families of farmers in Paraguay, located in rural areas with less economic development. Therefore, from its beginnings in 1998 until today, CODIPSA provides integral assistance to the producer in the technical, commercial, credit management and other areas of benefit.

The first plant was inaugurated in 1998, followed by three more plants in the following years, one of them fully equipped with European technology plus a unit for the production of modified starches.

During the 1998-2003 period, the company consolidated its brand in the Paraguayan market and became a reference within the category of food grade cassava starch.

The year 2004 marked the beginning of the internationalization of the company and the CODIPSA brand with the first exports to the regional market (MERCOSUR).

Currently, Codipsa is a leader in the export of native cassava starch throughout the American continent, as well as being present in other continents such as Europe and Africa.

As a natural consequence of the incursion into international markets with high parameters of demand, CODIPSA has had to face the challenges related to the continuous improvement of quality. This path started in 2012 with the certification of ISO 9001, to then access the Kosher certification, FDA (Food and Drug Administration of USA), Gluten Free, and in 2016 ISO 22 000. CODIPSA understands that its commitment to the quality of products and services offered to customers must be constantly evaluated in the search for opportunities for improvement. We continue writing, day by day, our history. We invite you to be part of it.

Codipsa Mitigates Its Exposure to Cassava Starch Price Volatility Through Partnerships and Diversification (A)

Current volume of production is 22,000 tonnes, with 9,000 tonnes sold to the local market and the rest being exported (~13,000 tonnes, but varies between 10,000-20,000 tonnes)

CODIPSA's strategy is to buy 100% of the roots that growers bring to their plants. Starch is produced based on the volumes received, and is not necessarily tied to purchase orders. This strategy sometimes leads to large stocks depending on the competitiveness of Brazil's production

Joint ventures have allowed CODIPSA to introduce product line extensions in other starch products

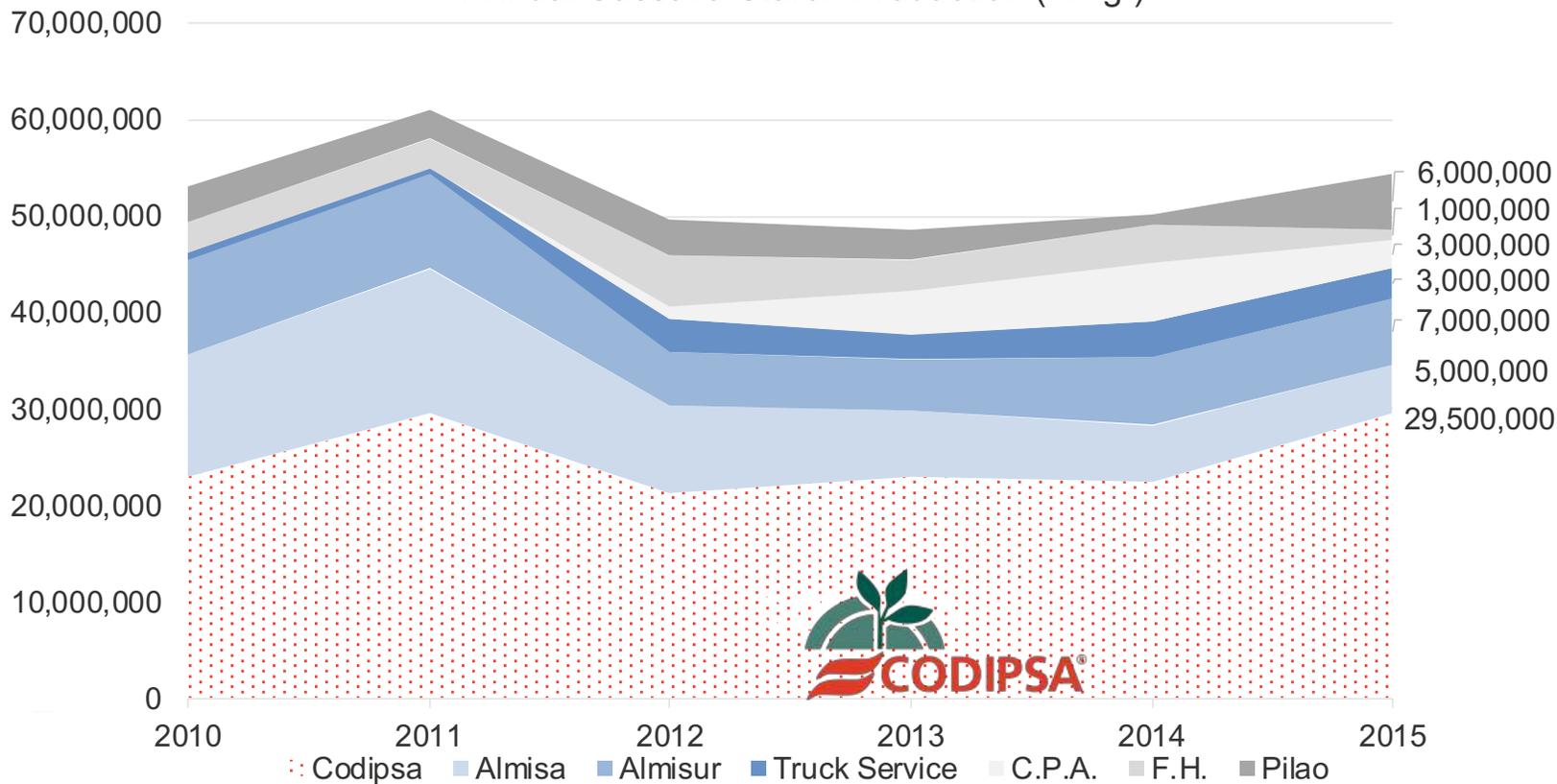


LEADERSHIP

CODIPSA Produced More Than Half of Paraguay's Cassava Starch in 2015



Annual Cassava Starch Production (in kg.)



SOURCE: Presentation at the Cassava Value Chains Workshop, CIAT, Cali, Colombia (Published on Sept 15, 2016)

CODIPSA Produced More Than Half of Paraguay's Cassava Starch in 2015



CASSAVA STARCH PRODUCTION IN PARAGUAY

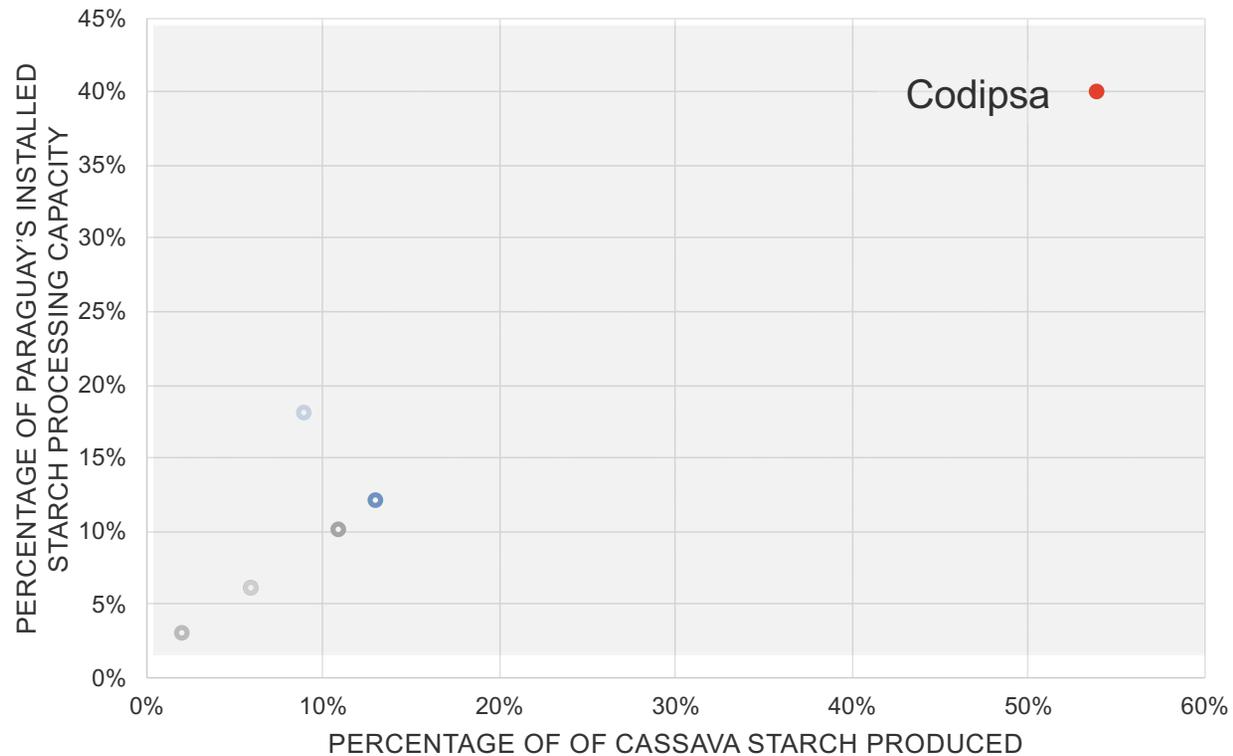
Entity	Cassava Starch Production in kg.						% of Total
	2010	2011	2012	2013	2014	2015	2015
● Codipsa	23,100,000	29,500,000	21,300,000	23,000,000	22,400,000	29,500,000	54%
Almisa	12,500,000	15,000,000	9,000,000	6,900,000	6,000,000	5,000,000	9%
Almisur	9,800,000	10,000,000	5,530,000	5,300,000	7,000,000	7,000,000	13%
Truck Service	875,000	500,000	3,600,000	2,500,000	3,750,000	3,000,000	6%
C.P.A.			1,200,000	4,600,000	6,000,000	3,000,000	6%
F.H.	3,000,000	3,000,000	5,280,000	3,200,000	4,000,000	1,000,000	2%
Pilao	3,750,000	3,000,000	3,600,000	3,200,000	1,000,000	6,000,000	11%
Total	53,025,000	61,000,000	49,510,000	48,700,000	50,150,000	54,500,000	100%

CODIPSA's Four Plants Managed 40% of Paraguay's ^(A) Installed Starch Processing Capacity in 2015



Entity	Location – Department	Capacity (T/day)	% of Total
Codipsa I	Raul A. Oviedo – Caaguazu	150	4%
Codipsa II	Repatriacion - Caaguazu	200	6%
Codipsa III	Guayabi - San Pedro	600	18%
Codipsa IV	Nueva Germania - San Pedro	400	12%
Almisa I	Caaguazu - Caaguazu	400	12%
Almisa II	Cnel. Bogado - Itapua	200	6%
Almisur I	Torin - Caaguazu	200	6%
Almisur II	Caaguazu - Caaguazu	200	6%
Truck Service	J.E. Estigarribia - Caaguazu	200	6%
S.P.A	Vaqueria - Caaguazu	200	6%
F.H.	Curuguaty - Canindeyu	100	3%
Pilao	Curuguaty - Canindeyu	150	4%
Pilao	Katuete - Canindeyu	200	6%
Agroind. Wendling S.A.	San Pedro	200	6%
Total		3,400	

CODIPSA Produced 54% Of Paraguay's Cassava Starch With 40% Of The Country's Installed Processing Capacity



CLAYUCA – Consortium of Public and Private Sector [ⓑ] Actors that Facilitates the Dissemination of Technology



Website: <http://www.clayuca.org/sitio/>

Research Areas:

- Cassava production
- Production, processing and use of cassava foliage
- Mechanization
- Animal feed
- Cassava processing
- Training and dissemination of information

CLAYUCA was established in 1999 as an alternative model. The consortium is based on strategic alliances between public and private entities to strengthen the exchange of experiences and information, transfer improved technologies and support the planning and financing of research and development activities for the cassava crop.

Thus, CLAYUCA contributes to the improvement of living standards and the sustainable management of natural resources in those regions of Latin America and the Caribbean, where cassava cultivation occupies a significant place in agricultural production systems.

CLAYUCA Supports Consortium Members with the Transfer of Improved Germplasm

B



CLAYUCA provides advice on the selection and introduction to each country where the project cassava member body, clones elite cassava selected for their high yield potential, high starch content and dry matter operates, tailored to the specific conditions of each country, resistance and tolerance to diseases and pests identified in the country.

SERVICES PROVIDED BY CLAYUCA:

Transfer techniques for in vitro handling and macro-propagation of Cassava to generate seed material quickly and in large quantities

Advisory formation of human resources required and adaptation of the techniques should be employed to ensure that the availability of adequate and with the required speed, the seed material of the varieties into the country amounts.

Advice on eco-efficient land and cassava cultivation management

Advice in formulating strategies for eco-efficient soil and cassava use, based on modern technologies seeking to regain and maintain soil fertility, for maximum productivity of the crop.

Mechanization for planting and harvesting

Identification of the most viable for machining the work of planting and harvesting in the cultivation of cassava, according to the specific characteristics of each project or country cassava technical and economic options.

Production and processing of cassava forage

Adaptation and validation of technology packages for the intensive production of cassava leaf for use in animal feed as a source of vegetable protein.

CLAYUCA – Consortium of Public and Private Sector [ⓑ] Actors that Facilitates the Dissemination of Technology



BACKGROUND: During the last 25 years, cassava research in Latin America and the Caribbean (LAC) has been the responsibility of the Centro Internacional de Agricultura Tropical (CIAT) in collaboration with national programs, and has been financed mainly with public-sector funds. At the end of the 1980s, this model was not longer viable due to changes in the world's socio-economic situation, forcing institutions and countries to organize and establish strategic alliances to continue cassava-based research and development activities. The cassava sector in Latin America and the Caribbean also felt this need. To solve this situation, it was necessary to identify and establish new models for financing and supporting cassava research and development to attend to the interests and needs of different groups of end-users of the technology from both the public and the private sector. It was proposed to form a Consortium to finance and support research and development of cassava, to strengthen the transfer of improved technologies, and to enhance the exchange of experiences, information and technologies among LAC countries. Thus, CLAYUCA was established. The mission of CLAYUCA is to contribute to improving living standards and sustainable natural resource management in regions of LAC where cassava plays an important role in agricultural production systems, through the generation, transfer and exchange of technologies, information and scientific knowledge among public and private sector institutions and farmers in the region.

MAIN OBJECTIVES ARE:

1. The organized participation of public and private sector institutions, including universities, non-governmental organizations and farmer groups, in the discussion and identification of priority issues and the definition of a regional research and development agenda for the cassava crop.
2. Execution of collaborative cassava-based research and development activities, with participation of diverse institutions in each member country.
3. Seeking additional financial support to implement research and development activities that could benefit all member countries.
4. Strengthening national capacity in each member country to execute research and development activities at the national level and to participate in activities at the international level.

The International Center for Tropical Agriculture (CIAT)



What we do: Delivering better varieties for income, nutrition, and resilience

CIAT scientists work with partners to boost yields by at least another 30% through continued genetic improvement and better agronomy as well as pest and disease management. CIAT seeks to develop and scale up cassava varieties that are agronomically competitive and more nutritious than varieties currently grown. Particular emphasis is placed on breeding for high content of provitamin A carotenoids.

The Center's cassava team also develops novel starch quality traits such as the waxy-starch and small-granule mutations which promise to strengthen the crop's appeal to industrial markets. To help counter the threat of pests and diseases, CIAT scientists devise diagnostic kits for disease detection and use advanced spatial analysis to study changes in the distribution of key pests and diseases. In search of solutions, researchers identify biological control agents and develop sources of genetic resistance. We develop better cassava that is:

HIGHER YIELDING

BETTER STARCH
QUALITY

NUTRITIONALLY
IMPROVED

RESISTANT TO
PESTS AND
DISEASES

How we do it: Leveraging genetic resources and biotechnology tools

CIAT conserves *in vitro* the world's most important collection of cassava germplasm. The cassava collection held in trust at CIAT includes a total of 6,592 accessions from 28 countries, represented in 5,709 clones of *Manihot esculenta* and 883 genotypes of wild species conserved using *in vitro* techniques. Over 37% of the cassava diversity held in CIAT's genebank originates from Colombia, with another 24% coming from Brazil. Collections from other South American countries (21%), as well as Central America and the Caribbean (7%), and Asia (7%) are also conserved at CIAT.

Cassava improvement at CIAT relies on biotechnology tools to speed progress and solve recalcitrant problems. Center researchers develop molecular markers for traits such as whitefly resistance, quantitative trait loci (QTLs) in populations derived from heterozygous parent materials, and protocols for rapid multiplication of disease-free planting materials through tissue culture.

Through the [Cassava Genome Hub](#), an online platform that produces and stores more than 15 terabytes of genetic data on cassava, CIAT is pioneering a new approach to big data management and analysis. Launched publically in late 2015, and accessible from anywhere in the world, the Hub allows researchers to manage and mine this huge amount of data themselves, using graphical and analytical tools to conduct complex analysis in a user-friendly way.

National Seed and Vegetable Quality and Sanitation Service (**SENAVE**)



SENAVE is the regulator of Paraguay's seed system, which is geared toward the soy and maize industry

SENAVE does not have clear legislation for the cassava seed system or for other vegetatively propagated crops

SENAVE has indicated that CODIPSA will have to register its seed as commercial, which dictates that seed be sold and not given away to producers

Export.gov | Paraguay Country Commercial Guide¹:

The National System of Information and Notifications (Sistema Nacional de Informacion y Notificacion Sobre Reglamentos Tecnicos, Normas y Procedimientos de Evaluacion de la Conformidad - SNIN), under the Ministry of Industry and Commerce, acts as a data bank for all standards-related matters (e.g., proposals, comments/input, approvals).

Final regulations are published in the government's Official Gazette. Each organization submits final regulations to the Ministry of Foreign Relations, which in turn submits them to the World Trade Organization¹.

(1) SOURCE: <https://www.export.gov/apex/article2?id=Paraguay-Standards-for-Trade>

CODIPSA Grower Committees



How Do Grower Committees Benefit Their Members?¹

- **Buy cheaper inputs.** By buying in bulk, the group can get discounts from suppliers and share transport costs.
- **Get services and advice** from CODIPSA's Extension Team, and other organizations that are willing to serve groups, but not individuals. Growers can share the costs of getting these services (such as travel costs).
- **Build their capacity** Members can easily share information and learn from each other. New ideas spread quickly through meetings, training and working together.
- **Obtain financial services** An individual grower may not have enough money to open a bank account or qualify for a loan. A group can get such financial services, and can acquire the skills to use them.
- **Get better prices for products** By marketing through a group, growers can share the storage, processing, transport and selling costs. By selling in bulk, they can attract new buyers and negotiate better prices.
- **Share the work burden** Group members can help each other with field work, harvesting, processing and administration. Members can focus on what they are skilled at, and leave other tasks to other members.
- **Do things that individuals cannot** Some problems can only be tackled on a large scale. Examples are controlling erosion in a watershed, managing irrigation, and filling a truck with produce.

(1) Framework adopted from: CRS and MEAS. 2015. Organizing and managing farmers' groups: A SMART Skills manual. Catholic Relief Services, Baltimore, MD, and Modernizing Extension and Advisory Services project, University of Illinois at Urbana-Champaign, IL.



James Legg

@jamesplegg

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Teamwork pays off in growing and selling [#cassava](#) in [#Paraguay](#) 😊 Farmer - Pastor Rivero works with a committee of farmers. They have a joint production and sales plan for their farming and get support from CODIPSA is maximising cassava yields [@IITA_CGIAR](#) [@RTB_CGIAR](#) [@ONikerson](#)



12:31 PM - 24 Apr 2018





Research & Varietal Development

CODIPSA Implemented a Varietal Evaluation Program to Increase Grower Access to Improved Varieties

Specific goals of the Program are to....



YIELD TARGET of 30 T/HA



DRY MATTER CONTENT of 27%, which is the native cassava level of dry matter



PLANT STRUCTURE FOR MECHANIZATION. Ideal plant structure is tall and straight for cutting into 18 cm stumps



DISEASE RESISTANCE to Bacterial Blight And Frogskin Disease



Photo Credit: David Eagle

Three Step Varietal Evaluation Program; First Two Steps of Have Been Established, but Not Yet Optimized

1 In-Vitro Review and Selection and Importation



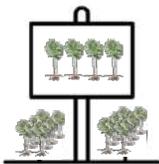
- Tissue culture is prepared in-vitro for later propagation
- All varieties (54 from CIAT) are reviewed at this stage
- 40 plants are advanced for further trialing

2 Greenhouse Testing



- 80 plants per variety advanced from In-Vitro Selection are tested in a greenhouse environment
- Plants are grown in greenhouses until the first leaves show, then they are transferred to be grown in a field environment

3 Field Trials



- All 54 varieties are taken into the field for trialing, with three observations taken over 18 months
- Best 10 varieties will advance to multiplication and commercialization, based on CIAT recommendations
- This stage has not yet occurred in the program

(1) In-Vitro Review and Selection and (2) Greenhouse Testing are occurring, but no varieties have been selected for advancement to **(3) Field Trials**

Consequently, new, improved varieties have not yet been bulked up and deployed to growers.

Three Step Varietal Evaluation Program; First Two Steps of Have Been Established, but Not Yet Optimized

1 In-Vitro Selection & Importation



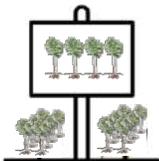
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James Legg
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Follow



CODIPSA technician describes work in evaluating 54 @CIAT_ #cassava varieties. They hope to select the ten best, promoting the best with their thousands of smallholder farmers @IITA_CGIAR @RTB_CGIAR @GCP21cassava @vianeyrweyendela

STEP 1: In Vitro Selection & Importation



OVERVIEW:

CODIPSA's primary focus is on maintaining in vitro plantlets in the lab; it conducts limited micropropagation of source material.

CODIPSA maintains 10-20 motherplants of each variety in the lab at all times.



In Vitro Cassava Germplasm at CIAT¹

(1) Photo Source: *Use of Tissue Culture Techniques to the Conservation and Exchange of Cassava Germplasm Material/Health Certification of Planting Material*, Rondon, Ericson Aranzales

EXPERIENCE:

In 2012, CODIPSA formed an alliance with CIAT to import, trial, and select cassava varieties for deployment into its partner growers in Paraguay. Takeaways include:

- First time that cassava germplasm had been officially imported to Paraguay, and due to bureaucracy Codipsa was only permitted to import 10 plantlets of each of the 50 CIAT varieties
- CODIPSA waited 1.5 years to get the germplasm through quarantine (one year) and government certification
- CODIPSA staff was inexperienced with early generation cassava plantlets, which combined with an export delay contributed to near 100% mortality of imported materials in 2014
- SENAVE required that all imported cassava varieties to be officially registered. Requirements of registration were:
 1. Must be a registered seed company and possess a seed variety registration (both);
 2. Must have a qualified breeder on staff (3 years of trial results and experience before he can defend); and
 3. Seed cannot be distributed for free to growers under the seed variety registration

STEP 2: Greenhouse Testing



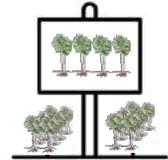
Step	Post-Lab Hardening	Styrofoam Cup	Plastic Tub	Main Pot
Days	15	12-18 Days	42-48	90-120
Description	<ul style="list-style-type: none"> • Harden plantlets from in vitro by placing them into small jars and cover them in plastic wrap for 15 days inside of a screenhouse prior to transplanting them into the Styrofoam cups 	<ul style="list-style-type: none"> • Transplant hardened in vitro plantlets from small jars into Styrofoam cups with substrate* • Grow in Styrofoam cups until first leaves emerge (12- 18 Days) 	<ul style="list-style-type: none"> • Transplant plantlets from Styrofoam cups into plastic tubs for root development 	<ul style="list-style-type: none"> • Transplant rooted-plants to larger pot for stem development and multiplication • Plants stay in the pots for between 90-120 days before they can be propagated and/or planted to the field; 1X every three months • Water manually; the irrigation system in greenhouse caused leaves to get too wet



To manage high internal greenhouse temperatures, CODIPSA added a shade cloth and installed fans

CODIPSA uses high-quality substrate to mitigate the introduction of soil-borne disease. CIAT recommended nutrient package is added to the substrate to support plant growth

STEP 3: Field Trials



CODIPSA HAS TAKEN ALL 55 CIAT VARIETIES TO THE FIELD:

- 55 varieties X 80 plants per plot X 5 locations = 21,600 clean stems from CIAT breeder seed
- Replicated grower practices in field trials to minimize any requirement that growers change their behavior to achieve like productivity
- Applied the same methodology as CIAT and Embrapa to streamline phenotypic trait analysis and varietal prioritization

KEY QUESTIONS TO BE ADDRESSED THROUGH FIELD TRIALS:

- What is the starch content of the varieties?
- Which varieties are best suited for first half of the year production (Jan-June when temperatures range from 15 to 35 degrees celcius) vs. second half of the year production (July-December when temperatures exceed 35 degrees)?
- What are the yields of the varieties at 18-24 months?

Once the top 10 varieties have been prioritized, Codipsa will determine how to bulk-up and deploy seed of those varieties get it out to the market



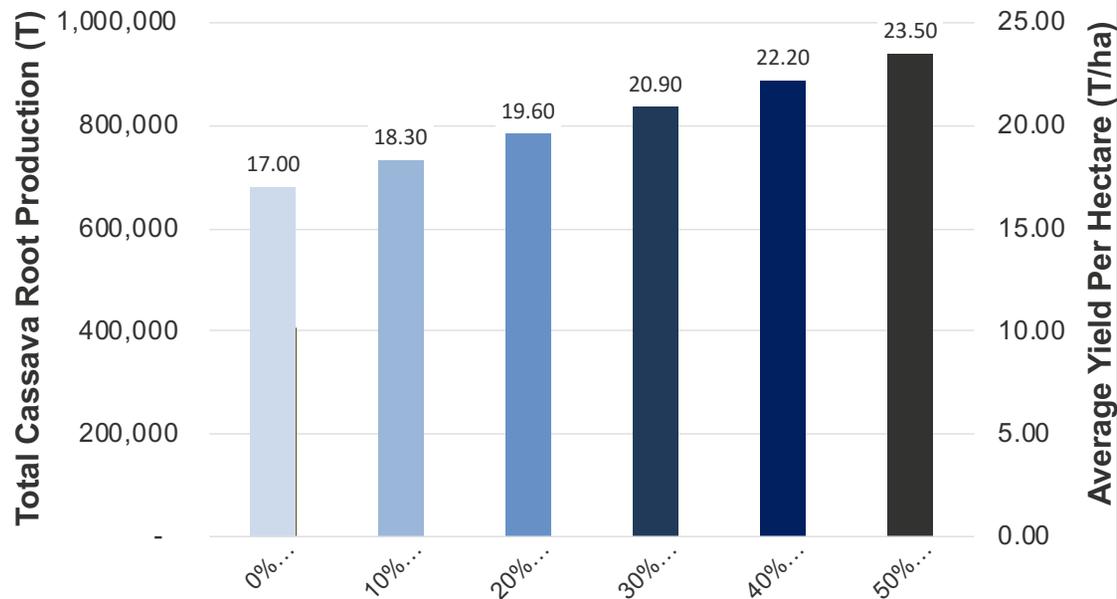
PERFORMANCE TRIALS OF PROMISING CIAT CASSAVA VARIETIES BY CODIPSA



CODIPSA plans to register prioritized varieties with SENAPE. To do so, three years of trial data, plus one year of on-farm data is required.

For Every 10% of Production Area That Adopts Improved Varieties, Cassava Root Production Increases by Over 30,000 Tonnes

Total Cassava Production & Average Yields Based on Varying Adoption Rate Assumptions

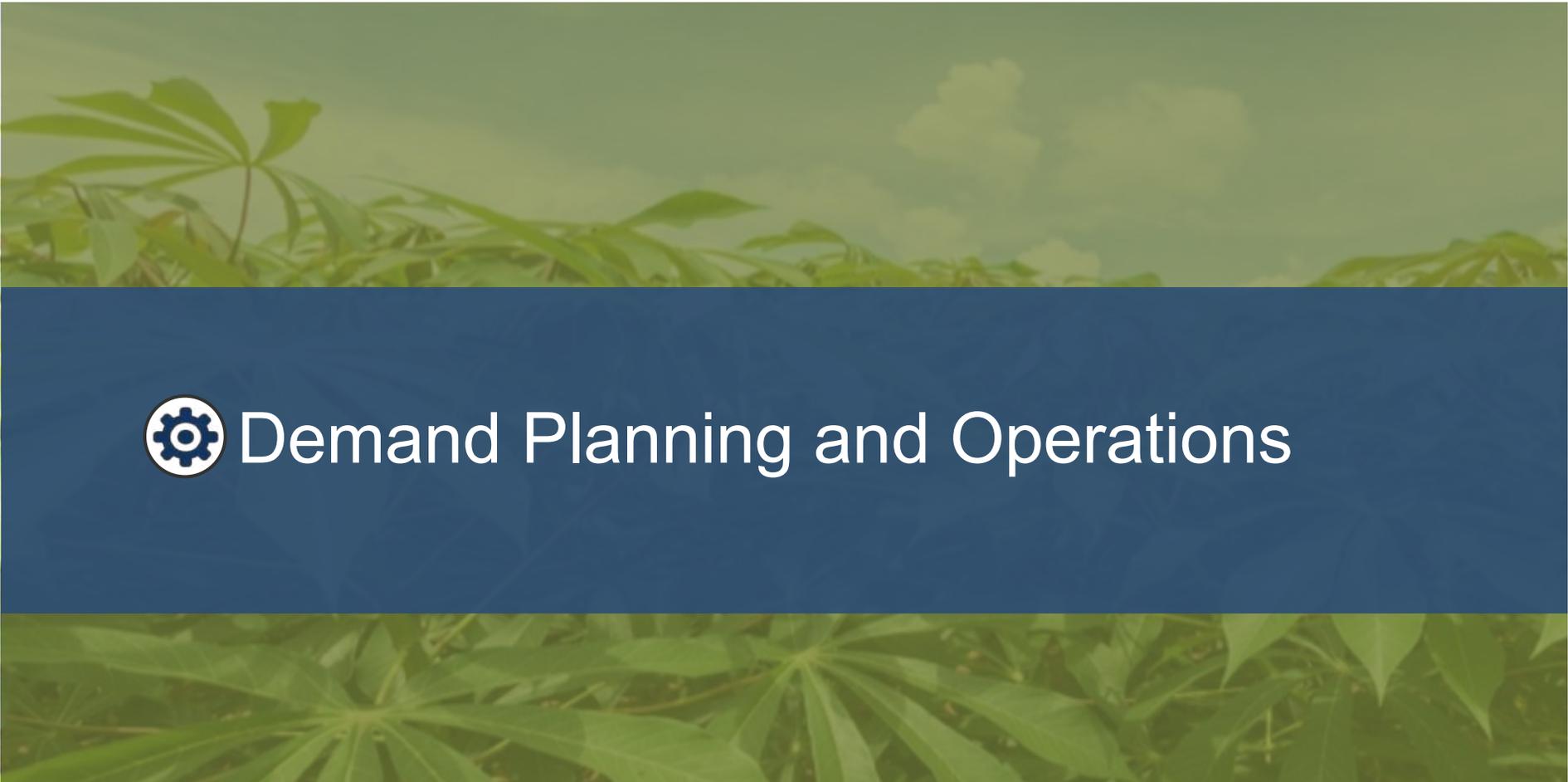


Key Input Assumptions

CODIPSA Grower Improved Variety Assumptions	
# of Growers	3,150
Avg. Cassava Hectares Per Grower	7.5
Total Number of Hectare	23,625
Planting Density Per Ha	12,000
Total Stem Planting Requirement	283,500,000
Average Yield Per Hectare	17
Total Cassava Root Production (in tonnes)	401,625
Average Yield of Improved Varieties	30
Improved Variety Yield Differential (T/ha)	13

Adoption Data Used to Chart Production Impact of Improved Varietal Adoption

Adoption Percentage of Improved Varieties	Cassava Production (T)	Prod. Increase (T)	Average Yield of Growers
0% Adoption [BASELINE]	401,625	-	17.00
10% Adoption	432,338	30,713	18.30
20% Adoption	463,050	61,425	19.60
30% Adoption	493,763	92,138	20.90
40% Adoption	524,475	122,850	22.20
50% Adoption	555,188	153,563	23.50



Demand Planning and Operations

Demand Planning and Operations



Close Working Relationship Between Cassava Growers and Processors Promotes Efficient Information Exchange

Core to CODIPSA's mission is its support of smallholder growers. This ethic is epitomized by the close, trust-based relationships that CODIPSA's extension team maintains with cassava root growers. Extension team members have personal relationships with growers, and are familiar their production practices, including: area under cultivation, crops in rotation, input preferences, historical sales to CODIPSA, and current year production commitments to CODIPSA. This relationship is supported by the use of a digital application to track growers' performance against their production volume commitments (vouchers).



Incentives of Growers and Processors to Increase On-Farm Productivity are Strongly Aligned

The incentives of cassava root growers and CODIPSA to increase on-farm productivity are strongly aligned. CODIPSA benefits from higher productivity through increased root supply, which increases processing efficiency and reduces the unit-cost of production. And lower production costs enable CODIPSA to increase profits through higher volumes, higher unit-margins, or both. Growers benefit from a higher return on their hecterage which would lead to a virtuous cycle of higher yields → increased production → higher grower and processor incomes → increased grower adoption of improved varieties.



CODIPSA and Growers Pre-Negotiate the Timing and Volume of Roots to be Delivered

CODIPSA and growers determine the volume and timing of root supply delivery to the local processing factory in February. Once terms have been agreed to, CODIPSA issues a voucher to growers. When growers honor the terms of the voucher, CODIPSA pays them a bonus (10K Paraguayan guaraní). The formality of the voucher system promotes accountability, and allows CODIPSA to better manage the volume and timing of supply to each of its four factories.



Processor-Led Extension Supports Supply Chain Assurance

Growers make root production delivery commitments to CODIPSA, and CODIPSA's agricultural extension team is able to track and support growers' performance against their targets through its engagement with growers. CODIPSA is able to leverage production information received from its agricultural extension to update its root supply forecast throughout throughout the agricultural production cycle.



Grower Committees Support Root Demand Planning by Clarifying Supply Expectations

Growers ban together in committees to make production and marketing decisions that impact CODIPSA's supply planning and operations. For example: how much land should be dedicated to cassava cultivation? What production volume commitments should be made to CODIPSA? When and where should planting implements be deployed?

CODIPSA's business model relies on a consistent supply of cassava roots to achieve its profit-maximizing starch output

CODIPSA's engagement supports cassava growers through...



DEMAND ASSURANCE

CODIPSA has a processing capacity of 1,350 tonnes/ day, and operates at 25% capacity



ACCESS TO MECHANIZATION

Growers can use Codipsa mechanization equipment at no charge



AGRICULTURAL EXTENTION

CODIPSA's technical team evaluates GAPs and provides training and technical support



ACCESS TO CREDIT

CODIPSA's engagement with growers has spurred the development of credit schemes¹



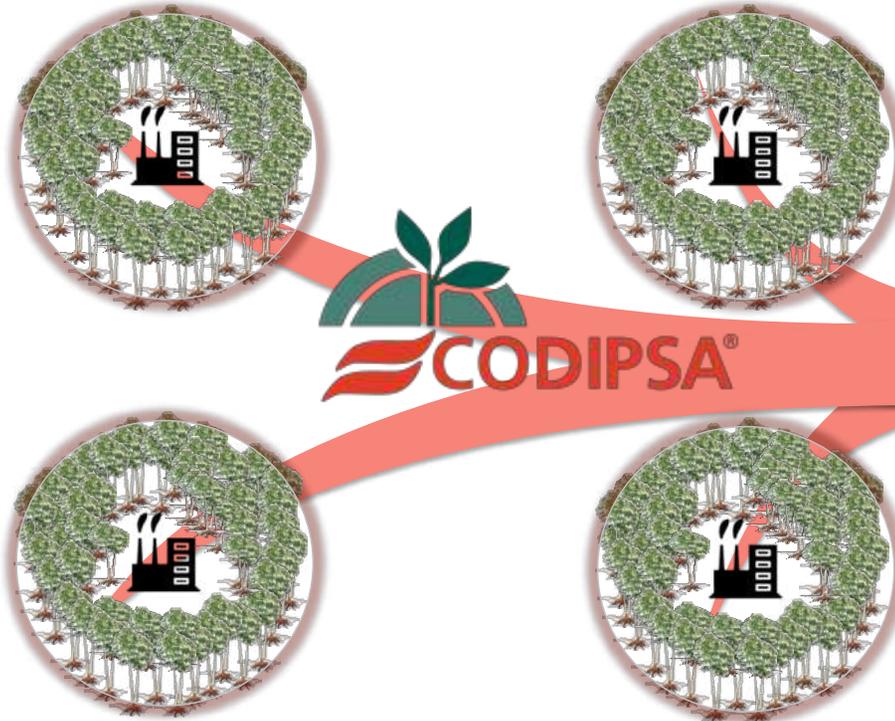
VARIETAL SELECTION²

CODIPSA is evaluating 54 CIAT varieties for registration and introduction to growers

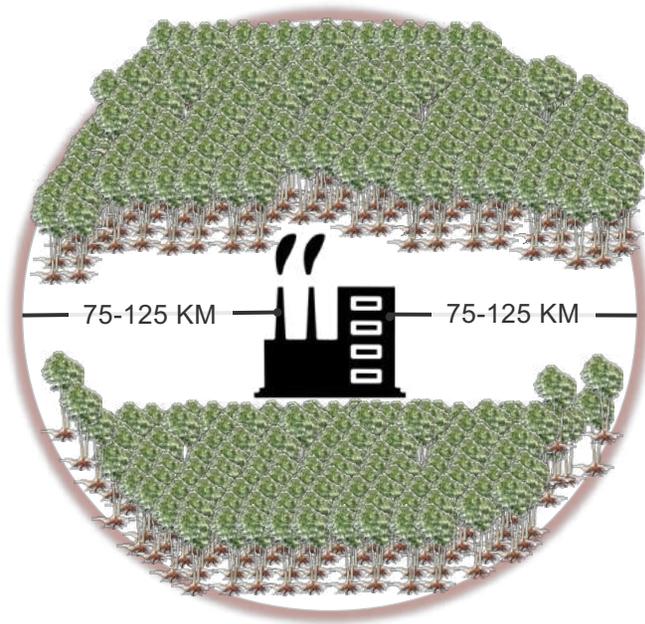
(1) Governmental policies eliminated private sector credit for producers, but growers relationship with Codipsa has nevertheless increased their credit worthiness because demand for their production is more assured
(2) CODIPSA is evaluating varieties from CIAT, but as of April 2018 none of the varieties had been made available to farmers or commercialized

CODIPSA'S Four Cassava Starch Processing Plants Source Roots From ~3,150 Growers

FOUR PROCESSING PLANTS WITH EACH HAVING A 75-125KM (3-4 HR DRIVE) CATCHMENT RADIUS



CODIPSA Buys Cassava Roots at Spot Prices from Growers, Grower Committees, and Aggregators that Deliver Production to their Processing Factories



SUMMARY: CODIPSA stratifies its growers into three tiers based on growers' interest in working with CODIPSA's agronomy-led extension team, their technical and root production capacity, and reliability as a supplier. The tiers receive differentiated support.

Growers manage and fund land preparation, cultivation, harvest, and the delivery of roots to CODIPSA's factories. CODIPSA and growers execute Memorandums of Understanding (MoU) that stipulate the time and volume of delivery to a specified CODIPSA factory. Growers receive a bonus when they fulfill the MoU terms. Growers are paid at delivery based on the volume, quality, and starch content of their roots. CODIPSA manages all subsequent value addition activities, including grading, cleaning, processing, packaging, marketing, selling, and distributing finished product.

KEY CHARACTERISTICS

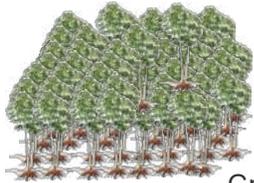
- High level of CODIPSA/grower coordination to implement good production practices with TIER I growers; direct buyer contact with growers and grower committees
- CODIPSA's root specifications are set and known by growers in advance

CODIPSA Provides Differentiated Support to its ~3,150 Growers Based on an Informal Tiering System

	Typology	Relationship With Grower	Support Provided	Number Of Growers
TIER I	Partner Growers	Trusted Advisor	<ul style="list-style-type: none"> •Access to Implements •Technical Assistance 	150
TIER II	Affiliated Growers	GAP Support and Information Exchange	<ul style="list-style-type: none"> •Technical Assistance 	2000
TIER III	Known Growers	Transactional	<ul style="list-style-type: none"> •Limited 	1000

CODIPSA's Goal Is To Improve Grower Productivity by Providing Access To High-Quality Producer Seed

Cassava Farm Profile



1-10 hectare farm size

Cassava is planted on a fraction of the farm

Grower typically has an off-farm job to supplement income

Many growers participate in committees, which provide the following functions:



Purchasing inputs

Marketing crops

Administrative functions



Native Brazilian variety is the primary cassava cultivated, along with varieties that were unofficially imported from Brazil

CODIPSA's planned strategy is to make high-quality producer seed available to growers to increase their yields and, in turn, to process more

HOWEVER, none of the varieties being tested by CODIPSA have been made available to growers or have been commercialized yet

Besides a small portion of plantation land, the vast majority of CODIPSA's supply is from local growers, which puts a premium on raising growers' productivity

Though CODIPSA has a very good relationship with growers, competition from a cassava biofuel plant threatens to compete for cassava root supply

Profiles of Three *Partner Growers* of CODIPSA

GROWER	Pastor Riveros	Benigno Acosta	Jose Del Carmen Britez Vera
PLANT	CODIPSA III	CODIPSA IV	CODIPSA IV
FAMILY SIZE	Three families farm 25 hectares, with 5 hectares dedicated to cassava	Group of four fathers farm 10 hectares, with 2.5-4 hectares dedicated to cassava per year	Family farm with 4 hectares of cassava and yields of 20,000 kilo per hectare. Family has nine members, with only 4 old enough to work
PRODUCTION PRACTICES	<p>Hand harvested 12,000 tonnes of cassava, with 100% going to CODIPA</p> <p>Main variety grown is the Native Brazilian variety and he does not rotate varieties</p> <p>Main production issue is with labor availability</p> <p>Receives Brazilian stems for free. Would pay for more productive stems one time and then would recycle them year after year</p> <p>Participates on a grower committee, that sells 300 tonnes per year</p> <p>Receives 1,500 cm of rain annually in his region</p>	<p>All cassava production goes to CODIPSA, besides ½ hectare for fresh consumption</p> <p>Grows 4-5 different native varieties that they receive for free through trade within local communities</p> <p>Participates in a grower committee. Each committee in the region has 30 members and membership allows free trade, use of equipment, and access to government funding</p> <p>Growers pool money to an internal fund, instead of using a banking system, all in an effort to help each other more effectively</p> <p>These growers plant with machinery from CODIPSA, weed by hand, and harvest through semi-mechanical means. Current productivity is 25 t/ha</p> <p>Access to more machinery would increase productivity, but also requires time to overcome a learning curve</p> <p>Receives 1,400-1,600 cm of rain annually in his region</p>	<p>Plants two native cassava varieties and harvests manually, with almost 100% going to CODIPSA</p> <p>Acts as an intermediary for CODIPSA and other growers- sometimes for delivery, sometimes does his own planting</p> <p>Is not a member of a committee because he perceives the meetings to be too time consuming</p> <p>Would be willing to try a more productive variety and use ½ hectare for field testing. Would also be willing to advocate for the use of better material if the field test was successful</p> <p>Willing to try fecula blanca because of the promise of higher yields and better starch</p>

Partner Grower Takeaways



CODIPA growers have high relative yields (20-25 t/ha) compared with the country average (17 t/ha)



Growers are willing to try different, higher-yielding varieties and mechanization



Progressive growers recognize the value of high starch varieties (i.e., fecula blanco)



Areas for improvement include: access to improved varieties (yield, starch level, starch stability) and mechanization services

CODIPSA Promotes the Diffusion of Cassava Production Technologies to Achieve Crop Efficiency

Technical Assistance Overview from CODIPSA Website¹:

<https://www.codipsa.com.py/asistencia-tecnica.html>

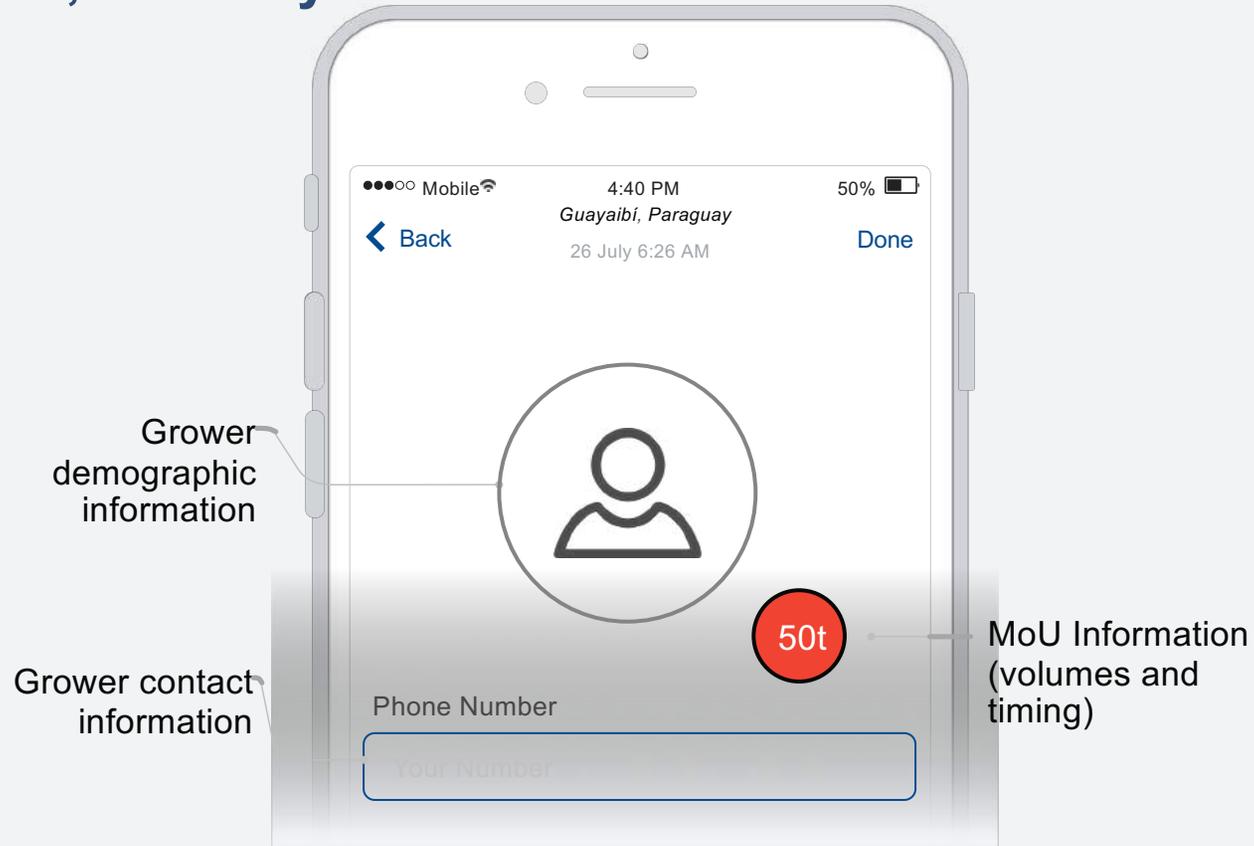
TECHNIQUES IN CULTIVATION CODIPSA accompanies the cassava growers through a team of agricultural technicians in:

- Crop planning
- Promotion of the application of technology in the cultivation of cassava for the income sector, with the aim of gradually transforming the agricultural culture of the grower
- Mechanization, indispensable for the efficiency of the item given that: - Optimizes the time of the grower, being able to dedicate to the diversification of items. - Decrease in production costs. - Increase the area planted in less time, among others



(1) CODIPSA. "Asistencia Técnica." Google Translate. <https://www.codipsa.com.py/asistencia-tecnica.html>.

CODIPSA Developed a Mobile Application to Streamline the Collection, Management, and Analysis of Grower Information



Information on Growers' Agronomic, Economic, and Demographic Characteristics Enables CODIPSA Extension to Offer Personalized Technical Support



Framework adopted from: *farm household-level decision making*

Between its Four Plants, Codipsa Possesses 20,000 Tonnes of Annual Starch Processing Capacity

**Plant I: Raul Oviedo (150 t/day)
800 Growers**



**Plant II: Repatriación (200 t/day)
1,000 Growers**



**Plant IV: Nueva Germania (600 t/day)
2,200 Growers**



**Plant III: Guayaibi (400 t/day)
3,000 Growers**



Comparison of Plants III and IV



Plant III: Guayaibí



Cost to build: \$5 million

Daily Starch Capacity: 150 tonnes



Plant III growers have a close relationship with CODIPSA

Plant III operates for eight months out of the year (March through October) and is closed for 4 months due to lack of supply. Each day is split into three shifts

Plant III operates 24 hours per day, but is closed daily from 5:00pm-8:00pm when the power grid is typically overloaded

CODIPSA is experimenting with a biogas energy source at Plant III. If successful, it may be introduced at Plant IV

The Drying process:

Energy is hydro and uses wood burning to generate heat. This process requires 1800-2000 kilos of wood per hour. Wood is bought legally from local growers with government documentation

- Cassava is brought in by conveyor belts, rinsed with water and disrupted using a large spinning rotation
- Manual labor then cuts off spare roots. A dryer dries the cassava up to 35%. From the dryer, it goes into a tube above plant to be flash dried
- In 2014, an additional process was added for starch to be used for paper production. For that process chemicals need to be added prior to drying, but these processes are only undertaken if demand exists, as it can only offer up to 5% max of revenue
- The waste by product is given to partner who uses it for feed for free, but the partner must pick it up on their own



Plant IV: Nueva Germania



Cost to build: \$11 million

Daily Starch Capacity: 100 tonnes



70% investment secured to increase fresh cassava capacity to 800 tonnes per day

Utilizes European technology to be more efficient in peeling cassava, compared to Plant III, by using barrels instead of wheels/sticks

Only operates for four months out of the year, due to lack of supply, with two shifts per day

Plant IV is not far (20km) from Plant III, but has a completely different grower culture:

Turnover at Plant IV is very high due to a much less constant supply from a lack of large scale growers. The culture of growers in this region is much more reliant on government subsidy than in the region where Plant III exists. Formal land ownership exists, but is disregarded in some cases, which was not taken into account when this plant was built. All technicians started within the last month and they are still working to build trust.

The Drying process:

- It takes five minutes from initial grinding to silo delivery
- Centrifuges are used to dry and separate the cassava starch matter
- This drying and separating stage supposedly only takes one person to operate

This plant produces higher quality starch compared to Plant III

10+ Minute Video Detailing CODIPSA's Automated Starch Processing Plant IV: Nueva Germania (600 t/day)



Larsson Sweden -- Case Study at Codipsa 4 _ Paraguay
<https://youtu.be/Ei4k4P8WB8Q>





Financial Sustainability

Proving Out the ROI on CODIPSA's Introduction of Improved Varieties Requires Significant Insight to Evaluate Whether Benefits Exceed Costs

Benefits

Cost Reduction – Efficiency

- Search Costs (less time to source cassava)
- Labor Cost (less time to ferry, sort, clean, and operate machines to produce same unit of starch)
- Machine Operating Hours (faster throughput → reduced machine operating variable cost (e.g. service per/hr, electricity per/hr, longer useful life))

Margin Increase – Opportunity Cost

- Margin made from the production of starch that would not otherwise have been produced/sold due to machine processing time bottleneck

Social Impact

- Smallholder farmer incomes
- Mission statement fulfillment
- Employee pride (retention) from working for a firm that partners with SHFs

Costs

Cost Increase – Establishment & Operations

- CapEx associated with screenhouse and field production establishment
- Incremental operational costs associated with managing seed increase, field trialing, and varietal introduction
- Increased average unit purchase price of stems/bundles



Enabling Environment

Enabling Environment



CODIPSA Makes Good on Its Mission to Generate Sustainable Income for Families of Growers

From its beginnings in 1998 until today, CODIPSA provides integral assistance to the grower in the technical, commercial, credit management and other areas of benefit. CODIPSA is solving for the lack of an enabling environment through the establishment of a private sector-led and funded initiative to increase agricultural productivity. As a for-profit social enterprise, CODIPSA is willing to support growers with agronomic extension in the absence of an effective public sector alternative.



CIAT is a Trusted Advisor that Supports CODIPSA's Varietal Evaluation, Selection, and Multiplication

CIAT has provided value-added advisory support to CODIPSA through its selection and importation of cultivars to Paraguay. CIAT continues to be a reference and technical advisor to CODIPSA on tissue culture management, greenhouse requirements, and field trial methodology. In other contexts, this advisory function would be provided by a national agricultural research institution; the direct linkage between CODIPSA and CIAT is a workaround



Free Trade of Cassava By-Products Within the Region

Paraguay's free trade agreement with key South American markets allows CODIPSA to be more competitive, because it does not have to incur or pass along export taxes to its buyers.



Close Proximity of Actors Supports Stakeholder Coordination

The co-location of cassava cultivation and processing plants in the eastern region of Paraguay reduces the risk of post-harvest loss and transportation costs, and it improves supply/demand coordination between CODIPSA and cassava growers. Additionally, Paraguay's border dynamics with Brazil are significant as companies can buy and sell stems and roots across the border.



Government Has Implemented Programs to Support Growers

The government of Paraguay has implemented select programs to support growers' livelihoods. For example, in the past, grower committees were able to access machinery and production intensification systems (greenhouses for vegetable crops).

CODIPSA's Technical Team Evaluates Good Agricultural Practices that Can Increase Grower Productivity



Codipsa

July 3 at 10:39 PM · 🌐

El Equipo Técnico de nuestras Plantas capacitándose en Descripción Varietal en campos de nuestra VAM, a demás realizando prácticas en el denominado "Campo Experimental".. cuyas técnicas de evaluación y ensayos realizados se pretenden implementar con nuestros Productores con el fin de mejorar sus rendimientos de cosecha en sus plantaciones! Compartimos imágenes:

The technical team of our plants trained in varietal description in fields of our vam, to others performing practices in the so-called "experimental field".. whose evaluation and testing techniques are intended to implement with our producers in order to improve their yields of Harvest on their plantations! We share images:



MEDA Has Taken an Equity Stake in CODIPSA to Advance its Social Impact



CODIP S.A.

Codipsa has provided a sustainable manioc market and agricultural assistance to smallholder farmers in Paraguay since 1998.

CODIPSA is currently the largest producer of starch in Paraguay, with a production capacity of 60,000 tonnes per year across four plants. It supplies most of the starch consumed in the country, and exports its product around the world.

Codipsa has supported more than 10,000 small-scale agribusinesses to increase their productivity levels via a unique training module and an incentive bonus system.

The training programme teaches best practices for planting, sustainable soil management and partnership-building. In particular, CODIPSA encourages growers to engage with credit providers and to streamline their working capital usage.

The bonus system rewards growers for meeting their crop yield targets within a certain date and for producing high quality products. These practices have helped farmers raise household income and reduce workload.

Impact

With MEDA's help, CODIPSA was able to create a positive impact in various ways:

- Access to goods and services: Has worked with over 10,000 smallholder farmers in Paraguay since inception, improving their farming income and supplying high quality starch and modified starch to over 18 countries
- High quality jobs: Created 112 jobs in four plants across the country. Sold their starch through more than 330 points of sales in Paraguay, 120 of which were owned by women. Offered loans for home renovation and children's education to employees. Ensured delivery of legal benefits, a rarity amongst formal businesses in the country, to all employees. Maintains a health and safety policy to reduce work-related injuries
- Governance and management: Improved governance by creating a professional board
- Innovation: Ensured that smallholder farmers would be primary suppliers, in contrast to normal Latin American practices of sourcing from large institutional farms. Introduced modified starch production to Paraguay and established the company as the leading exporter of starch from Latin America

(1) SOURCE: MEDA Website, <https://www.meda.org/component/content/article/30-english/investments/market-systems-investments/267-codip-s-a-investment>

CODIPSA is a For Profit Social Enterprise that has Impact Baked into its Business Model



So important for us is our motto: "Leading the export of cassava starch with social responsibility"

THEODOR REGIER •
DIRECTOR EJECUTIVO

(1) SOURCE: MEDA Website, <https://www.meda.org/component/content/article/30-english/investments/market-systems-investments/267-codip-s-a-investment>

MEDA, Along With 190 Local Private Investors, Were the Founding Partners of CODIPSA



We are a company founded by three groups of partners: the Association Mennonite Economic Development Associates del Paraguay (MEDA-Py), MEDA-NA (North America) and over 190 local private investors.

The majority shareholders are entrepreneurs Mennonite agroindustrial farmers and traders, who committed to small farmers, business and seek to provide sustainable alternatives to rural poverty in Paraguay.¹



thank you



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ACKNOWLEDGEMENTS

Thank you for your time and support in the development of the Cassava EGS profile!

Stakeholders Consulted

Name	Position	Organization
Mirta Silva	Head of Raw Materials	CODIPSA Plant III
Heidi Ediger	Plant Manager	CODIPSA Plant III
Artavio Suares	Trial Manager	CODIPSA Plant III
Allen Funk	Director	MEDA Paraguay
Joel Jaime	Administer and responsible for supply	CODIPSA Plant IV
Sizenando Feldkitcher	Production oversight supervisor	CODIPSA Plant IV
Luis Cuyer	Buying and supplying cassava	CODIPSA Plant IV
Ramon Lezcano	Technician	CODIPSA Plant IV



Cassava Seed Systems Learning - South America



James Legg

@jamesplegg · May 2, 2018

A team from East Africa, USA and Canada visited cassava production, seed system & processing activities in Paraguay & Brazil from April 23-30. Funded by the Bill & Melinda Gates Foundation. A wonderful learning experience. Check out the Tweets!

Dr. James Legg published a Twitter story with pictures and insights from the cassava EGS study tours to Paraguay (CODIPSA) and Brazil (Embrapa)

<https://twitter.com/i/moments/991536217429864448>



The following five slides about CODIPSA's varietal evaluation program were extracted from a CODIPSA presentation. The aspect ratio has been adjusted from Standard (4:3) to Widescreen (16:9).

Codipsa: Liderando la exportación de fécula de mandioca con responsabilidad social

Published on Sep 15, 2016

Presentation at the Cassava Value Chains Workshop

CIAT, Cali, Colombia. 24-26 August 2016

Speaker: Hans Theodor Regier, Executive Director, CODIPSA



**PROGRAMA DE
MEJORAMIENTO DE
VARIETADES DE
MANDIOCA EN EL
PARAGUAY
VAM**





**PROGRAMA DE MEJORAMIENTO DE
VARIEDADES DE MANDIOCA EN EL
PARAGUAY** >>>

OBJETIVO GENERAL: Elevar la eficiencia, productividad y competitividad del sector de la mandioca en Paraguay

Un proyecto de Codipsa con el apoyo de:



Centro Internacional de Agricultura Tropical
International Center for Tropical Agriculture
Consultative Group on International Agricultural Research

**PROGRAMA DE MEJORAMIENTO DE VARIEDADES DE MANDIOCA EN EL
PARAGUAY**

OBJETIVOS ESPECÍFICOS



OBJETIVO ESPECÍFICO 1: Selección de variedades e importación.

- Introducción de 55 variedades de mandioca



PROGRAMA DE MEJORAMIENTO DE VARIEDADES DE MANDIOCA EN
EL PARAGUAY



OBJETIVOS ESPECÍFICOS

Criterios de selección de variedades de mandioca:

- Alto potencial de rendimiento por hectárea
- Alto contenido de almidón
- Buena adaptación a las condiciones específicas de la zona templada y clima subtropical
- Tolerancia a las enfermedades
- Buena arquitectura de la planta
- Buena respuesta a condiciones de manejo agronómico

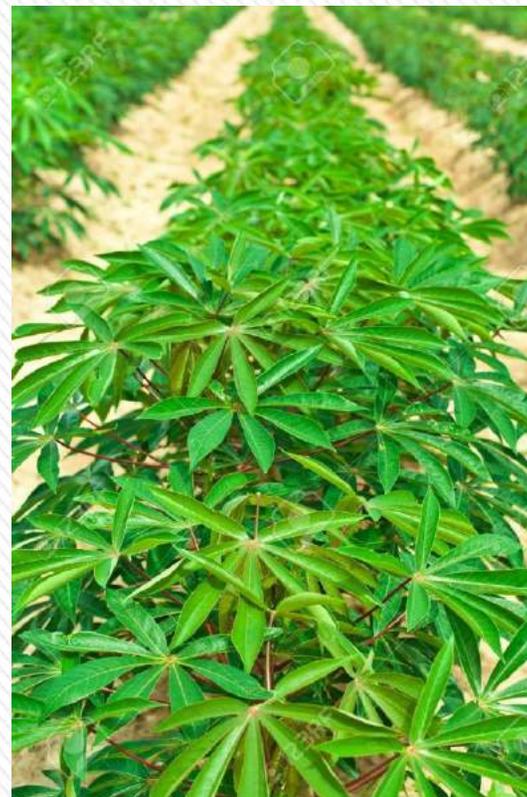


**PROGRAMA DE MEJORAMIENTO DE VARIETADES DE MANDIOCA
EN EL PARAGUAY
OBJETIVOS ESPECÍFICOS**



OBJETIVO
ESPECÍFICO 2:
Evaluaciones de los
Materiales

OBJETIVO
ESPECÍFICO 3:
Reproducción
, incremento
y plantación





The following presentation on CIAT's use and transfer of cassava germplasm is provided in its entirety

Use of tissue culture techniques in the conservation and exchange of cassava germplasm material: CIAT case

Ericson Aranzales Rondon
Palmira, Columbia, 28 July 2014

Link to Presentation: <https://cgspace.cgiar.org/bitstream/handle/10568/82943/CIAYUCA-2014.pdf?sequence=1&isAllowed=y>



INTERNATIONAL COURSE ON MODERN
TECHNOLOGIES FOR PRODUCTION,
PROCESSING AND UTILIZATION
OF THE CASSAVA CROP

Use of tissue culture techniques in the conservation and exchange of cassava germplasm material: CIAT case

Ing. MSc. Ericson Aranzales Rondón

Genetic Resources Program

e.aranzales@cgiar.org

Palmira, Colombia, 28 July, 2014

Holding Germplasm in CIAT Register into the International Treaty

(Agreement signed with the Governing Body on October 16, 2006)

Crops	Rank (No.)	Taxa (No.)	Country of origin (No.)	Accessions (No.)
Beans (<i>Phaseolus</i>)	1	44	110	37,625
Tropical forages	1	734	75	23,140
Cassava (<i>Manihot</i>)	1	33	28	6,632
		811		67,397

Germplasm materials as International Public Goods

(No. 2: Beans, USDA 17,192; Cassava, EMBRAPA 3,902; Tropical forages, ILRI 18,661)



MOCHICA-PERU CULTURE
AMANO MUSEUM-LIMA. 1300 B.C.

- *Manihot* is a Neotropical genus, distributed in its natural habitat from the southern United States through Mesoamerica, South America, Brazil, Perú, Bolivia, Paraguay and Argentina.

- Cassava is the fourth most important supplier of food calories in the tropics.

-The principal economic product is starchy roots, which are utilized in a wide range of end uses, most notably including human food, animal feed, and industrial products.



Status of Manihot germplasm at CIAT - GRP

Landraces	5,341
Wild	883
Breeding Material (CIAT)	408
Total	6,632

(materials coming from 28 countries)



Accessions registered into the Multilateral System
of the International Treaty

Source: CIAT-GRP, 2014

Composition of the **Manihot esculenta** collection

SOURCE REGIONS	ACCESSIONS
Colombia	2,000
Brazil	1,281
Other countries South America (6)	1,127
Others, Central America and Caribbean (11)	530
Asia (7)	374
Other countries (2)	29

5,341 landraces (28 countries)

Priorities for exploration: Bolivia, Brazil, Colombia, Haiti, Nicaragua, Peru, Venezuela, Paraguay (Hershey, 2008)

Recent acquisitions: Costa Rica (40) - Malaysia (11) 2012, Peru (560)

Future acquisitions: Guyana (90)

Holdings of cassava germplasm at CIAT- GRP

Country of origin	Accessions (No.)	Country of origin	Accessions (No.)
Colombia	2,000 (38,5%)	Thailand	37 (0,7%)
Brazil	1,281 (24,7%)	Honduras	27 (0,5%)
Peru	421 (8,1%)	Jamaica	20 (0,4%)
Venezuela	253 (4,8%)	Nigeria	19 (0,4%)
Paraguay	208 (4,0%)	Pto. Rico	17 (0,3%)
Costa Rica	81 (1,5%)	United States	10 (0,2%)
Indonesia	253 (2,6%)	Vietnam	9 (0,2%)
Argentina	122 (2,3%)	Salvador	10 (0,2%)
Ecuador	116 (2,2%)	Bolivia	7 (0,1%)
Mexico	106 (2,0%)	Fiji	6 (0,1%)
Guatemala	92 (1,7%)	Philippines	6 (0,1%)
Cuba	82 (1,5%)	Dominican Rep	5 (0,1%)
Malaysia	61 (1,1%)	Nicaragua	3 (0,1%)
Panama	47 (0,9%)	China	2 (0,1%)

Holdings of *Manihot* wild species at CIAT

Species	Genotypes (No.)	Species	Genotypes (No.)	Species	Genotypes (No.)
<i>M. esc. flabellifolia</i>	314 (35,5%)	<i>M. cecropiaefolia</i>	6 (0,6%)	<i>M. fruticulosa</i>	1 (0,1%)
<i>M. carthaginensis</i>	148 (16,7%)	<i>M. chlorosticta</i>	6 (0,6%)	<i>M. sparsifolia</i>	2 (0,2%)
<i>M. peruviana</i>	139 (15,7%)	<i>M. longepetiolata</i>	6 (0,6%)	<i>M. purpureo-costata</i>	1 (0,1%)
<i>M. caerulescens</i>	54 (6,1%)	<i>M. tristis</i>	6 (0,7%)	<i>M. pentaphylla</i>	1 (0,1%)
<i>M. guaranitica</i>	35 (3,9%)	<i>M. glaziovii</i>	5 (0,5%)	<i>M. brachyloba</i>	1 (0,1%)
<i>M. epruinosa</i>	27 (3,0%)	<i>M. filamentosa</i>	5 (0,5%)	<i>M. pseudoglaziovii</i>	1 (0,1%)
<i>M. violacea</i>	23 (2,6%)	<i>M. aesculifolia</i>	4 (0,4%)	<i>M. peltata</i>	1 (0,1%)
<i>M. janiphoides</i>	21 (2,3%)	<i>M. dichotoma</i>	4 (0,4%)		
<i>M. rubricaulis</i>	15 (1,7%)	<i>M. hastatiloba</i>	4 (0,4%)		
<i>M. triphylla</i>	14 (1,6%)	<i>M. irwinii</i>	2 (0,2%)		
<i>M. jacobinensis</i>	13 (1,4%)	<i>M. quinquepartita</i>	2 (0,2%)		
<i>M. orbicularis</i>	10 (1,1%)	<i>M. pilosa</i>	2 (0,2%)		
<i>M. alutacea</i>	8 (0,9%)	<i>M. anomala</i>	2 (0,2%)		

Why conserve wild species?

SPECIES	POTENTIAL BENEFITS
<i>M. flabellifolia</i> Pohl	Resistance to whitefly <i>Aleurotrachelus socialis</i> Bondar
<i>M. alutacea</i> Roger y Appan	Resistance to mites
<i>M. chlorosticta</i> Standley y Golman	Resistant to mosaic virus African and tolerant to drought
<i>M. carthaginensis</i> Mueller von Argau	Tolerant to drought and the high activity to pyruvate decarboxylase fosfoenol
<i>M. filamentosa</i> Pittier	High potential as forages
<i>M. glaziovii</i> Mueller von Argau	Resistant to mosaic virus African
<i>M. guaranitica</i> Chodat y Hassler	Tolerance to low temperatures
<i>M. longepetiolata</i> Roger y Appan	Lower length in plants
<i>M. orbicularis</i> Pohl	Tolerance to aluminum toxicity
<i>M. peltata</i> Pohl	Tolerance to acid soils
<i>M. Tristis</i> Mueller von Argau	High protein and starch content

CONSERVATION ALTERNATIVES



FIELD

Collection have traditionally been maintained in field plots.

Technical simplicity and the availability of planting material for evaluations, breeding nurseries, or other uses.

Periodic renewal every one or two years is desirable to avoid problems of excessive vegetative growth, cumulative disease and insect problems.

Material is not available for international shipment.



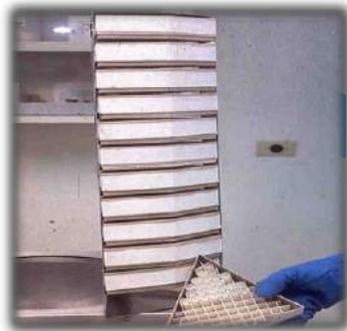
IN VITRO

Certified against viruses of quarantine importance and ready for distribution.

Need periodic regeneration.

Material is available for international shipment.

CRYOPRESERVATION



Conservation could theoretically be carried out indefinitely with no need for renewal. Long-term storage.

Inadequate for international distribution.

Investment in personnel and equipment.

Need periodic regeneration, but not frequent.

Suitable for storage and distribution of species.

SEED

Long-term storage.

Manihot wild species have not been systematically tested for seed storage behaviour. Seed storage behaviour: orthodox?

Preserving genes, but not the specific combinations of the parent clon(s).

Need periodic regeneration, but not frequent.

Suitable for storage and distribution of species.





Bonsai collection



Two plants per accession are maintained

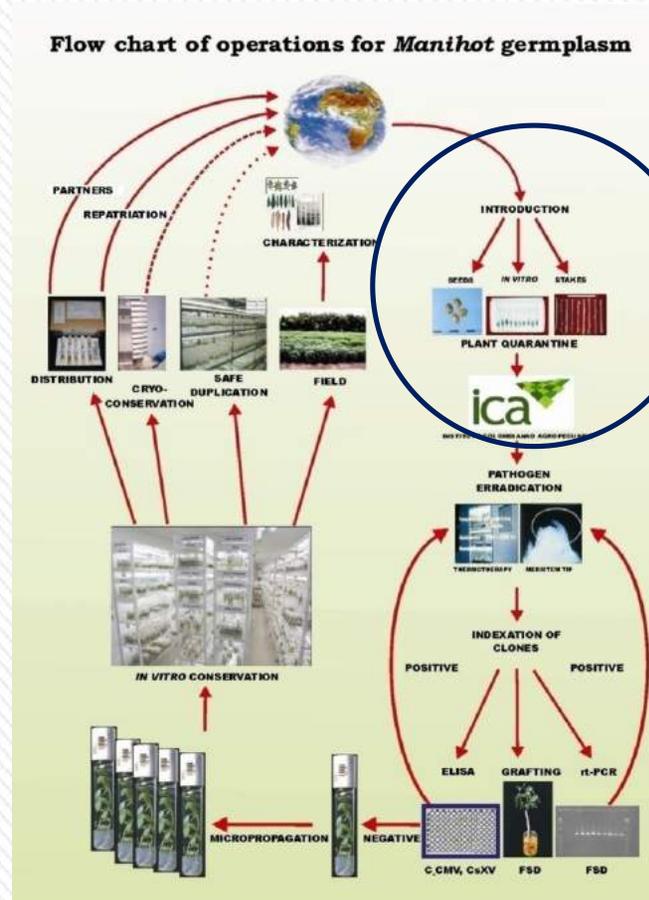


SLOW-GROWTH SYSTEM

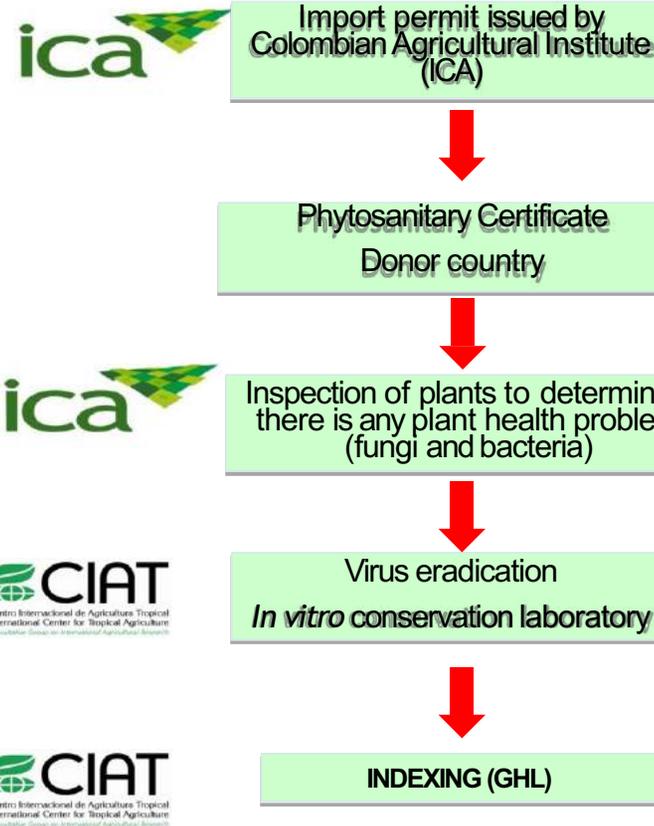


MONITORING

Slow-growth system based on restricting root development in small planting pots. Plants occupy only small fraction of the space they would occupy if allowed unlimited growth in the field.

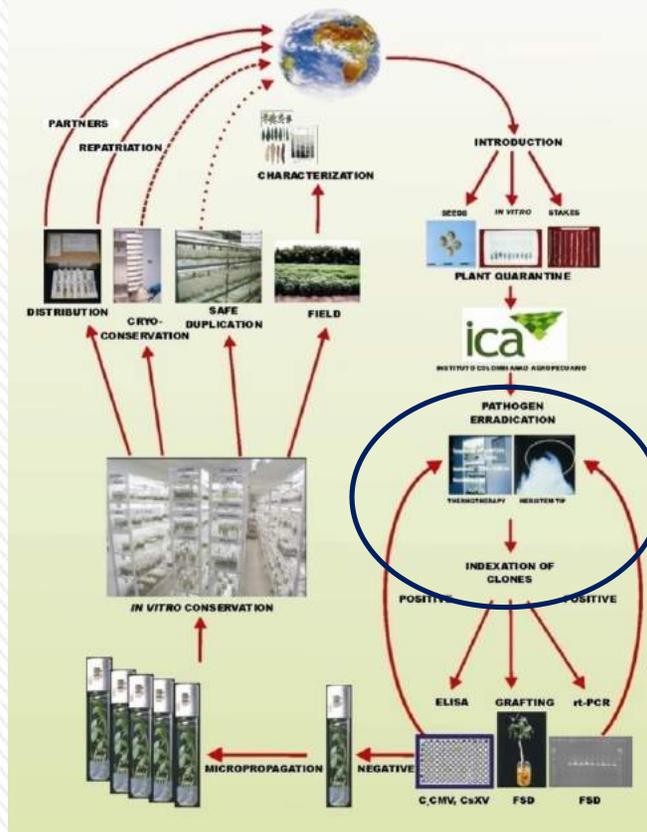


PROCEDURES FOR INTRODUCTION OF CASSAVA GERMPLASM

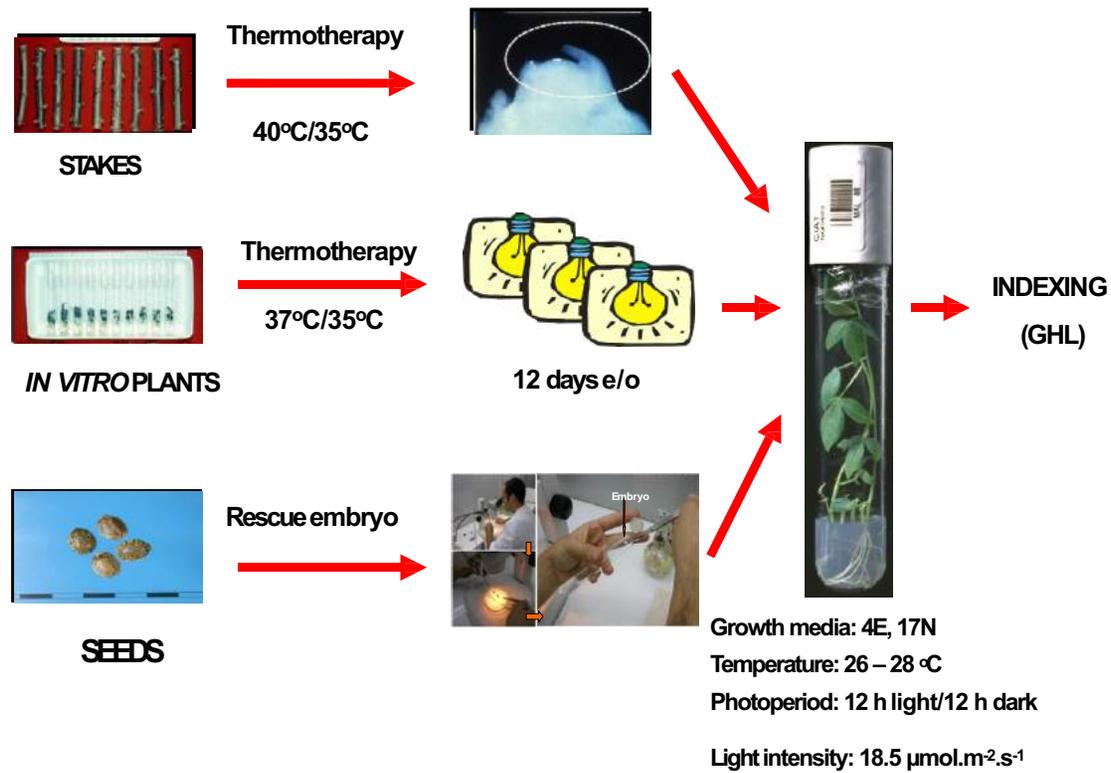




Flow chart of operations for *Manihot* germplasm

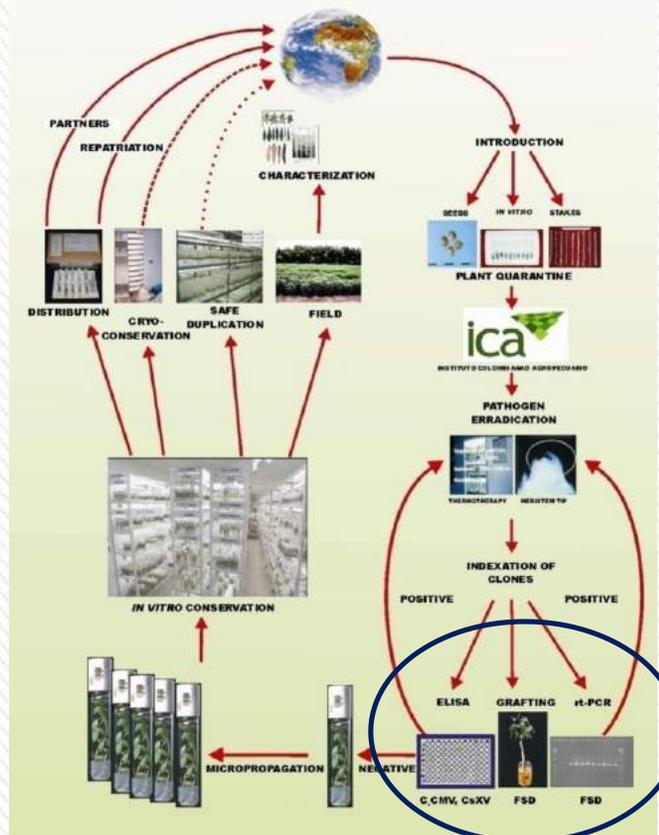


INTRODUCTION OPERATIONS



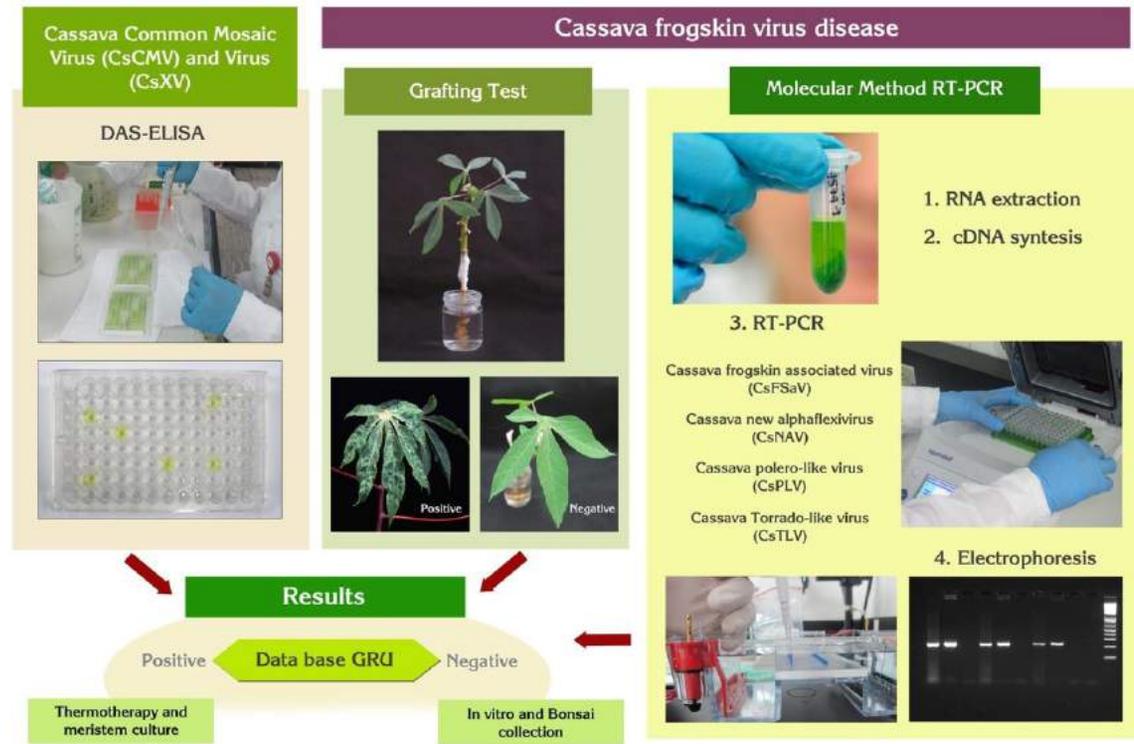


Flow chart of operations for *Manihot* germplasm





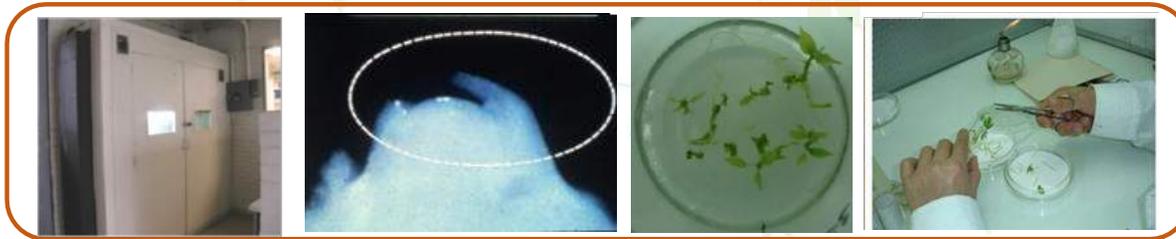
Flow chart for cassava indexation



Source: CIAT-GRP, 2014



- **Implementation of sanitation techniques:**



Thermotherapy followed by meristems culture

Thermotherapy *in vitro*

Thermotherapy and Criotherapy

- **Indexation of clones**

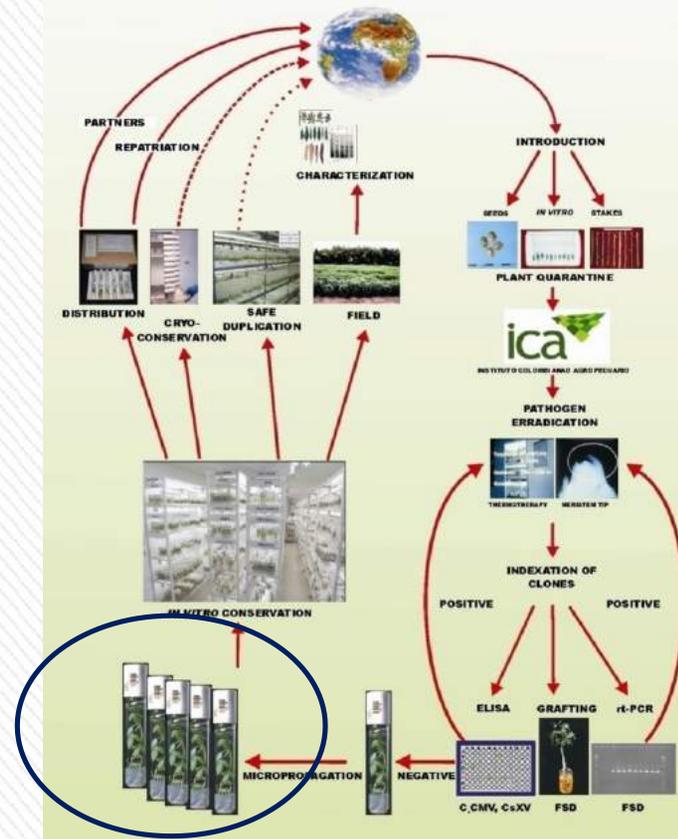
Germplasm Health Laboratory- GHL

- **Propagation of healthy material**

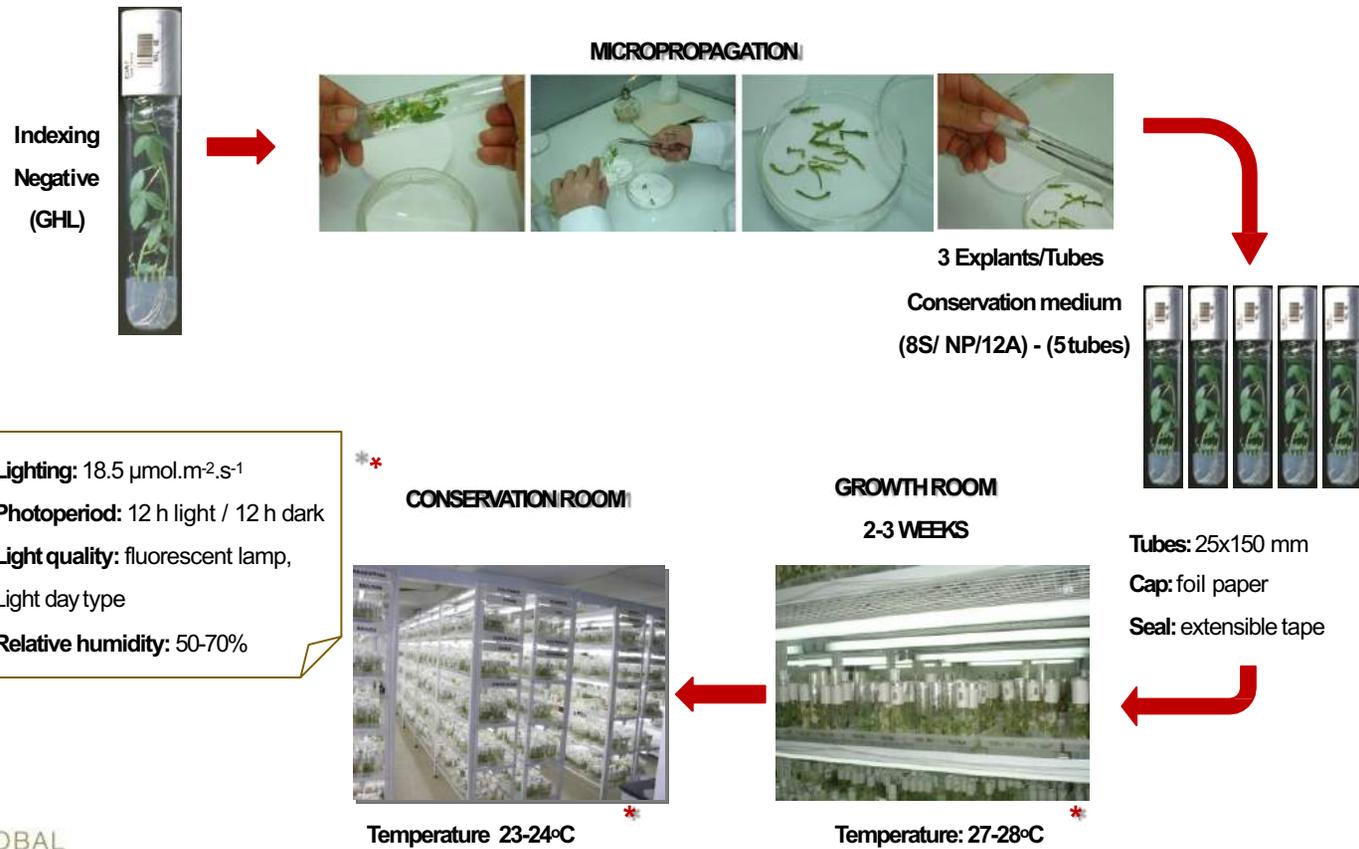




Flow chart of operations for *Manihot* germplasm



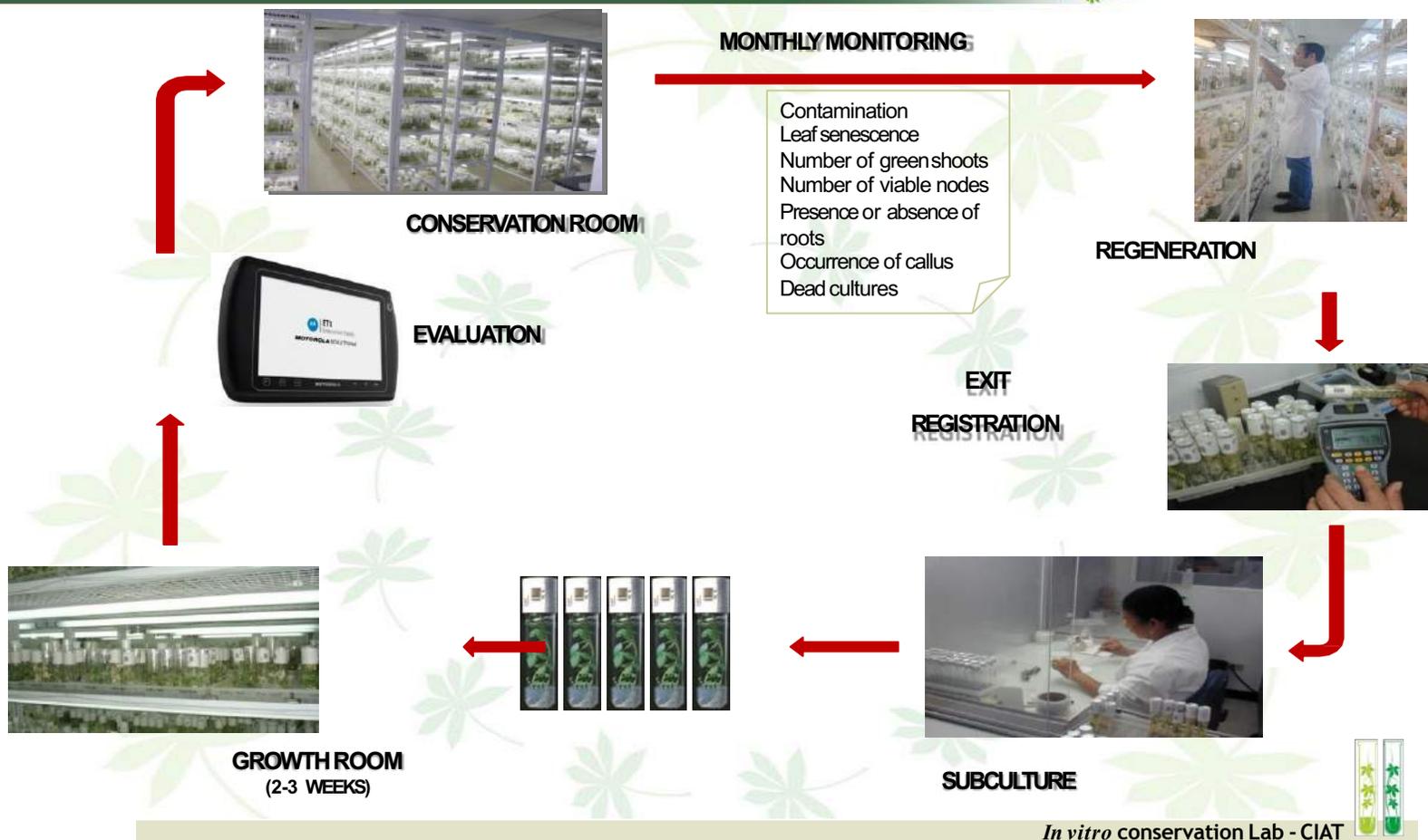
INTRODUCTION FOR *IN VITRO* CONSERVATION



SPECIFIC PROTOCOLS FOR MEDIUM TERM STORAGE



INTERNATIONAL COURSE ON MODERN TECHNOLOGIES FOR PRODUCTION, PROCESSING AND UTILIZATION OF THE CASSAVA CROP



Slow growth conditions for cassava with regular monitoring in CIAT

MTS conditions:

Temperature: 23 - 24°C

Photoperiod: 12h light

Lighting: 18.5 $\mu\text{mol m}^{-2}\text{s}^{-1}$

%R.H.: 50-70

Light quality: fluorescent lamps, light day type

Conservation 5 tubes x 3 explants = 15 plants per clone.
25x150 mm tubes

NP- Silver nitrate medium
CIAT (Standard protocol)

Conservation time: 24 months

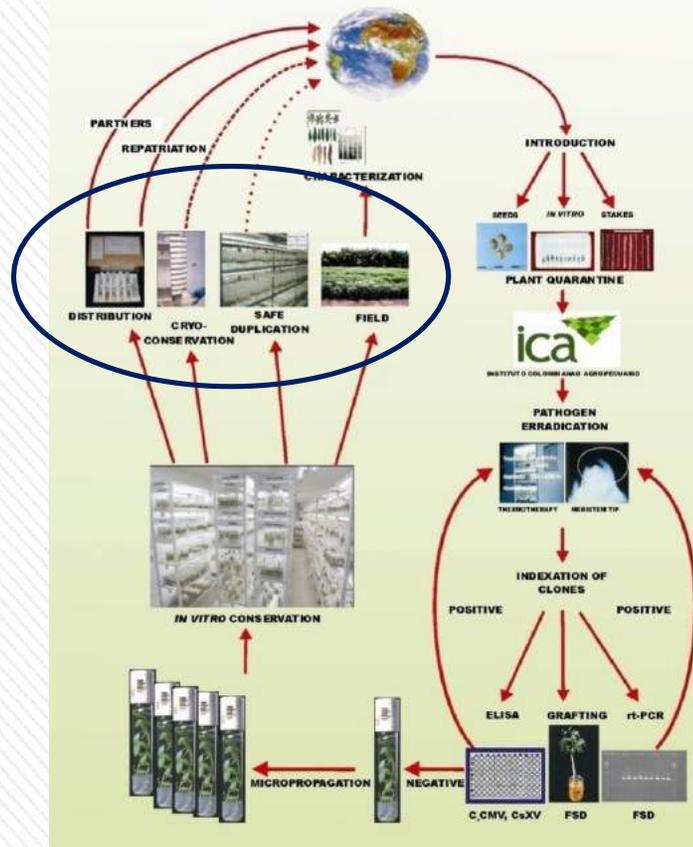


Available in:

http://isa.ciat.cgiar.org/urg/urgweb_folder/files/handbookprocedures/en/Microsoft%20Word%20-%20Handbook%20of%20Procedures-In%20vitro.pdf



Flow chart of operations for *Manihot* germplasm



DISTRIBUTION

REQUEST

Physical mail, electronic mail or through the website of the Program of Genetic Resources (<http://www.ciat.cgiar.org/urg>)

Material defined - suggested

PURPOSE FOOD AND AGRICULTURE

PHYTOSANITARY RULES

Import permit

Phytosanitary certificate

Phytosanitary Mobilization Certificate



ACCEPT THE STANDARD MATERIAL TRANSFER AGREEMENT (SMTA)

OPTION 1: Physical signature on the acceptance document of the Standard Material Transfer Agreement.

OPTION 2: Acceptance of the Standard Material Transfer Agreement through sealed shipments.

OPTION 3: Electronic acceptance of the Standard Material Transfer Agreement.

SYST



INTERNATIONAL COURSE ON MODERN TECHNOLOGIES FOR PRODUCTION, PROCESSING AND UTILIZATION OF THE CASSAVA CROP

EMS



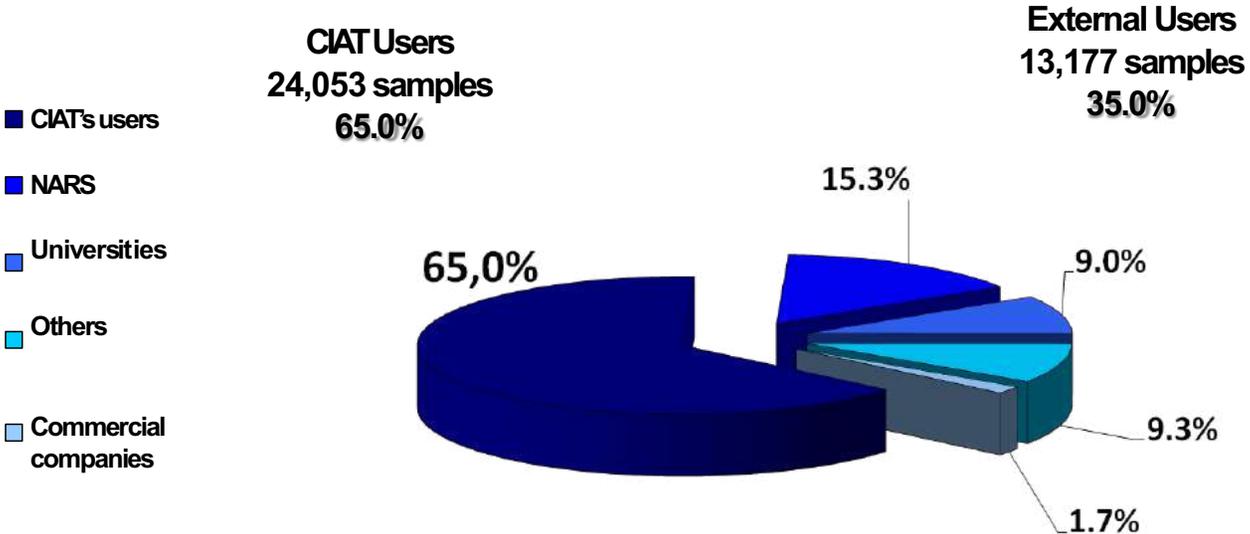
Distribution of cassava germplasm
from CIAT genebank - 1979-
2013

	No. Accessions designated FAO	No. Accessions distributed	Percentage of the collection distributed
CASSAVA	6,632	6,492	97.9%

CASSAVA 1979-2010 (No. Samples)

CIAT PROJECTS	EXTERNAL INSTITUTIONS	TOTAL
24,053	13,177	37,230
64.6%	35.4%	100%

Distribution of cassava germplasm from CIAT-GRP in 1979-2013



37,230 samples (6,492 accessions)
74 countries *

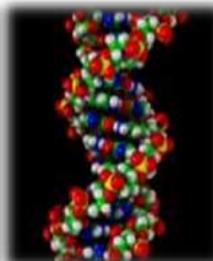
* Countries	No. samples
Belize	49
Barbados	52
Granada	4
Guyana	8
Jamaica	5
Trinidad and Tobago	26
Saint Vincent and the Grenadines	21

165 (85 accessions)

CASSAVA CONSERVATION STRATEGY



IN VITRO BANK	BONSAI	CRYOCONSERVATION	DNA	IN VITRO DUPLICATED
6,632 (in trust)	3000 (45 %)	619 (9.4%)	188 (2.8%)	3700 (70 %)



WEB SITE – INFORMATION AVAILABLE

Thank you !



DGD, 2012