



Food and Agriculture Organization
of the United Nations

FOOD LOSSES AND WASTE

IN LATIN AMERICA AND THE CARIBBEAN

The countries of the region
are progressing towards a
future with less Food
Losses and Waste

- I Food Loss and Waste Reduction, a component of the Action Plan for Food and Nutrition Security and the Eradication of Hunger in The Community of Latin American and Caribbean States (CELAC) 2025
- II Experiences in Food Loss and Waste Reduction and in making good use of sub-products
- III Building the institutional framework needed for Food Loss and Waste Reduction
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What are Food Losses and Waste?

The decrease in the availability of food apt for human consumption at any point along the food supply chain.

Food losses occur mainly during post-harvest production, storage and transport.

Food waste occurs during food distribution and consumption, and relates directly to the behaviour of wholesale and retail food distributors, services involving the sale of food, and consumers who decide to throw good food away.

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Main findings

- The countries of the region are building a future with less Food Losses and Waste.
- The **Community of Latin American and Caribbean States (CELAC)**, the main political forum of the region, has included Food Loss and Waste Reduction as one component of its **Action Plan for Food and Nutrition Security and the Eradication of Hunger 2025**.
- There are **countries with experience** in Food Loss and Waste Reduction that are making good use of sub-products.
- Steps are underway to build the institutional framework for the formation of a **Regional Alliance for Food Loss and Waste Reduction**.
- There is **concrete evidence** of food losses and waste in specific value chains in a few countries, and there are also potential solutions.





Food Loss and Waste Reduction, a component in the Action Plan for Food and Nutrition Security and the Eradication of Hunger in The Community of Latin American and Caribbean States (CELAC) 2025

In January 2015 in Costa Rica, following a request by the Community to FAO and in collaboration with the Latin American Integration Association (ALADI) and the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), **The Community of Latin American and Caribbean States (CELAC¹)** approved the **CELAC Action Plan for Food and Nutrition Security and the Eradication of Hunger 2025**.

The Action Plan is based on the pillars of Food and Nutrition Security (FNS) and their respective line of action. In this way, its objective is to «contribute to achieving concrete results which translate into significant improvements in the quality of life of communities, aimed at the eradication of poverty, especially extreme poverty, guaranteeing food and nutrition security through the perspective of gender and respecting diversity in food habits, in order to confront the challenges of food security and nutrition aimed at eradicating hunger and the enjoyment of the Right to Food, especially in vulnerable areas.»

Food Loss and Waste Reduction is one of the lines of action of the abovementioned Plan, and relates directly to the Right to Food. The following measures are proposed for the implementation of this line of action:

- ✓ Generate information and communication campaigns to raise awareness along the food supply chain among producers as well as consumers in terms of: improving habits to avoid food losses and waste, improving standards of labelling relating to shelf-life and expiry dates, the proper use of good agricultural and veterinary practices in the primary phases of production, and of good manufacturing and hygienic standards in the preparation of food, and any other practice or action that would prevent food losses or reduce food waste.
- ✓ Develop and conduct training in processes and strategies for the conservation of harvested products, particularly in small-scale agriculture for personal consumption or sale, taking into consideration non-traditional forms of use and consumption of produce.
- ✓ Promote policies and programmes that strengthen the quality and safety of food produced through family farming.
- ✓ Promote Food Loss and Waste Reduction, which often means improving infrastructure, particularly transport, energy and marketing facilities, by raising awareness in these sectors.
- ✓ Promote the development of, and facilitate access to, equipment and new technology/innovation that contribute to reducing Food Losses and Waste in all segments of the food supply chain.
- ✓ Include the subject matter of Food and Nutrition Security (FNS) and the ways of avoiding Food Losses and Waste at all levels of education, especially those directly related to food.
- ✓ Encourage South-South cooperation on any of the above issues.

¹ The Community of Latin American and Caribbean States (CELAC) was established in 2011 by the Heads of State and Government of the countries of Latin America and the Caribbean. Its role is to act as (i) an instrument for dialogue and concerted political action; (ii) an articulating mechanism that works on the basis of consensus; (iii) a forum for the convergence of common actions and interests; (iv) a platform for promoting greater global prominence for the region; and (v) a place to deal with common challenges.

II Experiences in Food Loss and Waste Reduction and in making good use of sub-products

There have been positive experiences in Food Loss and Waste Reduction at both country and regional levels, which are presented below.

In the region

Latin American and Caribbean Experts' Network for Food Loss and Waste Reduction

Within the framework of the **Regional Experts' Consultation on Food Losses and Waste**² (Santiago, 8-10 October 2014), the **Latin American and Caribbean Experts' Network for Food Loss and Waste Reduction** was set up to provide technical support and be the facilitator body of the **SAVE FOOD** initiative at the country level in the LAC Region. FAO would be the Technical Secretariat of the Network.



The consultation analysed the challenges facing the region on the aforementioned issue, as well as the future incorporation of coordinated activities on Food and Nutrition Security policies and the strengthening of the food system. A **proposal was validated for a regional plan for Food Loss and Waste Reduction** that would take into consideration the following components:



²In order to carry out the Consultation, an open invitation was issued to Experts in Food Losses and Waste. Applications came in from 63 professionals from 18 countries in Latin America and the Caribbean. Eventually, a total of 25 persons, selected according to a series of criteria such as practical experience and publications on relevant issues, were invited to the Regional Office of FAO to share their experiences and establish the framework for regional guidelines on Food Loss and Waste Reduction in Latin America and the Caribbean. **For more information on the Consultation and its conclusions, see [online]:** <http://www.fao.org/americas/eventos/ver/en/c/253246/>

In the region

The Global FoodBanking Network in Latin America

Food banks are efficient, sustainable organizations that offer an alternative to throwing food away. They manage the movement of food products of high nutritive value by recovering them before the end of their shelf life within certification regulations.

Global Foodbanking Network (GFN) supports existing and potential food banks in 30 countries where over one third of the people who are hungry or undernourished live. GFN is made up of 32 food banks on all five continents, of which 53% are in Latin America. Since 2006, GFN has trained 259 people in 55 countries on matters to do with the development, setting up and running of food banks, the recovery of food from the industrial and retail food chains, the quest for funding, marketing and publicity.

In 2013, **over 500,000 tonnes of food were distributed** through 25,500 charity organizations throughout the world. In Latin America, **about 190,000 tonnes of food were recovered** and distributed through 12,700 organizations (60% of them in Mexico) in 15 countries. Both perishable and non-perishable goods were rescued from the food industry, the food supply chain, wholesale markets and central storage facilities, the farming sector and hotels. The corporate business sector and civil society organizations participated as allies by donating infrastructure, training, nutritional support for children, food donations, general support and volunteers.



One of the programmes established by a food bank is the **Hearts of the Children Project** in Guatemala, which provides school breakfasts for 180 days to children in marginalized rural areas; by 2014, these children had gained weight and height and improved their performance in school. In Monterrey (Mexico), support was provided to 3,000 families through 66,000 food baskets and 550 educational workshops on food, nutrition, health and human development. In Argentina, several programmes were held in collaboration with other organizations, such as **Fruit and Vegetable Rescue**, which has recovered an average of 4,800 tonnes since 2009; **The Corn Crew** where volunteers harvested 2,200 tonnes of donated maize; and **Textured Soy**, with the receipt of grains of processed soy, an easy-to-use product of high nutritional value with the same protein content as beef only much more economical.

Alfredo Karsdorf
Global Foodbanking Network

In the region

Disco Soupe

Disco Soupe is an international movement that stimulates the avoidance of food waste and proposes to “fill stomachs, not garbage bins.” Its objective is to create consciousness and demonstrate that so-called “waste” is perfectly good, tasty food safe enough to be eaten. This anti-waste phenomenon started in Germany in January 2012, and was imitated massively in France in the same year. Since then, it has come to exist on every continent under different names and characteristics.

The central idea is that of organizing a community party at which volunteers set about rescuing fruit and vegetables intended for dumping (as a result of current standards of selection, such as shape, colour and size) by the markets. These food items are washed, cut up and used to prepare delicious dishes to the rhythm of music, that are then distributed immediately and free of cost.



Apart from the amount of food rescued, the strength of Soup Disco lies in its direct impact on a wide range of consumer groups, promoting social harmony and participation through a positive message based on example. Soup Disco has proven to have considerable potential for cooperation between local groups and for the exchange of know-how; it has also been mentioned at the United Nations as one of the more significant projects associated with taking care of the environment.

Federica Marra
Disco Soupe International Movement



Rescued food, collaborative cooking, music, ideas, projects and fun!

Disco Soupe Chile. A collective independent movement that puts food waste on the table in a simultaneously festive and restorative manner. The first Disco Soupe in Chile took place on December 20 at the Technology Faculty of the University of Santiago in Chile in the borough of Central Station in the Metropolitan Region of Santiago. About 200 kg of fruit and vegetables were rescued and utilized.

In the region

Biogas: making the most of post-harvest residues

During the **XXXIII FAO Regional Conference for Latin America and the Caribbean**, ITAIPU Binational and FAO signed a **Protocol of Intent on Cooperation** for the strengthening of governmental institutional capacity and public policy through South-South triangular cooperation.

Consequently, the signatory parties declared their intent to cooperate in the fulfilment of objectives such as «**the promotion of initiatives that offer supply chain opportunities to farmers and family farmers (reduction in and good use of production and post-harvest waste, production of renewable energy, biogas technology, and so on).**»

The proper handling of post-harvest residues and animal waste (manure) can help generate value-added products (biogas and bio-fertilizer), as well as other benefits like improving environmental sanitation, reducing contamination and generating efficient integrated productive systems.

Biogas, a mix made up principally of methane (CH₄) and carbon dioxide (CO₂), can be captured and used as fuel or electricity and represents a potential substitute for the main fossil fuels. Since rural areas have poor access to energy resources, the utilization of animal residues offers a solution for reducing electricity dependence that simultaneously provides both financial and environmental returns.

The project **Cooperative Agro-Energy for Family Farming** in the state of Paraná in Brazil is a reflection of the support that the **ITAIPU Binational** hydroelectric centre provides to new forms of decentralized energy generation. The project comprises 33 small-scale family farms. Each farm has its own biodigester, in which the residues of farm produce such as maize, beetroot and potato, as well as the manure of farm animals such as pigs and cows are processed. Annually, about 16,000 tonnes are treated, which produce 319,000 cubic metres of biogas per year.

The biogas produced is transported through a pipeline to a central plant where it is purified and sold, and the organic effluent channelled to fertilize the soil of the rural properties. So, through clean development mechanisms, carbon bonds are changed for the methane emissions saved. This initiative has the great potential to be replicated in other countries of the region.

Biogas yields by substratum

Substratum	Biogas yield	Methane fraction
Residuos animales	m³/t MF*	%CH₄
Cattle slurry	20-30	60
Pig slurry	20-35	50-70
Cow manure	40-50	60
Pig manure	55-65	60
Bird guano	70-90	60
Residuos of agricultural crops		
Corn silage (entire plant)	120-200	50-55
Pasture silage	170-200	54
Cereal silage (entire plant)	170-220	~55
Sugar beet	170-180	53-54
Sugar beet tops	50-100	52
Wheat chaff	280-380	51
Potato	120-150	52
Residuos of agro-industries		
Brewery residue	105-130	~80
Fruit residue	100-130	52
Potato pulp	~300	50
Molasses	290-340	70-75
Glycerine	750-850	50
Grape marc	250-270	65
Other residues		
Food residues and expired food	50-480	45-61
Stale bread	450-530	53
Market waste	45-110	60-65
Solid urban residues (organic portion)	220-260	60

Source: Ministry of Energy / GIZ. 2012.
Guide for the Planning of Biogas Projects in Chile

Javiera Suárez
FAO Regional Office for Latin
America and the Caribbean

In each country

Argentina

Food preservation technologies and the utilization of subproducts

One challenge for the food industry has been the development of technologies that would guarantee food safety, extend the shelf-life of food products, minimize waste, add value, require minimum processing (minimally processed produce, MPP) and recover compounds of interest from their effluent and residues.

The **National Agricultural Technology Institute (INTA)**, within the framework of the **Specific Project Technologies for food preservation and the utilization of subproducts** of the **National AgroIndustrial and Value-Added Programme**, is seeking to develop, adapt and transfer technologies that would provide answers to concrete issues relating to food preservation technologies and the best use of subproducts.

Project Modules

- ✓ Develop preservation technologies.
- ✓ Technologies for the development of minimally-processed fruit and vegetable produce.
- ✓ Valuation of value-added of subproducts.

The project started up in 2013 and will last for six years. It is expected to generate knowledge for the training of highly-skilled human resources, the diffusion of the technology, and the writing of masters' and doctoral theses. Similarly, it is hoped that the technology can be innovative through the training of actors on the ground, and that technological links would be established to expand the network of institutional know-how.

Gustavo Polenta
National Agricultural Technology Institute

National Programme for Food Loss and Waste Reduction

The **Ministry of Agriculture, Livestock and Fisheries**, through the Department of Value-Added and New Technology, under the Food Produce Division, has started working on a **National Programme for Food Loss and Waste Reduction**. The objective is to coordinate, propose and implement public policies that look into the causes and effects of Food Losses and Waste. This will be done by consensus with the participation of private sector, civil society and international organizations.

The Programme envisages several avenues of investigation, amongst which are:

- ✓ Seek out and coordinate initiatives, activities and projects among the various actors in the food-producing industry.
- ✓ Facilitate the transfer of technology appropriate to the objectives of the programme in each segment of the supply chain for the basic products.
- ✓ Produce manuals containing good practices and recommendations on Food Losses and Waste, and strengthen existing practices.
- ✓ Expand diagnostic studies into the proper infrastructure for storage and transport that would yield measures to minimize food losses in the post-harvest and distribution phases.

- ✓ Implement public-awareness campaigns on the negative impacts of Food Losses and Waste, and the actions that would lead to the revaluation of food and the kind of responsible consumption needed to instill a new social paradigm to reduce, recycle and reutilize food.
- ✓ Develop knowledge and know-how in operators in the food supply chain on the benefits of handling food in accordance with food safety practices that avoid food waste through failure to achieve minimum standards.
- ✓ Promote links with food banks and other national and international bodies.
- ✓ Subscribe to agreements with media, educational establishments, non-governmental organizations, associations and prestigious individuals in various spheres committed to the importance of the initiative and the objectives of the Programme.

Research, technology and knowledge

At the beginning of 2015, the Ministry of Agriculture, Livestock and Fisheries, with the support of FAO, launched the project ***Methodological design for the assessment of food waste in Argentina in the distribution and retail stages and in household consumption***, designed by the Food Production Division, and presented through the National Directorate for International Food Industry Relations.

The project enabled the design of a suitable methodology for the qualitative and quantitative evaluation of food waste in Argentina, as an essential input for the future diagnosis of the situation at the country level.

Information and communication

The magazine *Argentine Food*, a free trimestral publication of the Ministry of Agriculture, Livestock and Fisheries, included in its edition N° 65 of March 2015 a piece on **“Food Losses and Waste,” an estimation of its causes and the magnitude of the problem in the country.**

The *Argentine Food* website publishes monthly technology factsheets for the food industry, many of them focused on useful information for the development of new products, the adaptation of the processes to specific qualities and attributes of the raw materials, and the optimization of processes for the preservation and transport of food.

For more information, see [online]:

<http://www.alimentosargentinos.gov.ar>



The *Agricultural Research Magazine* (known by its Spanish acronym, RIA) is a scientific bulletin published by the National Institute of Agricultural Technology. Edition N° 39 of December 2013 dealt specifically with the issue of food losses and waste.

For more information, see [online]: <http://ria.inta.gov.ar/>

Natalia Basso
Food and Nutrition Education – Food Industry Division
Ministry of Agriculture, Livestock and Fisheries
National Committee for Food Loss and Waste Reduction
Argentina

Challenges to the management of food waste



In 2013, there were **7.2 million people** in Brazil going hungry or lacking a balanced diet, according to the **Brazilian Institute of Geography and Statistics**. In direct contrast, the amount of food lost or wasted (mainly grain, vegetables and fruit) is so high that it would be enough to provide food security.

Zero Hunger is a series of programmes implemented by the **Municipality of Belo Horizonte** (1993) and the Federal Government (2003). Its objective is to guarantee The Human Right to Adequate Food and Freedom from Hunger. It employs various strategies to encourage more responsible consumption and reduce waste, such as:

- ✓ the drive to direct marketing of family farming products.
- ✓ food support through access for low-income persons to vegetables, grain and fruit at prices that are established and monitored.
- ✓ promoting urban farming through school and community kitchen gardens which reduces the distance between the place of production and that of final consumption.
- ✓ education on consumption through workshops and informative shows, as well as videos and didactic material, in the dining rooms of schools, institutions and community establishments.
- ✓ recycling and using discarded food through food banks.

These steps have helped to feed thousands of people with nutritious, good quality food and have led to the donation of, and greater awareness about, discarded food; there are less food losses from discarding and improper handling; pricing is fairer, and individual income and employment more just. Nevertheless, there is still need for research and strategies to increase public awareness about the difference between preferred consumption and expiry dates.

Maria Angela Girioli
Prefecture of Belo Horizonte

EMBRAPA Agroindustry in the reduction of food losses

The public enterprise EMBRAPA was established in 1973 in order to carry out research in the agricultural sector in Brazil. The enterprise consists of 47 research centres established according to the organization of the agricultural sector in the country, and classified as focus- or science-based, eco-regional, or by product or service.

The goal of the **Food Technology Centre of EMBRAPA AgroIndustry** is agricultural sustainability through value-added in primary products, and the reutilization of agroindustry food residues for human consumption.

The areas of focus of the Centre are food security and quality in the post-harvest processing of fruit and vegetables, the processing of raw materials, and the recovery and value-added of food residues. Inasmuch, **the research focused on the reduction of food waste is directed towards post-harvest handling techniques, the prolongation of the shelf-life of products, the design of intelligent packaging, and the development of functional food products and by-products through the recovery of food waste.** Work has been conducted on **making the best use of the banana, papaya, passion fruit, milk, tilapia and grape.**

EMBRAPA also contributes by preparing participative local diagnostics and projects, building multipliers focused on the most productive agricultural and manufacturing practices and the safe use of processed foods, as well as the establishment of food banks.



© Embrapa

Murillo Freire
Embrapa Agroindustry

The “*Buen Provecho*” Programme

In 2014, the partnership between Alpina S.A., a company that produces food and milk derivatives, and the Colombian Association of Food Banks (ABACO), achieved a positive impact on the nutritional status of **280,000 children, pregnant and nursing mothers, and senior citizens** in eleven cities around the country, through the recovery and donation of more than 500 tonnes of food products. The nutritional content was equivalent to the recommended annual consumption of calcium for 1,800 children between the ages of one and five years old.

The recovery of food products for donation represents the first step for Alpina towards a greater commitment to Food Loss and Waste Reduction. To this end, in addition to continuing in partnership with ABACO, the company launched the **Enjoy Your Meal Programme** in January 2015, in an effort to support the struggle against hunger by means of projects and partnerships working towards Food Loss and Waste Reduction.

The Programme is implemented on three fronts:

1. Improving internal operations to reduce food losses.
2. Partnerships with suppliers, wholesale distributors and other associates to reduce Food Losses and Waste along the whole food supply chain.
3. Sharing the experience with competitors, other industries, academic institutions, cooperation agencies and the public sector, to generate greater impact on food security in Colombia.

Pablo Emilio Fergusson, Luisa Fernanda Acevedo
Alpina S.A.



Food banks, a strategy for reducing food waste

Food banks are the answer to the problem of food waste in the world: the phenomenon focuses not only on the access to food but also on making the most of the food that is produced and sold.

Therefore, partnerships are essential: the food industries donate those products that cannot be sold before their expiry date, are damaged or too ripe; farmers hand over old stocks of harvested crops and those not marketable due to their shape or size; the food banks recover and redistribute this food to vulnerable populations.

In 2014, **ABACO** rescued 18,000 tonnes of food waste from 703 donor enterprises, which enabled them to **feed over 400 000 people**. The project **REAGRO** recovered 2,467.7 tonnes of fruit and vegetables from 409 producer associates, feeding **35 764 hungry people**.

Ana Catalina Suárez Peña
Colombia Association of Food Banks

Costa Rican Network for Food Loss and Waste Reduction

Following the **Regional Experts' Consultation on Food Losses and Waste**, the **Technological Institute of Costa Rica** and the **FAO Country Representative** held the first **Workshop on Food Loss and Waste Reduction** on 18 November 2014. The event brought together thirteen public sector and independent institutions that of their own accord established the **Costa Rican Network for Food Loss and Waste Reduction**. In February 2015, a second meeting was held with the manifest support of the **Ministry of Agriculture and Livestock (MAG)**.

Actions carried out by the Costa Rican Network for Food Loss and Waste Reduction

- ✓ **The Costa Rican Action Plan for Food Loss and Waste Reduction** focuses on three areas: innovation and knowledge, governance and partnerships, communication and public awareness.
- ✓ Press releases issued by the FAO Country Representative and the Costa Rica Technical Institute, the publication of an article in one of the leading newspapers, television spots, an article in a farming magazine and radio interviews.
- ✓ Application of the FAO/World Resources Institute (WRI) methodology to demonstrate the volume of food losses in the tomato supply chain, and the adaptation of the WRAP methodology in an institutional refectory.
- ✓ Programming of a meeting with representatives of the private sector, aimed at holding a third meeting of the Network in April 2015 that would provide the opportunity for the establishment of public-private partnerships to reduce Food Losses and Waste.
- ✓ Lectures at the various organizational levels of TEC, the National Learning Institute (INA), MAG and the Costa Rican Institute of Fisheries and Aquaculture (INCOPECA).
- ✓ Confirmation of their participation in the Legislative Forum against Hunger.

For more information:

http://www.nacion.com/m/vivir/ambiente/Instituciones-unen-combatir-desperdicio-alimentos_0_1463853707.html

<http://www.repretel.com/Una-tercera-parte-de-los-alimentos-que-se-producen-en-el-Planeta-se-desperdician>

http://www.mediatoolsadvanced.com/MG_NOTI/MTA/CRC/TMP/20150226__tv6__notici12__123915.mp4

Laura Brenes
Technological Institute of Costa Rica
Costa Rican Network for Food Loss and Waste Reduction

Guatemala

Technologies recycling residues for human consumption



El 74,6 % de la población del Departamento de Sololá se encuentra en pobreza, lo que ha llevado aln the Department of Solola, 74.6% of the population live in poverty, leading 72.3% of the children to suffer from chronic malnutrition. In 2009, local farmers reported some 54.5 tonnes of losses in their carrot crop, that is, some 8% of total production. Therefore, **an effort was made through the use of the proper machinery to reduce food losses, generate income and supply nutritive food products.**

The solution consisted of the collecting, processing, extracting, pasteurizing and packaging of juice, and the making of flour from the pulp. **Through the mechanization of the washing process, losses were reduced to 34 tonnes (2.5%). By establishing and operating a juice factory (2013), the waste of produce was reduced to less than 1%.**

The results confirmed that the introduction of the appropriate machinery to family agriculture procedures enables losses to be reduced in the production and processing stages, as well as producing highly-nutritional food products.

In the Department of Retalhuleu, **flour is made from the skins of oranges**, which can be used as a functional food (food aid in the prevention or treatment of illness). Thus the skins were processed and packed for various uses (masks, infusions, capsules, and ingredient and feed for the human- and pet-food industries). **The solid residues have been reduced by 5%, the juice processors have increased their net income from sales by 10% through the sale of fresh orange peel and the population has been supplied with a functional food.** In this way, **the residues and waste now contribute to the family budget of some farming households.**

These projects are profitable and sustainable as long as they receive financial, logistical and technical support for large-scale marketing. In this sense, **strategic partnerships are essential.**

Edy Gamboa
INSEPRAL, HORTICOPE, R. L.



III Building the institutional framework needed regionally for Food Loss and Waste Reduction

Towards the establishment of a Regional Alliance for Food Loss and Waste Reduction

The region is making progress in building the institutional framework needed to set up a Regional Alliance for Food Loss and Waste Reduction, a forum for political harmonization and innovation that would enable common goals to be established to reduce Food Losses and Waste, through building tools such as an **International Code of Conduct for Food Loss and Waste Reduction**.

The Alliance is being set up through **National Committees**, made up of several representatives of the public and private sector and civil society organizations. Some countries, such as Argentina, Costa Rica and the Dominican Republic for example, have already set up Committees.

National Committees for Food Loss and Waste Reduction

Functions

- ✓ The establishment of cooperation agreements and public-private partnerships for the development of innovation, technology and awareness, and mobilization of resources.
- ✓ Quantify, evaluate and monitor Food Losses and Waste in food supply chain segments around the country
- ✓ Develop a national action plan for Food Loss and Waste Reduction.
- ✓ Develop jointly with other National Committees a code of conduct or regulations with directives for Food Loss and Waste Reduction.

The Committees can be made up of representatives of Government Ministries, academia, food networks, the food industry, producers' associations, consumers' associations or civil society organizations.





IV The status of Food Losses and Waste in basic food products

The Caribbean

The production of cassava is widespread in the Caribbean. Therefore, sustainable strategies for the reduction of post-harvest losses are essential to the economy of the region. Several studies have been carried out through an integrated project using the **FAO Methodology for the Evaluation of Food Losses and Waste** (2012) in order to measure the magnitude of **post-harvest losses** in the cassava, mango and tomato crops in **Guyana, Saint Lucia** and **Trinidad and Tobago**.

Cassava



Guyana

Produced in coastal regions. Weak demand. Consumed dehydrated, boiled, fried, in local dishes and artisanal bread.



Losses of **23 %**



839 619 USD

Trinidad and Tobago

Produced in coastal regions. Weak demand. Consumed dehydrated, boiled, fried, in local dishes and artisanal bread.



Losses of **27,5 %**



500 000 USD

Mango

Critical Loss Points (CLP): **CLP1** Harvesting, **CLP2** Packinghouse, **CLP3** Retailing.

Guyana

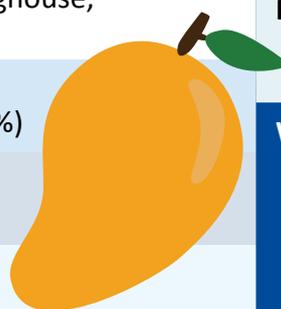
Losses of **32 %** (Harvest: 15 %; packaging: 17 %)

Saint Lucia

Losses of **23 %** (Harvest: 8 %; value-added: 13 %; retail sales: 2 %)

Trinidad and Tobago

Losses of **17 %** (Harvest: 5 %; packaging: 17 %)



Tomate

Guyana

Losses of **20 %** (Harvest: 7 %; value-added: 8 %; retail sales: 5 %)

Saint Lucia

Losses of **20 %** (CLP1: 7 %, CLP2: 8 %, CLP3: 5 %)

Trinidad and Tobago

Losses of **27 %** (CLP1: 7 %, CLP2: 8 %, CLP3: 12 %)



How was this measured?

Mapping of the post-harvest handling system of each product.

Identification of the Critical Loss Points (CLPs):

- CLP1** Harvesting
- CLP2** Packing
- CLP3** Retail sales.

Random samples repeated thrice.

Register of weight and classification:

- Fit for sale** (loss of quality of the raw material along the food supply chain.)
- Unfit for sale** (post-harvest losses).

Main causes

Physical damage, deterioration, high temperatures and drying.

What can be done?

- ✓ Invest in equipment and supplies
- ✓ Intensify training in post-harvest practices
- ✓ Promote the use of packaging technology
- ✓ Encourage supply-chain workers and service providers to strengthen their skills
- ✓ Carry out guided interventions
- ✓ Disseminate the appropriate technology and approaches

An estimate of Food Losses and Waste in food basket products

A **preliminary qualitative study** was carried out on food losses in rice, lettuce and potatoes. It was based on investigative field work using pertinent information from persons in the various segments of the food supply chain, as well as an estimate of the amount of bread wasted in households in the Metropolitan Region of Santiago. The four products most relevant to the Chilean diet have distinct characteristics in terms of their supply chain value and post-harvest perishability. The **case studies offer an approximation of the current status of Food Losses and Waste** in basic products in the country.

RICE



140,4 tonnes lost per year



0,5 % of total rice sold
(by the miller under study)



12 066 USD
per year



9 000 rice portions
per week*

Principal cause
Improper handling of the product damages the grains which fall to the floor.

How was this measured?

A study was carried out at one of the main industrial mills in Chile.

What can be done?

- ✓ Improve the quality of the storage sacks
- ✓ Training in the proper handling of the sacks
- ✓ Maintenance of the selection and packaging

*Consumption of 30 grams per day, according to the Ministry of Agriculture (2012).

Yesenia López, Luis Sáez
Universidad de Santiago de Chile

Lettuce



12,015 lettuces lost per hectare
(Ranging between 8 582 and 16 551 lettuces per hectare)



20 % of the potential harvest



2 688 USD per hectare

Principal causes
Climate, mechanical damage and market selection.

How was it measured?

Monitoring ten farmers in three municipalities where the greatest acreage is grown.

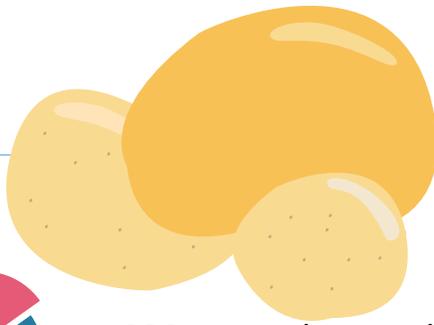
What can be done?

- ✓ Provide technical assistance in facing climatic conditions
- ✓ Create a (secondary) market for products of lesser calibre ("seconds")
- ✓ Change the sales format: sell lettuce by weight instead of by unit

Francisca Gutiérrez, Luis Sáez
Universidad de Santiago de Chile

21

Chile



How was it measured?

Monitoring eight potato farmers in the municipality of Melipilla, an area with high levels of potato production.

Potato

Harvest



1,086 tonnes lost per hectare

3,6 % lost of potential harvest



12,066 USD per hectare

What can be done?

- ✓ Provide technical assistance to deal with climatic conditions
- ✓ Create a market for seconds – products of lesser calibre

Storage



1,7 toneladas lost for each hectare stored (2,85 kg per sack)

5,7 % losses



488 USD per hectare stored

Marketing



13,4 kg lost for each tonne sold

1,3 % losses



168,4 USD per hectare stored

Principal causes

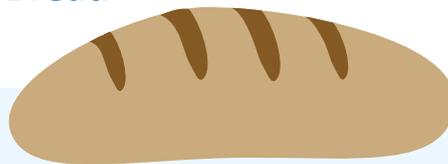
Climatic conditions, mechanical damage and grading for the market.

Nicole Arias, Luis Sáez
Universidad de Santiago de Chile

How was it measured?

Monitoring ten families from three municipalities in the Metropolitan Region for three months.

Bread



63,3 kg wasted per year (estimated average)



16,7 % of the average consumption of the whole

What can be done?

- ✓ Reduce the amount of crumbs in the bread
- ✓ Sell smaller loaves

Principal causes

Waste of breadcrumbs and pieces of bread.

*Consumption of 85,6 kg per year, according to the Ministry of Agriculture (2012).

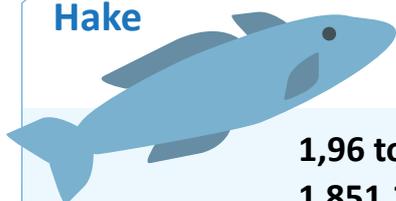
Gabriela Herrera, Luis Sáez
Universidad de Santiago de Chile

Chile

Quantitative estimate of food losses of hake (*Merluccius gayi gayi*) and cuttlefish (*Dosidicus gigas*) in the supply chain of artisanal fisheries

Some of the waste from artisanal fisheries is apt for human consumption, so that fostering the sustainability of fisheries food systems necessarily takes into consideration Food Loss and Waste Reduction in the supply chain. Due to the importance of fish and shellfish to Food and Nutrition Security in all the countries of the region, a study to estimate the level of losses in the supply chain of hake and cuttlefish was conducted in the Region of Valparaíso in 2014.

Hake



1,96 tonnes lost per day
1 851,29 tonnes lost per year (estimated)

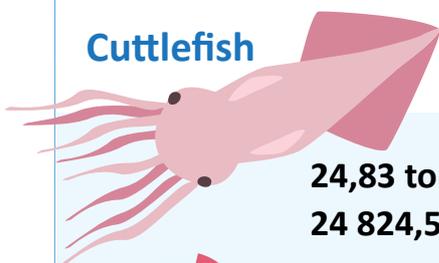


53 % of the total catch



This would feed
903 persons per year*

Cuttlefish



24,83 tonnes lost per day
24 824,53 tonnes lost per year (estimated)



44 % of the total catch



This would feed
24 020 persons per year*

Principal cause

Lack of awareness of Food Losses and Waste in the daily work of fishermen, fisheries officials, cleaners and intermediaries.

How was it measured?

A study carried out in two fishing coves in the Region of Valparaíso.

Participative mapping of the supply chain.

Qualitative evaluation by questionnaire.

Quantitative evaluation by monitoring the load and register of daily operations.

What can be done?

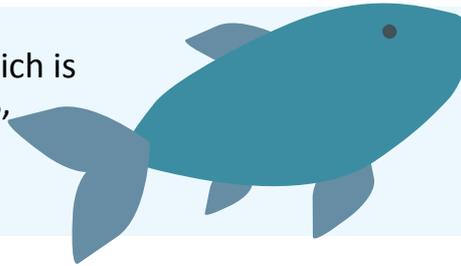
- ✓ Develop improved technologies and infrastructure
- ✓ Train supply chain actors in all aspects of handling the species
- ✓ Promote a policy framework aimed at getting the most out of the fisheries industry artesanales

*Covering 75 grams of the FAO/WHO/UN recommended daily intake of protein.

Costa Rica has not yet developed the data or methodology that would provide a diagnosis of food losses: however, it plans to use the methodology recommended by FAO and the World Resources Institute (WRI) in 2015. The current data on Food Losses and Waste are based on estimates or case studies, of which there are a few preliminary examples.

Pesca

Estimates show that the product, which is supplied mainly by artisanal fisheries, **reflects differences of up to 50 %** between total catch and total sales.



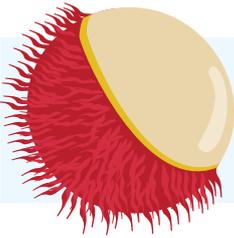
What can be done?

- ✓ Improve installations for handling the product
- ✓ Install sales points at fisheries terminals

Principal causes

Condiciones de desembarque, manejo y conservación.

Rambután



The drive to increase production in 2007 has presented several **challenges regarding the best use** of this crop

Principal causes

Damage and appearance of the fruit, post-harvest perishability and market acceptance.

What can be done?

- ✓ Strengthen support to farmers to extend post-harvest shelf life.
- ✓ Foment the development of processed food products to enter the market.*

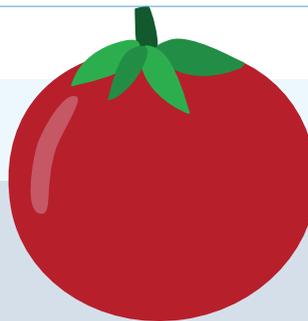
*This has been achieved with fruit and dairy products, a supply chain based on yoghurts and ice-creams.

Tomate

Variations in output of **up to 46 %** based on production system*

Producers report **losses of about 10 %** due to defects (pathologies, physical damage).

Losses are estimated at 1% to 3 % in the wholesale market and **6% to 9 %** in the retail market.



What can be done?

- ✓ Carry out a formal survey to conduct case studies of the main marketing channels.*
- ✓ Develop industrialization strategies for processing healthy safe tomatoes not fit for sale.

*In 2015, tomato losses began to be monitored on farms, wholesale markets and retail outlets.

*Based on research carried out by the Costa Rica Institute of Technology and the Research and Technology Transfer Programme in Tomato (PITTA).

Three case studies demonstrate the level and causes of post-harvest losses in fruit and vegetables countrywide.

Agriculture: urban and suburban (2013)



Average national losses of **2,6 %**



Sales points are located no further than 5 km from the producers

How was it measured?

Analysis based on data reported by the National Aggregation of Urban and Suburban Farmers.

Wholesale and local markets (2014)



Reported losses of **between 3 % and 20 %** at points of sale



Products most damaged: guava, pawpaw, avocado, anon, pepper, banana, beans and okra

How was it measured?

Interviews with sellers at points of sale

Fruit and vegetable processing plants (October 2010 to March 2011)

Total damage to produce (quality indicators) and percentage losses

Conventional processing of fruit

	Damages	Losses
Banana	9,02 %	8,69 %
Papaya	2,14 %	2,59 %
Avocado	1,87 %	1,93 %
Melon pear	1,16 %	1,19 %
Guava	2,29 %	2,89 %
Tomato	3,25 %	7,70 %
Melon	1,96 %	0,15 %
Pineapple	6,4 %	3,15 %
Capsicum	0,67 %	0,78 %

Conventional processing of vegetables

	Damages	Losses
Creole cabbage	1,70 %	1,64 %
Capsicum	0,91 %	0,83 %
Tomato	0,90 %	0,87 %
Cucumber	0,98 %	0,95 %
Ch. cabbage	0,54 %	0,47 %
Carrot	4,75 %	5,55 %
Swiss chard	1,352 %	1,39 %
Lechuga	0,85 %	0,98 %
Espinaca	0,56 %	0,98 %

How was it measured?

Quality indicators of fruit and vegetables on arrival at the processing plant: dry or wet rot, mechanical damage, insect damage, degree of ripeness, insufficient weight, length or diameter, and so on.

Degree of loss measured on the basis of the relationship between the discarded mass and the total weight of the batch.

157.184 tonnes: 61 batches of fruit and 59 of vegetables harvested on farms in different provinces of the country.

What factors contribute to post-harvest losses?

Level of training on the **best time to harvest** each product; level of training in **pre-and post-harvest technologies**; **handling** of produce; availability, condition and schedules of **transport**; **compatibility** of the products transported; ambient **temperature** and the existence of a **cold chain**; quality, cost and handling of **packaging**; infrastructure and level of technology at the **processing plant**; **distances** between processing plants, farms and sales outlets; absence of **artisanal industries**.

The **National Crusade Against Hunger** by the Government of Mexico aims to «minimize the post-harvest losses of food during storage, transport, marketing and distribution». The Food Losses and Waste Group was set up to this end, and built the Food Loss Index (2013) to determine the scale of the problem nationwide and seek solutions. The Index to support the inter-ministerial struggle against hunger is made up of a baseline and instruments of evaluation.

Food Waste Index in Mexico



37,26 %
Average National Food Waste
(Weighted: 37.11 %)



This could **feed 7,4 million people** living in extreme poverty and food insecurity*

Some of the most wasted foods

Guava	57,73 %
Cow's milk	57,14 %
Mango	54,54 %
Fish and sardines	54,07 %
Avocado	53,97 %
Green bananas tabasco	53,76 %
Prickly pear	53,26 %
Rice	46,87 %
Cucumber	45,46 %

*16 litres milk, 3.6 kg potato, 2.6 kg onion, 3.5 kg pork and 4.2 kg beef per week.

How was it build?

Sources

a. Microdata from the National Survey on Income and Household Expenditure (2010) carried out by the **National Institute of Statistics and Geography (INEGI)**.

b. Data on Apparent National Consumption of food from Atlas Agriculture and Fisheries (2013) of the Agriculture and Fisheries Information System of the **Ministry of Agriculture Livestock, Rural Development and Food Supply (SAGARPA)**.



There were 34 selected products in the basic food basket from which it was possible to calculate Average National Food Waste without losing accuracy.

Additionally, technical conversions were carried out using coefficients reported in the literature and in the industry for specific products (for example, 1.450 kg of cornmeal is equivalent to 1 kg of corn tortillas).

Formula

National Food Waste (DN) is the weighted sum of the waste of each food item, the weighting factor is the proportion of each food item in the diet of the population.

Food item waste index i

$$D_{i,t} = CNA_{i,t} - \sum_{i=1}^n c_{i,t}$$

Labels in the diagram:
 - $CNA_{i,t}$: Apparent National Consumption
 - $c_{i,t}$: Actual consumption of product i , in period t

General Food Waste Index for Mexico

$$DN = \frac{D_{1,t}}{C_t} \frac{\pi_{1,t}}{1} + \frac{D_{2,t}}{C_t} \frac{\pi_{2,t}}{1} + \frac{D_{3,t}}{C_t} \frac{\pi_{3,t}}{1} + \dots + \frac{D_{k,t}}{C_t} \frac{\pi_{k,t}}{1}$$

Labels in the diagram:
 - $D_{i,t}$: Food waste
 - $\pi_{i,t}$: Proportion of food item in diet
 - C_t : Total consumption of food of the Mexican population

Mexico

Principal causes of Food Losses and Waste nationwide

In the food supply chain

- Lack of certification
- Lack of quality control standards
- Inefficient management of materials and products
- Inappropriate practices in the handling of materials and products
- Inadequate transport, distribution and storage systems
- Lack of appropriate infrastructure
- Use of inadequate packaging and packing materials
- Personnel lacking the necessary training

Consumption

- Overripe produce
- Excess purchases
- Improper handling of merchandise
- Product mishandled / in poor condition
- Mixture of good-quality produce with produce not fit for consumption

What can be done?

In the supply chain

- ✓ Train and supervise the handling of products
- ✓ Incorporate specialized equipment and systems
- ✓ Standardize transport fleets based on the needs of the product
- ✓ Improve and expand infrastructure
- ✓ Improve capacity to manage materials, produce and stocks
- ✓ Carry out continual quality control checks on the product
- ✓ Improve packing and packaging materials and practice
- ✓ Improve the display of the product and its conservation
- ✓ Adopt new marketing strategies

Consumption

- ✓ Promote the exchange of best practices
- ✓ Promote publicity and awareness campaigns on the value of the food items and the prevention and reduction of food waste
- ✓ Promote training courses on the value and care of food items

Genaro Aguilar
National Polytechnic Institute of Mexico
Social Development Secretariat

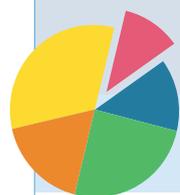
The Dominican Republic

A study was carried out to estimate the volume and causes of Food Losses and Waste in the food supply chain (2014), aimed at designing a strategy both for Food Loss and Waste Reduction, and for the recovery of edible food through the creation of new Food Banks throughout the country.

The survey took as benchmark importers, producers, grocers (shops and stores), supermarkets, agribusiness enterprises, storage centres, hotels and restaurants in certain areas of the country. All of these were considered to be potential donors to the Santo Domingo Food Bank.



1 127 468 kg of food are wasted or lost each week



93 % is discarded during **production** (post-harvest losses)

7 % loss during **marketing** and **processing**

What happens to the discarded food?

- 66 %** is thrown away
- 13 %** is returned to the supplier
- 10 %** is fed to animals
- 4 %** is donated privately for other ends (manure, biofuel)

Principal causes

Short shelf-life, damage to packaging and packing material, expiry date reached.

How was this measured?

Interviews with owners, managers and employees of 336 establishments belonging to 129 institutions.

The survey covered the areas with the highest levels of spending in the country: Santo Domingo, the Northern and Eastern Regions.

What can be done?

- ✓ Develop policies to support producers in the planning and efficiency of crops.
- ✓ Establish cooperation agreements on a donor programme for food products for the Food Bank.
- ✓ Extend the collection of products to a time closer to their expiry dates.
- ✓ Develop agreements that limit the legal responsibility of donors (restaurants and hotels) in utilizing discarded food for consumption.

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FAO The Dominican Republic

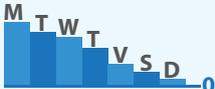
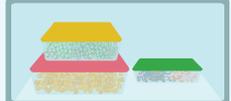


Food Loss and Waste reduction in Latin America and the Caribbean is **urgent** and **essential**.
We can all make a difference.

What does **responsible consumption** mean?

- Remember** the food you already have 
- Plan** your grocery shopping 
- Buy** only what you need 
- Keep** your food in adequate places 
- Be aware** of the difference between *consume by* and *expiry date* 
- Choose** "ugly" fruits and vegetables too 
- Listen** to your stomach before buying food 
- Share** large portions in restaurants 
- Take** home your leftovers 

How to **reduce food waste at home?**

- Test** yourself for a week 
- Consume** your food in order of purchase date 
- Establish** a day in the week for cooking the "older" food 
- Refrigerate or freeze** fresh products and leftovers 
- Make sure** your fridge is working properly 
- Prepare** preserves and pickles with vegetable surpluses 
- Consume** the riper fruits and vegetables first 
- Use** every part of your food 

How can we work towards a **community without food waste?**

- Share** the leftovers from your parties and meetings 
- Start or join** a food network 
- Join** to Save Food 
- Share** this information 



Food and Agriculture Organization of the United Nations

For more information

SAVE FOOD: Global Initiative on Food Loss and Waste Reduction

www.fao.org/save-food

Regional Experts' Consultation on Food Loss and Waste Reduction in Latin America and the Caribbean

www.fao.org/americas/eventos/ver/en/c/253246/

Food Losses and Waste in Latin America and the Caribbean: First Bulletin– July 2014

www.fao.org/3/a-i3942e.pdf

Contact

RLC-save-food@fao.org



**ZERO
HUNGER,
ZERO FOOD
LOSS AND
WASTE**



Food and Agriculture Organization
of the United Nations

Supplement

**PÉRDIDAS Y
DESPERDICIOS
CERO,
HAMBRE
CERO**

**ZERO
HUNGER,
ZERO FOOD
LOSS AND
WASTE**

Documentos técnicos / Technical documents

Nº1

**Case studies in selected value chains:
Postharvest loss management and storage need
along the cassava value chain in the Caribbean**

Majeed Mohammed and Kelvin Craig

*Presented at FAO Regional Conference on Cassava in the Caribbean and Latin America,
February 10-12th 2014, University of the West Indies, Cave Hill, Barbados.*

Introduction

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

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

Objectives

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

Methodology and data collection

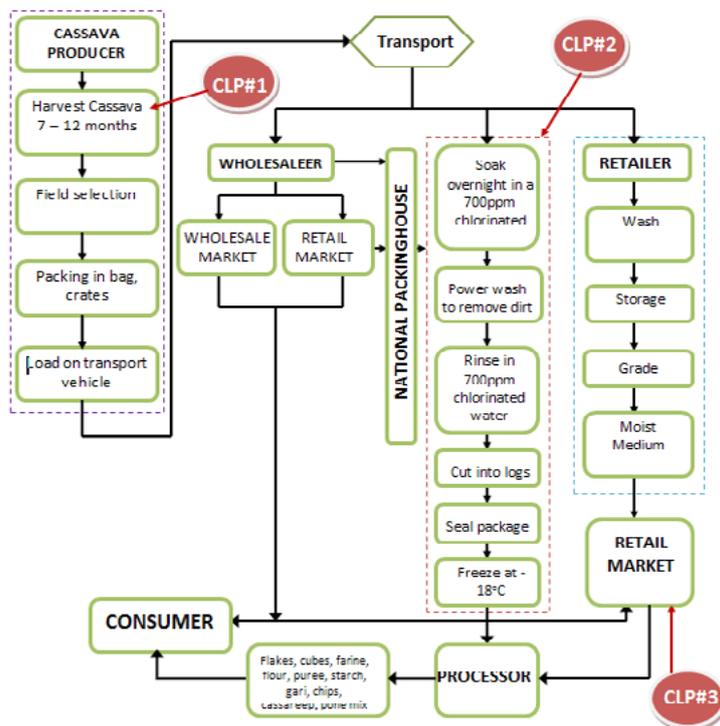
The methodology used for this study involved: (i) Carrying out a literature review (ii) Collection and analysis of the documentation and technical information on cassava (iii) Selection of the specific supply chains to the study and justification for this choice. (iv) Identification of 3-4 stages of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

Results

Critical Loss Points - type and level of food losses

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

Figure 1 Cassava Value Chain in Trinidad and Tobago and Guyana.



The losses were as follows in Trinidad and Tobago (Table 1) and Guyana (Table 2).

Table 1. Quantitative and qualitative losses occurring in the cassava value chain in Trinidad and Tobago

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

Table 2. Quantitative and qualitative losses occurring in the cassava value chain in Guyana

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

Causes of losses

Quality losses

Quality losses of cassava roots in both countries were initiated in the field and primarily associated with the manual method of uprooting plants using a fork to loosen the soil from the roots and a cutlass to separate roots from the mother plant. The resultant physical damages were due to punctures and abrasions arising from incisions made on the peel and flesh from the fork as well as breakages at the primordial and distal ends from the manual force exerted during root extraction from the soil and subsequent separation of soil from roots. Quality losses which varied between 30% and 40% in Trinidad and Tobago and Guyana respectively were not only related to the equipment and method of harvest but to the soil type as well. Clay soils which were more dominant in Guyana than Trinidad and Tobago accounted for higher levels of quality losses. Most times in Trinidad and Tobago separate field labourers were engaged in the actual uprooting of the plants from the soil while other labourers were employed to place the harvested roots in polypropylene bags. This often created major logistical deterrents which impacted negatively in accelerating quality losses in the field. Harvested roots with physical damages created avenues for contamination from adhering soil, damages due to insect infestations, water loss, secondary pathological infections as roots were left exposed to prevailing high temperatures and low relative humidity as shown in Table 3 for periods ranging from 4 to 6 hours. In Guyana, labourers performed both functions at the same time, that is, harvesting and bagging but cassava filled bags remained in the field exposed to environmental conditions and at time intervals as in Trinidad and Tobago before being transported to the packinghouses thereby accounting for quality losses as well.

Table 3: Quality Attributes of cassava and Environmental Conditions at the three critical loss points in Trinidad and Tobago and Guyana

Parameters	Quality attributes	
	Trinidad and Tobago	Guyana
Fresh weight (kg)	0.28 – 0.48	0.30 – 0.55
Length (mm)	208.60 -265.10	205.3 – 266.9
Width (mm)	42.80 - 57.60	44.6 – 55.0
Total soluble solids	3.20 - 3.50	3.2 – 3.4

Trinidad & Tobago and Guyana (Environmental conditions)			
	Skin Temp °C	Pulp Temp °C	Relative Humidity (%)
CLP#1	30 - 32	34 – 36	60 – 65
CLP#2	27 - 29	29 – 30	55 – 65
CLP#3	31 - 33	35 – 37	55 – 65

In both countries, polypropylene feed bags which were often used were characterised with poor ventilation and slippery surfaces. These bags contained 42-44 kg of cassava roots, tightly packed sometimes with root protrusions permeating the bags. Such handling practices coupled with loading from the field unto the hard surfaces of carts, van trays and tractor driven trailers, accentuated quality losses. In many instances cassava filled bags were loaded at drop heights that further promoted quality losses averaging 25% and 20% for Trinidad and Tobago and Guyana respectively (Tables 1 and 2). Transport of overfilled slippery bags that were inappropriately stacked over rough roads and hilly terrains accounted for higher quality losses in Guyana than Trinidad and Tobago due to the greater distances between production sites and packinghouses in Guyana compared to Trinidad and Tobago. In Guyana, cassava roots were stored under ambient conditions for longer periods before being sold at market outlets incurring a 30% quality loss (Table 2).

While several supermarkets in Trinidad and Tobago had small quantities (18-20 kg) of fresh cassava displayed for sale, in Guyana this was not observed. Roots appeared very desiccated when displayed in open plastic crates on supermarket counter tops where air condition temperatures prevailed. Quality losses were 65% due to high incidence of desiccation and vascular streaking (Table 1).

Quantitative losses

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

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

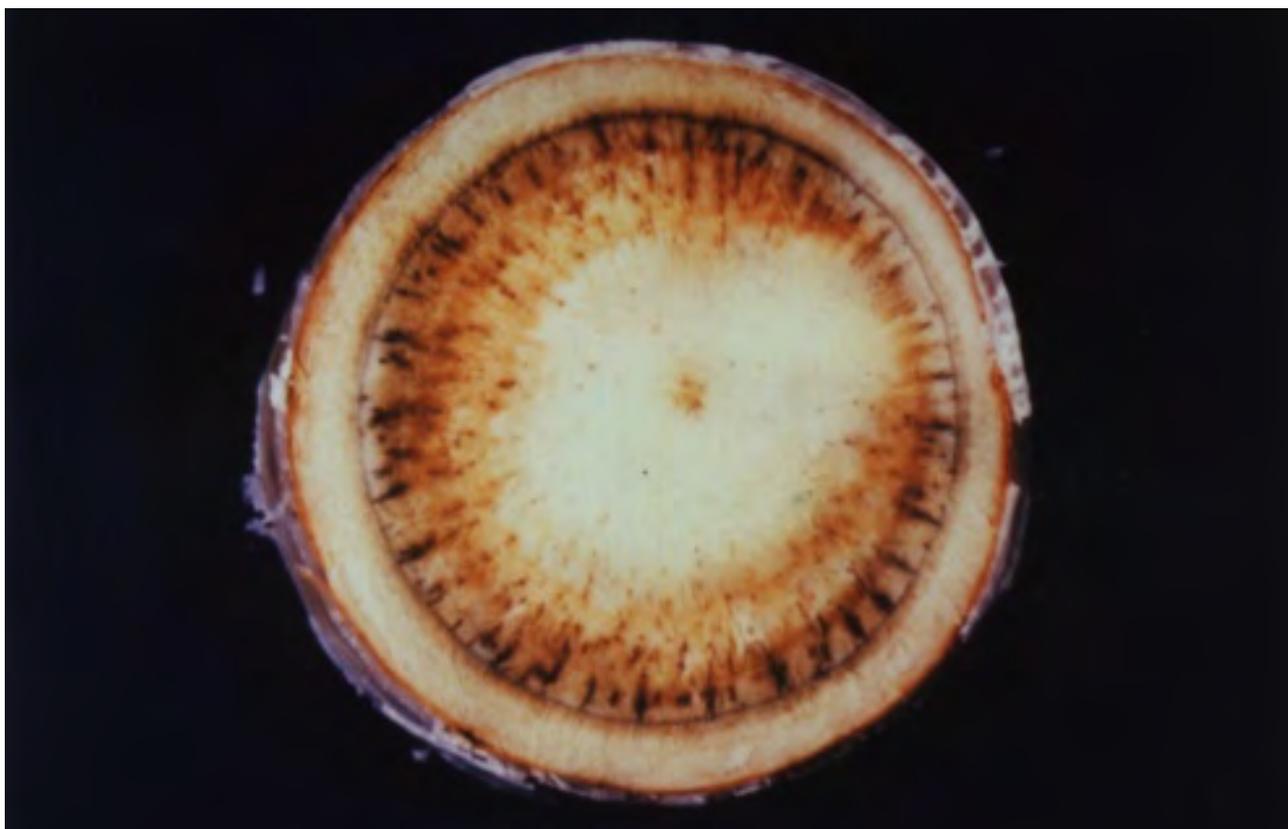
In both countries, physical damages included splits, lateral cracks and skin abrasions, wounding from harvesting equipment (forks and cutlasses mainly used), skin abrasions, skin and flesh bruises, punctures and stem and distal end breakages. These damages were due to inappropriate harvesting tools,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

Physiological disorders were not detected at CLP#1 but cassava roots had visible evidence of moisture stress. However at CLP#1, pathological and entomological losses accounted for 2% postharvest losses in Trinidad and Tobago as waterlogged soil conditions persisted due to unusual high rainfall in the last 2 months in 2013 which continued in January in 2014 when data were being collected. These conditions ultimately promoted microbial decay causing pith breakdown near the peduncle more so in farms where cassava samples were

cultivated in low lying areas such Caroni, Felicity, Cunupia despite having cambered beds. Entomological damages were associated with insect damage causing cassava brown streak to develop, also related to waterlogged soils. Waterlogged soils, poor drainage and high rainfall patterns posed similar challenges in a more consistent nature in Guyana thereby increasing pathological and entomological losses by an additional 1.5% as compared to Trinidad and Tobago.

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

Plate 1. Vascular streaking of cassava roots due to severe physical damage followed by secondary microbial development



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

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

Food loss reduction strategies: conclusions and recommendations

Field harvest (CLP#1)

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

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

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

Packinghouse (CLP#2)

Cassava roots that are transported to packinghouses in Trinidad and Tobago as well as Guyana should be subjected to the following postharvest treatments to maintain quality. From the field a second sorting and grading procedure should be implemented to remove damaged or unmarketable roots arising from transportation vagaries from the field to the packinghouse. Cured roots should be washed and dipped in an approved sanitizer such as sodium hypochlorite at 500-700 ppm followed by a fungicidal dip consisting of imazalil (Mertec). Treated cassava roots could then be packed in polyethylene bags which would create a modified atmosphere and high relative humidity within the sealed bags to reduce transpiration, and respiration and so induce an extended shelf life up to 4 weeks and also prevent vascular streaking. However, to achieve this, roots must have minimal or preferably no physical damages, provided with protection from sunlight, treated with a fungicide and packed within 2-3 hours of harvest. Another method to limit vascular streaking is to cover the roots with paraffin wax by dipping the root in wax at a temperature of 55-65°C for a few seconds after treatment with a fungicide to achieve a shelf life up to 2 months.

Retail marketing (CLP#3)

Cassava roots must be subjected to a rigorous sorting procedure to eliminate all types of damages. Roots should not be marketed at CPL#3 beyond 2-3 days unless they are cured, treated with a fungicide, protected from the sunlight and subjected to waxing and refrigerated storage. Cassava can be stored under refrigerated

conditions at 3-4°C up to 4 weeks. However, if roots are stored above 4°C, roots develop vascular streaking more rapidly and have to be discarded after 2 weeks of storage. Supermarket produce managers in Trinidad and Tobago and in Guyana should apply the technique of packaging cassava roots in sealed polyethylene bags and storing at 3-4°C to acquire the benefits of modified atmosphere packaging outlined above since this technique is currently applied to other commodities at these outlets where equipment to seal package and refrigerated display facilities already exist. Demonstrations, short workshop sessions and exposure to information are highly recommended to educate suppliers as well as produce managers on these postharvest procedures.

References

J. A. García, T. Sánchez, H. Ceballos, L. Alonso, 2013. Non-destructive sampling procedure for biochemical or gene expression studies on postharvest physiological deterioration of cassava roots, *Postharvest Biology and Technology*, 86, 529

J. Mpagalile, 2013. Reduction of postharvest losses along the food chain in the CARICOM Sub-region 19pp

K. Reilly, R. Gómez-Vásquez, H. Buschmann, J. Tohme, J. R. Beeching, 2004. Oxidative stress responses during cassava postharvest physiological deterioration, *Plant Molecular Biology*, 56, 4, 625

T. Sánchez, D. Dufour, J.L. Moreno, M. Pizarro, I.J. Aragón, M. Domínguez, H. Ceballos, 2013. Changes in extended shelf life of cassava roots during storage in ambient conditions, *Postharvest Biology and Technology*, 86, 520

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