



Food loss analysis: causes and solutions

Tomato supply chain in Guyana

Tomato (*Lycopersicon esculentum* Mill.) is one of the most popular and versatile vegetable crops with many uses. It makes a significant contribution to human nutrition because it contains sugars, acids, vitamins, minerals, and antioxidants such as lycopene and other carotenoids. Tomato production is increasing because of the strong year-round demand. Several varieties are grown in Guyana and the market is segmented with regard to size with the cultivar Heatmaster being the dominant large tomato and Mungal the small.

to 10.5 percent losses that occur during packinghouse operations when tomatoes are sorted daily until they are red ripe. Physical damage such as punctures, scuffing and abrasions that are not visible during harvesting become prominent during ripening and are therefore culled. Improper temperature management during ripening results in tomatoes with blotchy colouration and, in most cases, the tomatoes fail to attain the desired red peel colour. The highest CLP of 12.5 percent occurs during retail marketing when all the damage incurred at the earlier stage of the supply chain become apparent. Loss of marketable weight because of moisture loss is favoured by the poor conditions during retail at municipal markets and roadside stalls.

The tomato supply chain and the critical loss points

The West Berbice area of Region 5 in Guyana is the main production area that supplies Georgetown and the adjoining areas with tomatoes. About 80 to 90 percent of the tomatoes are channelled through intermediaries to consumers. The intermediaries are the main suppliers of tomatoes to the municipal markets and compete with the farmers in selling to supermarkets and hotels. Farmers also sell directly to various district municipal markets or roadside stalls (Table 1). A small volume of tomatoes is also delivered to exporters based in Georgetown.

The tomato industry in Guyana is characterised by widely scattered production areas, highly diverse stakeholders and fragmented marketing system. The main production seasons are November to January and May to July. Tomatoes are harvested the day before market

day at the green to pink stage of maturity. Harvesting is by hand and the tomatoes are field sorted before being placed in plastic buckets or boxes. The tomatoes are then taken to a shed adjoining the house and placed on newspaper or the cardboard-covered concrete floor for ripening. Farmers sort the decayed and unmarketable fruits daily. At the red ripe stage, tomatoes are sorted based on size, packed in corrugated fibreboard boxes and transported to the wholesale and retail markets in Georgetown, which is 104 km away from the farm.

The critical loss points (CLP) are during harvesting, packinghouse operations, and marketing (Table 1). CLP 1 amounting to 11 percent occurs during harvesting and is attributed to physical damage in the form of fruit cracking, scuffs, cuts, punctures, abrasions and stem end damage. During harvesting, tomatoes are hand-pulled, which often results in stem end damage. CLP 2 amounts

Impact of post-harvest losses

The total post-harvest loss of 21.5 percent at CLP 1 (harvesting) and CLP 2 (packinghouse operations) which are completed by farmers greatly reduced the volume of tomatoes that can be sold and reduced the supply at the different retail outlets. In Guyana, the annual value of tomato production is USD 23 314 000. With the high postharvest loss of 34 percent, which is equivalent to an economic loss of USD 7 926 760. This tremendous loss greatly impacts the rural poor par-

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

Supply Chain	Production	→ Wholesale Retail Export	→ Hotels Supermarkets Municipal markets	→ Consumption
Stakeholders	Farmers Transporters	Intermediaries Transporters Exporters	Retailers	Consumers
Operations	Harvesting Sorting Ripening Packaging Transporting	Sorting and grading Packaging Transporting Distribution	Retailing	Consumption Buying
Critical Loss Points (CLP)	CLP 1: Harvesting CLP 2: Packing house		CLP 3: Retail markets	
Losses	CLP 1 = 11.0 % CLP 2 = 10.5 %		12.5 %	

TABLE 2
Profitability of using plastic crates as field and transport containers in Guyana

Item/Unit	Value
Product quantity (tonne/yr)	11.364
Product value (USD/tonne)	2 002
Loss (%)	11.0
Food loss (tonne/yr)	1.25
Economic loss (USD/yr)	2 502.50
Cost of intervention (USD/pc)	150.00
Total cost of intervention (USD/yr)	180.00*
Client cost of intervention (USD/tonne)	15.84
Anticipated loss reduction (%)	65.0
Volume of loss reduction (tonne/yr)	0.812
Loss reduction savings (USD/yr)	1 625.62
Profitability of the intervention (USD/yr)	1 445.62

*Including yearly cost of investment (USD 30) and total cost of operation (USD 150)

ticularly those whose main source of income is tomato farming and trading. Moreover, tomato is one of Guyana's export crops and the high postharvest losses translate to reduced volume for export hence reduced foreign exchange earnings.

The importance of good post-harvest handling

Loss of quality and quantity occur between harvest and consumption. In tomato, losses occur because of immaturity, physical damage resulting from faulty harvesting, improper packaging, rough and repeated handling and poor transport conditions. Tomatoes can be harvested at any stage of maturity depending on the distance to the market. Tomatoes are harvested at the breaker to pink stage of maturity using clippers leaving the calyx attached to the fruit because the stem scar serves as the main avenue for water loss. Use of clippers prevents the problem of stem end damage, which often occurs when the fruit is hand-pulled. The most appropriate containers for tomatoes are plastic crates that are rigid, stackable and returnable. Plastic crates protect the tomatoes better than the corrugated fibreboard cartons that are traditionally used to transport ripe tomatoes over a distance of 104 km. Ripe tomatoes have low resistance to vibration and compression damage thus they need to be packed in rigid containers that can be stacked properly in the vehicle. The quality of tomatoes at the ripe stage, especially the colour, is affected by temperature. Consumers prefer red ripe

fruit which is achieved at 18 to 22 °C. High temperature results in ripe tomatoes that are blotchy, and in fruit that are either yellow or orange when ripe. Relative humidity in the ripening room should likewise be maintained at 85 to 90 percent to prevent water loss from the fruit. Personal hygiene of workers and sanitation of the ripening facility, packaging materials, and transport vehicle should be properly observed to ensure the safety of the fruit when offered to consumers.

Recommendations to reduce post-harvest losses and their Economic benefits

Physical damage on the fruit is one of the main causes of losses because of improper packaging. Corrugated fibreboard boxes that are used to transport ripe fruit do not provide adequate protection during transport and repeated handling of tomatoes. Plastic crates can be used as field and transport containers since they are rigid and stackable (Figure 1). Compared with corrugated fibreboard boxes that can be used only once, plastic crates can last from 5 to 10 years thus the high initial investment cost can be readily offset by long usage. Assuming the volume of production per year is 11.364 tonnes, with postharvest loss of 11 percent, this is equivalent to a food loss of 1.25 tonnes per year and an economic loss of USD 2 502.50 per year. With the use of plastic crates that cost USD 150 per piece, losses are anticipated to be reduced by 65 percent resulting in a profitability of USD 1 445.62 per year (Table 2).

TABLE 3
Profitability of using a ripening room for tomato in Guyana

Item/Unit	Value
Product quantity (tonne/yr)	54.54
Product value (USD/tonne)	2 002
Loss (%)	10.5
Food loss (tonne/yr)	5.73
Economic loss (USD/yr)	11 471.46
Cost of intervention (USD/piece)	4 200
Total cost of intervention (USD/yr)	620*
Client cost of intervention (USD/tonne)	11.37
Anticipated loss reduction (%)	70
Volume of loss reduction (tonne/yr)	4.01
Loss reduction savings (USD/yr)	8 028.02
Profitability of the intervention (USD/yr)	7 408.02

The other critical loss point is during packinghouse operations when tomatoes are ripened in a shed adjoining the farmer's dwelling. When conditions during ripening are not properly managed, the resulting ripe fruit is of low quality in terms of peel colour. A ripening room could be installed, where the temperature can be maintained at 18 to 22 °C with a relative humidity of 85 to 90 percent, to prevent moisture loss from the fruit. Based on the assumption of an annual production of 54.54 tonnes per year and a loss of 10.5 percent, this translates into a food loss of 5.73 tonnes per year. Using a ripening facility that costs USD 4 200, it is anticipated the loss would be reduced by 70 percent resulting in a profitability of USD 7 408 per year (Table 3).



FIGURE 1
Plastic crates for tomatoes as field and transport containers