



## Food loss analysis: causes and solutions

### Cassava supply chain in Trinidad and Tobago

Cassava (*Manihot esculenta*) is widely cultivated in the CARICOM Subregion for its tuberous roots from which cassava flour, starch, bread and frozen logs are produced. In Trinidad and Tobago, it is popularly eaten as a staple, either boiled or fried, and as cassava pone that is eaten as a dessert or as a snack between meals. In Central Trinidad, the main final product is frozen cassava logs, which are available in supermarkets. Cassava is a good source of dietary fibre as well as folic acid, thiamine, magnesium and potassium.

#### The cassava supply chain and the critical loss points

Observations, interviews with stakeholders and actual measurements were taken of quantitative and qualitative losses as well as their nature and causes at several points in the supply chain. The main production areas are in Cunupia/Caparo in Central Trinidad, Tunapuna/Macoya in the North and Rio Claro in the South. Similar to other crops, the cassava industry is characterised by a highly diverse number of producers and traders, widely scattered production areas and fragmented marketing system. Cassava tubers are transported from the farm to the wholesale markets, packinghouses, processing facilities, supermarkets, and retail markets such as municipal markets, roadside stalls, and mobile markets in Chaguanas, Tunapuna and Macoya (Table 1).

Cassava is grown throughout the year with minimal inputs. The cultivar MMEX is

popularly grown because the roots can be harvested and marketed over a period of 7 to 15 months without becoming bitter, fibrous and woody compared to the other cultivars. Cassava is harvested when the leaves turn yellow and start to fall. The soil is first loosened using a spading fork then the plant is uprooted manually and the roots are separated from the mother plant using a cutlass. Harvested roots are then packed in polyethylene bags, loaded in pick-ups, trucks or vans in 3 to 4 layers and transported over rough, narrow roads. Depending on the intended use, cassava roots are taken to the wholesale and retail markets or to the processing facility to be converted into various value-added products.

There are three critical loss points (CLP) in the cassava supply chain. CLP 1 occurs during harvesting where losses amount to 3.5 percent mainly in the form of punctures and abrasions that take place when a spad-

ing fork is used to loosen the soil. Breakage of the distal end of the roots also occurs because of the manual force exerted when the plant is uprooted. Damaged portions become an entry point for decay-causing micro-organisms, the symptoms of which become apparent during retail. Insect damage is also evident leading to the development of brown streaks in the roots. CLP 2 occurs at the packinghouse with losses amounting to 3.5 percent attributed to physical damage incurred during packaging and transport. The high post-harvest loss of 13 percent occurs at CLP 3 during retail marketing where all forms of deterioration become evident. Damage is incurred during harvesting, packaging in polyethylene bags stacked 3 to 4 layers high in the vehicle, abusive loading and unloading, which is aggravated by high temperature during retail eventually result in decay, weight loss and further development of vascular streaking. The latter disorder is characterised by the development of blue-black pigmentation of the vascular tissue, which commonly occurs at or near the infected areas of the roots. This is followed by the discolouration of the flesh rendering the roots unmarketable.

TABLE 1  
The tomato supply chain, stakeholders, operations and the critical loss points

Supply Chain	Production	→ Wholesale Retail Processing facility	→ Municipal markets Roadside Stall/Mobile Market Supermarkets	→ Consumption
Stakeholders	Farmers Transporters	Wholesalers Transporters Processors	Retailers	Consumers
Operations	Harvesting Sorting Packaging Transporting	Sorting and grading Packaging Transporting Processing Distribution	Retailing	Consumption Buying
Critical Loss Points (CLP)	CLP 1: Harvesting CLP 2: Pack-house		CLP 3: Retail markets	
Losses	CLP 1 = 3.5 % CLP 2 = 3.5 %		CLP 3 = 13 %	

**TABLE 2**  
Profitability of using a hand lifter to aid harvesting of cassava in Trinidad and Tobago

Item/Unit	Value
Product quantity (tonne/yr)	29.54
Product value (USD/tonne)	682
Loss (%)	3.5
Food loss (tonne/yr)	1.03
Economic loss (USD/yr)	702.46
Cost of intervention (USD/pc)	300
Total cost of intervention (USD/yr)	50
Client cost of intervention (USD/tonne)	1.69
Anticipated loss reduction (%)	50
Volume of loss reduction (tonne/yr)	0.515
Loss reduction savings (USD/yr)	351.23
Profitability of the intervention (USD/yr)	301.23

\*Including yearly cost of investment (USD 30) and total cost of operation (USD 20)

**TABLE 3**  
Profitability of using plastic crates as field and transport containers for cassava in Trinidad and Tobago

Item/Unit	Value
Product quantity (tonne/yr)	29.54
Product value (USD/tonne)	682
Loss (%)	3.5
Food loss (tonne/yr)	1.03
Economic loss (USD/yr)	702.46
Cost of intervention (USD/pc)	300
Total cost of intervention (USD/yr)	60
Client cost of intervention (USD/tonne)	2.03
Anticipated loss reduction (%)	60
Volume of loss reduction (tonne/yr)	0.618
Loss reduction savings (USD/yr)	421.48
Profitability of the intervention (USD/yr)	361.48

### The importance of good post-harvest handling

Cassava roots are highly perishable and normally remain marketable for only two days. Unlike sweet potato and yam that have dormancy period and are reproductive organs, cassava roots are used only to store energy. Once the roots are harvested, physiological deterioration in the form of vascular streaking is initiated as a consequence of tissue damage during harvesting. Vascular streaking is the cause of loss of market acceptability followed by microbial spoilage, which starts at the damaged roots. During harvesting, damage can be prevented and lifting of the roots can be facilitated by cutting the main stem at a height of 30 to 50 cm so that the roots can be slowly drawn from the soil either manually or with the aid of a hand lifter. Care must be taken not to break the roots or to split the skin creating wounds that will serve as an entry point for decay-causing micro-organisms. Moreover, rotting starts at the point of detachment of the roots from the mother plant. Thus, a short portion of the stem should be left attached when the roots are separated.

Root breakage and skinning are also incurred during packaging in polyethylene bags that are piled several layers high in the vehicle. Rigid containers such as plastic crates can be stacked several layers high thus providing protection to the roots. Plastic crates also provide adequate ventilation during transport and even during wholesaling thus preventing microbial spoilage, which

made worse by the high humidity inside the polyethylene bags. If a longer marketable life is desired, and if the roots are intended to be stored, curing should take place immediately after harvesting. During curing, the skin thickens and new tissues are formed beneath the injured roots resulting in reduced water loss and lower incidence of decay. Curing, however, is not effective if the roots are severely damaged.

### Recommendations to reduce post-harvest losses and their economic benefits

Post-harvest losses in cassava are mainly caused by physical damage incurred during manual harvesting using a spading fork to loosen the soil followed by lifting the roots from the soil. The cassava hand lifter (Figure 1) that costs USD 300 per piece is recommended as an aid to harvesting particularly on sandy or clayey soils. On a 5-acre lot, the use of a hand lifter will reduce losses by 50 percent resulting in a profitability of USD 301.22 per year (Table 2). Packing cassava roots in polyethylene bags that are stacked several layers high in the vehicle coupled with improper loading and unloading is also a contributory factor to loss in the form of damaged roots. Plastic crates provide adequate protection to the roots because they are rigid and stackable (Figure 2). Using plastic crates as field and transport containers, losses will be reduced by 60 percent with a profitability of USD 361.48 per year (Table 3)



**FIGURE 1**  
Cassava hand lifter



**FIGURE 2**  
Plastic crates for cassava