



## Food loss analysis: causes and solutions

### Mango supply chain in Guyana

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Mango (*Mangifera indica* L.) is one of the non-traditional crops in the Caribbean Community (CARICOM) Subregion that is given importance in meeting the challenges of competition, exploring niche market opportunities, and reducing dependence on single commodity. The fruit is a good source of energy, carbohydrates, fibre, vitamins and minerals. As in other CARICOM countries, the fruit is popularly eaten in Guyana as green, fresh-cut slices or frozen fresh-cuts and later used as ingredients in dishes, processed into kuchelar and other products or consumed as fresh ripe. Buxton Spice is the only commercial cultivar both for the fresh market (domestic and export) and for processing.

on the fruit and physical injuries in the form of cuts, punctures and abrasion. Processing into value-added products such as kuchelar and frozen mango slices are CLP 2 and 3, respectively with losses amounting to 2.9 and 3.2 percent (Table 1). Failure to sort at the point of receipt, physical injuries incurred during harvesting and over packing of mangoes in 60 kg plastic bags contribute to losses. The absence of ventilation in the plastic bags and exposure to high ambient temperature further contribute to losses because of development of physiological disorders. A loss of 4.3 percent also occurs during retail, when mangoes are sold as fresh table ripe (CLP 4). Losses are the result of physical injuries that are incurred during the earlier part of the supply chain (packaging and transport) and the poor conditions during ripening in the wholesale and retail markets. Compared with the other varieties of mango, Buxton Spice has a thinner skin; hence it is more susceptible to water loss resulting in shrivelling. It is also at this stage when decay resulting from anthracnose and stem end rot became apparent.

#### Impact of post-harvest losses

The mango supply chain in Guyana results in a total loss of 28 percent thus reducing the availability of mango fruit for distribution,

The mango supply chain in the study that was tracked and analysed is in the Berbice Region on the west coast of Guyana, because this is one of the major production areas that contribute to employment generation and poverty reduction. Observations, interviews with stakeholders and actual measurements of quantitative and qualitative losses were taken as well as their nature and causes were noted.

Similar to the producing regions in CARICOM, the mango industry in Guyana is characterised by widely scattered production areas, highly diverse stakeholders and a fragmented marketing system. Farmers are responsible for producing the crop with minimal inputs during the months of December to February and June to August. Mangoes are harvested by hand, and by shaking

the panicles, at the green to turning stage of ripeness. The harvested fruit is placed in bags, buckets or directly into trays of animal- or tractor-drawn trailers. Plastic crates are rarely used as field containers if the fruit is for the local markets. However, if mangoes are intended for export, plastic crates are used as field and transport containers. Mangoes are transported from the farm in pick-ups, trucks or vans to Georgetown wholesale and retail markets or to processing facilities over a distance of 104 km (Table 1). Consumers directly buy from municipal markets, roadside stalls and supermarkets.

There are four (4) critical loss points (CLP) in the mango supply chain, the highest at 17.5 percent occurs during harvesting (CLP 1). The faulty harvesting method and the absence of harvesting aids result in latex stains

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

Supply Chain Level	Production	Wholesale market			Retail market / Local market	Consumption
		Value added products		Fresh table ripe		
		Kuchelar	Fresh-cuts			
Stakeholders	Farmer Transporter	Processor Wholesaler Transporter	Processor Wholesaler Transporter	Wholesaler Transporter	Retailer	Consumers
Operations	Harvesting Sorting Field packing Transporting	Washing Peeling Cutting & Slicing Drying Packaging Selling	Washing Peeling Cutting Packaging Freezing Selling	Ripening Sorting Transporting	Retailing	Buying Consumption
Critical Loss Points (CLP)	1-Harvesting	2-Kuchelar processing	3-Fresh-cuts processing	4-Ripening		
Losses	17.5 %	2.9 %	3.2 %	4.3 %		

**TABLE 2**  
Profitability of using a mango picking rod on a 5-acre of mangoes in Guyana

Item/Unit	Value
Product quantity (tonne/yr)	18.9
Product value (USD/tonne)	1 880.00
Loss (%)	17.5
Food loss (tonne/yr)	3.31
Economic loss (USD/yr)	6 222.80
Cost of intervention (USD/pc)	300.00
Total cost of intervention (USD/yr)	80.00*
Client cost of intervention (USD/tonne)	4.23
Anticipated loss reduction (%)	60.0
Volume of loss reduction (tonne/yr)	1.98
Loss reduction savings (USD/yr)	3 722.40
Profitability of the intervention (USD/yr)	3 642.40

\*Including yearly cost of investment (USD 60) and total cost of operation (USD 20)

processing and consumption. For the farmers, losses during harvesting translate into reduced volume for sale. For the processors of kuchelar and green fresh-cuts, losses are incurred because of rejection of mangoes that exhibit physical injuries, pathological damage such as stem end rot, insect damage from fruit fly, and physiological disorders related to internal breakdown, reduce the volume of mangoes that can be processed. In the case of mangoes that are sold as fresh ripe, physical injuries and decay become more apparent at this stage where, in most cases, the fruit becomes unmarketable. For fruit that exhibits slight symptoms of damage, hence it is still marketable; the selling price however, is lower than those without damage. The loss in nutritional value represents the hidden loss, which is important since mangoes are increasingly being consumed for their nutritional value. The loss in quality and quantity of mangoes along the supply chain is equivalent to an economic loss of USD 786 254.52, which greatly affect the income and impact the rural poor, particularly those whose main source of income is mango farming and trading.

### The importance of post-harvest handling

The quality and potential storage life of mango fruits are established at harvest. Mangoes need to be harvested at the proper stage of maturity, whether they are intended for processing or sold as fresh ripe. Fully mature mangoes have more food reserves thus shelf-life is extended. Abrasion and compression,

incurred because of over packing in 60-kg capacity plastic bags, coupled with rough handling during transport, can be prevented by using rigid, returnable and stackable plastic crates. In the case of mangoes that are intended to be sold as fresh ripe, the onset of ripening results in reduced compressive strength of the fruit hence rigid plastic crates will provide adequate protection to the fruit. Hence when mangoes are not subjected to integrated disease management during production, the timely application of hot water treatment provides an adequate degree of disease control. During ripening, proper temperature and relative humidity management are required for the attainment of the characteristic peel colour of the variety. For mangoes intended for processing into kuchelar or as frozen fresh-cuts, minimum standards should be established as to stage of maturity and freedom from physical injuries, insect and disease damage. The personal hygiene of workers and sanitation of all equipment, tools, packaging materials, and processing facilities should be properly observed to ensure the safety of the processed products.

### Recommendations

The highest losses occur during harvesting as a result of physical injuries associated with faulty harvesting methods. A simple and low-cost recommendation to reduce losses is the use of a picking rod with netted pouch (Figure 1). The picking rod has a cutting blade that detaches the fruit from its natural abscission point thus preventing la-

**TABLE 3**  
Profitability of using a ripening room for a 5-acre mango farm in Guyana

Item/Unit	Value
Product quantity (tonne/yr)	18.9
Product value (USD/tonne)	1 880.00
Loss (%)	4.3
Food loss (tonne/yr)	0.81
Economic loss (USD/yr)	1 522.80
Cost of intervention (USD/pc)	3 000.00
Total cost of intervention (USD/yr)	700.00*
Client cost of intervention (USD/tonne)	37.04
Anticipated loss reduction (%)	75
Volume of loss reduction (tonne/yr)	0.61
Loss reduction savings (USD/yr)	1 146.80
Profitability of the intervention (USD/yr)	446.80

tex staining because there is no continuity of latex vessels between the fruit and the point of detachment. The pouch attached at the end of the picking rod catches the fruit as it is being detached from the pedicel.

Assuming that a 5-acre mango orchard produces 18.9 tonnes per year valued at USD 1 880 per tonne, with a loss of 17.5 percent during harvesting, this is equivalent to an economic loss of USD 6 222.80 per year. With the use of the picking rod that costs USD 300 per piece, the anticipated loss reduction will be 60 percent resulting in a loss reduction savings of USD 3 722.40 per year. The economic profitability of a simple intervention is estimated at USD 3 642.40 per year (Table 2).

The other critical loss point is during retail where the fruit is sold at the table stage with loss amounting to 4.3 percent. When conditions during ripening are not properly managed, the resulting ripe fruit is of low quality in terms of peel colour, aroma and flavour development. A ripening room facility can be installed, where temperature can be maintained at 20 to 22 °C and relative humidity at 90-95 percent to prevent moisture loss from the fruit. For a 5-acre farm that produces 18.9 tonnes per year, a ripening facility will cost USD 3 000 with depreciation period of 15 years will give a yearly cost of the intervention amounting to USD 700 (Table 3). The anticipated loss reduction of 75 percent will result in a savings of USD 1 146.80 per year. The profitability of using a ripening facility will amount to USD 446.80 per year.