



Food loss analysis: causes and solutions

Mango supply chain in Trinidad and Tobago

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Mango (*Mangifera indica* L.) is one of the non-traditional crops identified in the Caribbean Community (CARICOM) Subregion that needs to be developed in terms of increasing production and improving post-harvest practices because it contributes to employment generation and poverty reduction. The fruit is a good source of energy, carbohydrates, fibre, vitamins and minerals. In Trinidad and Tobago, the fruit is popularly eaten 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. There is varietal differentiation with regard to the intended use – the variety Julie for the fresh market and Long for processing.

and seed weevil also contribute to losses at this stage. CLP 2, amounting to 3.6 percent, occurs during processing into kuchelar while CLP 3 occurs in green, fresh-cut slices that are either sold fresh or frozen and amounts to 3.5 percent (Table 1). The lowest CLP of 2.3 percent was obtained in the fresh, table ripe fruit, which was attributed mainly to physical damage and diseases such as anthracnose and stem end rot.

Impact of post-harvest losses

Considering that farmers have small landholdings with mango farming being one of the main sources of income, the losses incurred at the earlier part of the supply chain, i.e. during harvesting, translates into reduced volume for sale hence lower income. For the processors of kuchelar and green fresh-cuts, losses are incurred because mangoes are rejected if they exhibit physical injuries such as compression and punctures, pathological damage like 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 or consumed as fresh ripe, physical injuries and decay become more apparent at this stage which, in most cases, means the fruit be-

The mango supply chain followed is in the primary production area of Chaguanas, Central Trinidad, up to the retail market and processing facilities. Observations, interviews with stakeholders and actual measurements were taken of quantitative and qualitative losses as well as their nature and causes were noted.

The mango industry 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. Mangoes are harvested at the green or turning stage using either a picking rod with pouch, by hand or by beating the fruit clusters. Field containers are buckets, boxes or plastic bags. Plastic crates are rarely used as field or transport containers. Mangoes are then transported using vans, pick-ups

or trucks to the wholesale and retail markets such as wet markets, roadside stalls or supermarkets, or to the processing facilities that are either village-type or large commercial plants. For mangoes intended for sale as fresh ripe, ripening occurs at the wholesale or retail market where there is no temperature and humidity control.

Because of inappropriate harvesting method, poor packaging and transport and inadequate ripening facilities, losses are incurred along the supply chain (Table 1). There are four critical loss points (CLP) and the highest loss occurs during harvesting (CLP 1) amounting to 9.5 percent, which is attributed to rough handling leading to punctures, cuts and abrasions. Rejections because of latex staining, insect damage from fruit fly

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					
	Kuchelar		Fresh-cuts			
Stakeholders	Farmer Transporter	Processor Wholesaler Transporter	Processor Wholesaler Transporter	Wholesaler Transporter	Retailer	Consumers
Operations	Harvesting Sorting Field packing Transporting	Harvesting Sorting Field packing Transporting	Peeling Cutting and slicing 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	9.5%	3.6 %	3.5 %		2.3 %	

TABLE 2
Profitability of using a mango picking rod on a 5-acre of mangoes in Trinidad and Tobago

Item/Unit	Value
Product quantity (tonne/yr)	18.9
Product value (USD/tonne)	1 563.00
Loss (%)	9.5
Food loss (tonne/yr)	1.79
Economic loss (USD/yr)	2 797.77
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)	1.074
Loss reduction savings (USD/yr)	1 678.66
Profitability of the intervention (USD/yr)	1 598.00

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

comes unmarketable. For fruit that exhibits slight symptoms of damage, hence are still marketable, the selling price is lower than those without damage. In Trinidad, the value of annual mango production is USD 78 150. With total loss of 18.9 percent, this is equivalent to economic loss of USD 14 770.35.

The importance of post-harvest handling

The quality and potential storage life of mangoes are established at harvest. The fruit needs to be harvested at the proper stage of maturity, whether intended for processing or sold as fresh table ripe. Fully mature mangoes have more food reserves thus shelf life is extended. Cuts, abrasions, punctures and compression damage that occur because of poor packaging and rough handling during transport can be prevented by using rigid, stackable, returnable plastic crates. In the case of mangoes intended to for sale 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 for mangoes that are not subjected to integrated disease management during production, the timely application of hot water treatment provides adequate degree of disease control. During ripening, proper temperature and relative humidity management are required for the attainment of the variety's characteristic peel colour.

For mangoes intended for processing into kuchelar or as 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, 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. One simple and low-cost recommendation to reduce damage is the use of a picking rod with netted pouch (Figure 1). The pouch catches the fruit as it is being detached from the panicle with a cutting blade that is attached to the picking rod. Moreover, as the fruit is severed from its natural point of detachment, latex staining is prevented because there is no continuity of latex vessels between the fruit and the point of detachment.

Assuming that a 5-acre mango orchard produces 18.9 tonnes per year valued at USD 1 563 per tonne and loss reduction of 60 percent with the use of picking rod that costs USD 300 per piece, the economic profitability of this simple intervention is estimated at USD 1 598 per year (Table 2).

The other critical loss point occurs during retail where the fruit is sold at the table ripe stage. When conditions during ripen-

TABLE 3
Profitability of using a ripening room for a 5-acre mango farm in Trinidad and Tobago

Item/Unit	Value
Product quantity (tonne/yr)	18.9
Product value (USD/tonne)	1 563.00
Loss (%)	2.3
Food loss (tonne/yr)	0.43
Economic loss (USD/yr)	679.43
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 (%)	33
Volume of loss reduction (tonne/yr)	0.33
Loss reduction savings (USD/yr)	509.58
Profitability of the intervention (USD/yr)	-190.42

ing are not properly managed, the resulting ripe fruit is of low quality in terms of peel colour, aroma and flavour development. A ripening room can be installed where temperature during ripening can be maintained at 20 to 22 °C and relative humidity of 90 to 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 15 years depreciation. The yearly cost of the intervention will amount to USD 700. With an anticipated loss reduction of 33 percent, the loss reduction savings will only be USD 509.58 resulting in negative profitability for a 5-acre farm (Table 3). The proposed intervention will be profitable if the ripening room will be made available as a common service facility to other farmers in the locality. The ripening facility will be managed by the farmers' association.



FIGURE 1
Use of picking rod