Appendix 8.17

This case study forms part of the overarching
2017–19 ACIAR Mango Agribusiness Research Program

Project:	**Enhancing mango fruit quality in Asian mango chains**
Study:	**The Philippines**
Project number:	**AGB/2016/009**
Date:	**30 October 2019**
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Contents

1 Acknowledgements

This study report for the Mango Quality project was prepared by Emma Ruth Bayogan and Leizel Secretaria from the University of the Philippines Mindanao.

2 Case summary

Mango (*Mangifera indica L.*) is one of the top export fruit crops of the Philippines along with banana and pineapple. The opportunity in the international market for Philippine mangoes is expanding; however, the great challenge lies on the capability of smallholders, (a major stakeholder of the mango industry) to cope with the high demands of volume and quality in the market. By understanding the quality and volume demands of the market, farmers may enhance and alter their production which may consequently improve their livelihood. Thus, organised smallholder farmers may benefit from this study into enhancing the mango quality in Asian mango supply chains. The common language developed in assessing mango quality provides a better understanding of both opportunities and issues within emerging export markets such as Hong Kong and mainland China, and can offer a comparative advantage in coping with demand and meeting the export quality standards of the global market.

The mango quality manual was found to be very useful during sorting and grading in the farm, in the processing plant and in the pack house of the export company. The wholesale/retail markets do not always assess the fruit upon receipt since it is expected that it will be accepted/rejected by the export or processing company. However, the manual can still be helpful when sorting the fruit according to quality that, in turn, may dictate different prices. The traders assessed only the ripeness of fruit by change in peel colour from green to yellow. The manual was easy to use and helpful, except for when assessing blush, firmness and smell of mangoes. The Carabao mango variety does not have a strong smell when ripe or unripe. The peel of the ripe mango is so thin that repeated handling of the fruit may damage it. To assess the fruit's firmness, a sample may be subjected to the destructive method using a fruit penetrometer.

Through key information received from the farmers, traders, processors, exporters and importers, the draft quality manual was trialled. There is an expanding market for the Philippine mangoes; however, producing high volumes at export quality is restricted by various problems in production and post-harvest handling of fruit. Using the manual, the quality of mangoes was assessed at different stages of the supply chain. The higher rejection by the export company (30–50%) was mainly due to bumps, scab, lenticel spotting and sap burn, which can be reduced through proper pre-harvest and post-harvest management. The quality of different mango varieties available in the local market was assessed using the mango quality manual. The identification and characterisation of other available varieties may highlight quality characteristics for consumers and traders. The availability of other varieties can provide consumers with other options that may suit their preferences, such as the Florida mango which is now being exported to South Korea.

To keep up with the higher volume and quality demand in the market, there is a need to assist smallholder farmers. The 'all-in' pricing scheme should be discouraged since the farmer can deliver high-quality export fruit with grading and sorting. Through this, the smallholder farmers may sustain the costs of production and demand a higher price for export-quality fruit. Higher mango losses due to pre-harvest and post-harvest defects can be reduced through proper management of fruit from the farm to the buyer. Some modifications in the manual include suggestions or preferences of the supply chain players such as images of Carabao mango for reference, specifically to demonstrate flesh colour and defects. Standards and maturity indices can be included in the manual as these are useful for determining the standard quality dictated by the market. The 1–6 scale for peel colour is widely used and is therefore recommended, particularly for Carabao mango.

3 Introduction

3.1 Project background

Mango (*Mangifera indica L.*) is a horticulturally important crop in the Philippines. It is one of the top export fruit crops (next to banana and pineapple). The top export variety is the Carabao mango which is also known in the international market as the 'Super Manila' mango. Carabao mango is one of the best varieties in the world because of its unique taste and aroma. The Philippine Carabao mango was listed in the 1995 Guinness Book of World Records as the sweetest fruit in the world (Castillo-Israel et al., 2015). However, due to its thin skin when ripe, the long production process and its relatively short shelf life, optimising its potential in the international market is a challenge. As the global demand for mangoes increases, improvements on the pre-harvest and post-harvest protocols must be continuously evaluated in order to reduce production losses, as well as improve and maintain fruit quality that will meet international standards. Post-harvest issues resulting from the long processes in the supply chain which are compounded by the unavailability of proper facilities in the Philippines have limited the production potential of export-quality mango.

The increasing demand of fresh and processed mango in domestic and export markets pose both opportunities and challenges. As one of the top mango producers in the world, the Philippines endeavours to keep up with the high demand of both fruit quantity and quality. Over the last three years, lower export volumes of mangoes was accompanied by a reduction in areas planted and harvested as well as lower mango quality. Exporters are facing a dilemma in supplying the volume and quality demand of the market as most suppliers of mangoes are smallholder farmers. These smallholders do not have enough resources for production inputs. Helping these small farmers understand market demand based on quality can boost their production and improve their livelihood. Thus, smallholder farmers, particularly those who are organised, may benefit from the output of this study in enhancing mango quality in Asian mango supply chains. The common language developed in assessing mango quality provides better understanding of both opportunities and issues within the emerging export market, such as Hong Kong and mainland China, and can provide a comparative advantage in keeping up with demand and meeting export-quality standards of the global market.

3.2 Study objectives

The aim of this study is to contribute to the development of a common approach in assessing, describing, and improving fruit quality in Asian mango supply chains. The study objectives were to:

- give an overview of the mango market in the Philippines
- collect resources on subjective and objective quality assessments in the Philippines and review mango consumption data relevant to Philippine markets
- assess domestic mango quality using the mango quality manual
- test the mango quality manual along the supply chain
- capture feedback from supply chain stakeholders on the draft manual
- comparatively analyse the data for different varieties in the local market
- identify opportunities and issues to further develop the mango quality manual.

3.3 Study methodology

This study covered the domestic and international Carabao mango chains, preparation and assessment along the supply chain in accordance with the mango quality manual, and characterisation of other mango varieties. Likewise, the study reviewed the current

status of the mango industry in the Philippines, including the domestic and international supply chains.

To contribute to the development of a common language in assessing mangoes, the mango quality manual was tested and assessed in the domestic and international supply chains with the participation of the key stakeholders. This involved assessment of mango quality in the farm, wholesale/retail market, processing company, export company, export consignment and at consumption.

The study aimed to evaluate and improve the mango quality manual as a common language in assessing mango quality in Asian mango supply chains. The manual was developed by the Queensland Government's Department of Agriculture and Fisheries. The participation of colleagues from different countries in the Asia-Pacific region in Workshop 1 provided clearer guidance towards achieving the goals of the project. Through discussion and consultation with representatives from other partner countries, the design and focus of the research was established. Results and analysis from this study were shared with partners and stakeholders during Workshop 2.

The methodology followed the design that was agreed upon by country collaborators in Workshop 1. Some methods were modified based on available respondents and mango varieties.

Research design

Philippine Carabao mango supply chain

The domestic and international supply chains of the Carabao mango were verified using key information from farmers, traders, wholesalers, exporters and importers. The Carabao mango supply chains were validated through key informants. Interviews with the exporter from the Philippines and importers in China were conducted. A meeting with the importer was held in one of their retail markets – the Citysuper inside the Raffles City Mall, Shanghai, China – during the Carabao mango export shipment trial in which additional information was validated.

Road testing the manual

The mango quality manual uses a common language to assess the physical qualities of whole and cut fruit. An optional evaluation involved the destruction of fruit to assess chemical properties. For Carabao mango, whole fruit assessment included visual quality (skin defects and colour), firmness, aroma, optimal shelf life and reason for end of shelf life. On the other hand, evaluation of the cut fruit was based on flesh defects, colour and aroma while optional assessments involved firmness using a penetrometer, total soluble solids (TSS) using an Atago pocket refractometer (Tokyo, Japan), and colour using a Nix Pro colour sensor or a CR-400 Konica Minolta chromameter to measure the L*, a*, b*, chroma and hue angle.

The manual was tested in the field during harvesting by the export company, Southern Philippine Fresh Fruit Corporation (SPFFC), and on the export consignment in Shanghai, China. Four post-harvest researchers were involved in evaluating the manual in the farm during harvesting. In the export company, one researcher and three undergraduate thesis students conducted post-harvest research using the manual. In the field, whole fruit and optional assessments were conducted. Whole fruit and optional assessments were also conducted in SPFFC and on the export consignment in Shanghai, China.

Whole fruit assessment involved two farms (each with 60 samples) while six fruit from each farm were used for optional assessments. In SPFFC and the export consignment in Shanghai, China, 180 samples were used for whole fruit assessment. For the optional assessment of colour using Nix Pro, 108 fruit were used. For cut fruit assessment, TSS and firmness were assesses using 54 fruit during each evaluation period, at the receiving and packing stages, and three and six days after arrival in China.

The manual was tested and assessed by different supply chain players: farmers (n= 10), wholesalers/retailers (n=30), processors/exporters (n=7) and consumers (n=33).

Assessment of different mango varieties

Different mango varieties available in the market were procured and their quality characterised. The mango quality manual was used to assess quality, including sensory analysis. The consumer's acceptability of the aroma, texture, flavour and overall acceptance of the three other mango varieties was evaluated.

4 The Philippine mango market

4.1 Mango production and export

Mangoes are considered to be one of the top export fruits from the Philippines (next to banana and pineapple) with a total production of 737,000 metric tonnes of which 16,116 metric tonnes was allotted for export in 2017 (Philippine Statistics Authority, PSA). In the second quarter of 2018, the Ilocos Region (Luzon) was the highest producer of mangoes contributing about 21.3% of the total national production, followed by the Zamboanga Peninsula (Mindanao) and Central Visayas with 11.2% and 9.2%, respectively (PSA, 2018). The Davao Region was the fourth-largest mango producer in 2017, contributing 7.10% of total national production.

The Carabao or 'Super Manila' mango is the top variety grown and exported from the Philippines. This variety is considered by many as the best mango in the world for its unique taste and aroma. The production of the Carabao variety in the first quarter of 2018 represented 80% of the total mango production in the country (PSA, 2018). However, lower production of mango crops in recent years is a result of decreasing domestic production, which is accompanied by a decline in the total area planted and harvested. The incidence of cecid fly, capsid fly and fruit fly, as well as intermittent rain showers during flower induction, are among the reasons of the decreasing volumes and lower quality of fruit (PSA, 2018). As part of the government's effort to help the industry, the Department of Agriculture and Fisheries drafted a five-year Philippine Mango Industry Development Roadmap through a consultative forum with industry stakeholders. This roadmap was anchored on the House Bill 3538, also known as the *Philippine Mango Development Act of 2016*, '*that would refresh and bolster the competitiveness of the Philippine Mango through lower production costs, decreased post-harvest losses, modernised techniques and technologies, and international marketing strategies'*.

4.2 Mango market information

Carabao, Pico and 'Indian' mangoes are the top varieties in the Philippines. During peak harvesting seasons (May to July), the price of mangoes generally decreases. In 2017, farm-gate prices rose by almost 5% due to a decline in output which forced traders to pay more for the crop. The average farm-gate price increased by 37.26% which resulted in an average price of PHP39.31 per kg – up from PHP28.51 per kg in 2016 due to reduced production in 2017 by almost 10% (Business Mirror, 2018; PSA, 2018).

There is a widespread practice of 'all-in' farm-gate pricing in which (regardless of the quality) fruit are under a single price (Briones, 2013). Breakdown of the price margins for mangoes in relation to their export price was studied by Digal (2005). Export price is only slightly different to retail price. This difference was calculated from the 27% of the retail price and 44% of the wholesale price. This can also be explained by marketing costs such as transportation, materials and labour that traders are responsible for. Marketing channels are involved from the production to consumption stage of mangoes. Farm traders and consolidators buy directly from the growers. The traders then deliver the fruit to buying stations with packaging facilities, or deliver fruit to processors, wholesalers, or

exporters. Wholesalers distribute the fruit to retailers or sell to exporters and fruit processors. Retailers are the ones from whom consumers directly buy the produce (Digal, 2005; Rivera, 2010). Mango processing provides additional income due to the high market value of processed mango products.

4.3 Carabao mango supply chain

The domestic and international supply chains were verified through key information received from the farmers, traders, importers and exporters. Figures 1 and 2 show the domestic and international supply chains of Carabao mango, respectively. In the domestic supply, harvesting is usually undertaken by contractors and, occasionally, by traders who manage and finance the farm. Most of the farmers usually enter into a contract with a mango contractor who provides financial support and manages the mango farm during the application of fertilisers, pesticides and flower-induction chemicals. During harvest, fruit are sold to traders on an 'all-in' basis under a single price regardless of quality. The trader sorts and packs the mangoes according to quality that is, in turn, dictated by the buyer. The buyer can be the local wholesale market, institutional market, Manila market, processing company or exporter. When the mangoes are not in season in Luzon, the Manila market sources fruit from Mindanao, such as in the Davao Region.

The traders sell the mango crop to buyers according to quality whereby the higher the quality of fruit, the higher the price. Excellent fruit are sold to export companies that sell fresh mangoes to Hong Kong, China, South Korea and other countries around the world. However, most of the farms cannot supply excellent quality mangoes to fresh fruit exporters. Fruit that does not meet the high standard of the fresh fruit export company are sold to mango processors. Traders resort to selling fruit of low visual quality to the processing plant (as long as the flesh of the fruit is considered acceptable). Fruit for processing are either delivered to processing companies within Davao City or to Cebu City, which takes two days of transportation via land and sea. Processed mango products are sold locally and in the international market. Aside from the processing company, other cities like Manila and the local wholesale market get a proportion of lower quality fruit. Companies that export fresh fruit provide technical support to their accredited farmers and monitor the trees from flower induction to harvest. The assigned technician often accompanies the delivery of mangoes to the export facility since the fruit can be taken by the other export companies by enticing the farmers/traders with a higher buying price. This situation happens when there is a low volume of available export-quality fruit.

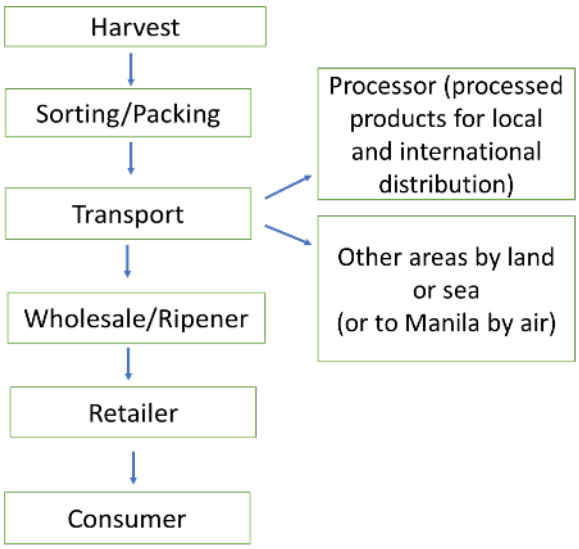

Figure 1. Domestic supply chain of Carabao mango from the Davao Region

Source: Authors' analysis

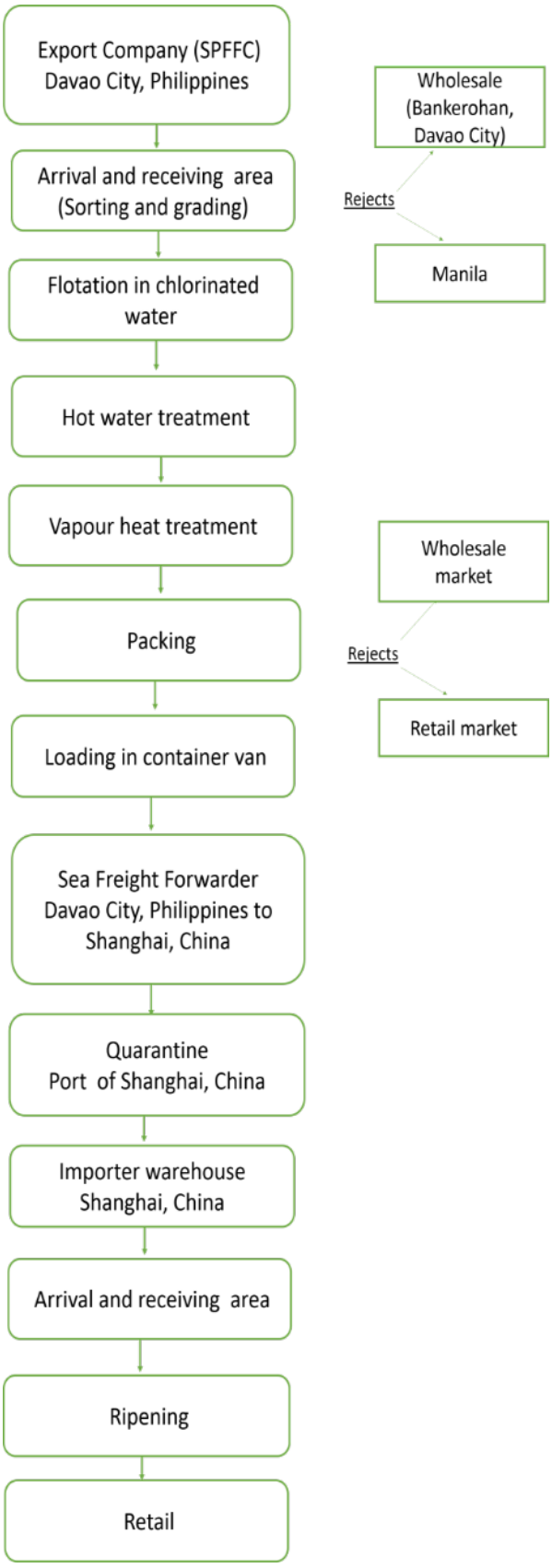

Figure 2. International supply chain of Carabao mango from the Davao Region

Source: Authors' analysis

The Southern Philippines Fresh Fruit Corporation (SPFFC) is a fresh mango export company and is expanding to export bananas and pineapples (initially to China). The company owns and operates a vapour heat treatment (VHT) plant and handles other fruit that require VHT for export. The company was established in 2005 when it constructed the facility (including the VHT plant). Following accreditation, they started exporting in 2007. They have fully-owned facilities in South Korea and Japan, except in China where they have a partnership with the importer.

Export to other countries

The company initially exported to Japan, then to Korea and to other Asian countries such as Hong Kong and China. Originally, the company exported a higher volume (around 70%) to Japan; however, due to restrictions in minimum residue levels (MRL) their export volume was reduced to 3%. Currently, they export 70% of their volume to South Korea, and the remaining 30% to Hong Kong, of which 7% is exported to China.

Export to China

The company directly exports to Shanghai, China from the Davao City port. They also ship to Hong Kong where they have two clients that are involved in food services. Mangoes shipped to Hong Kong are subjected to hot water treatment (HWT) only. Fruit exported to China are for retail and special services (restaurants) and are subjected to HWT and VHT. SPFFC ships 2–2.5 tons of mangoes (300 boxes) per week. This volume does not fully load the container van. They fill the van with a horizontal layer of empty cartons below the boxes containing the fruit. The price per kg is RMB300 or around PHP2,500 in the wholesale market in China. Medium Carabao mangoes were seen to sell at RMB118 (PHP1,003) in the retail market. SPFFC exports class A, 0–0, 0–1 mangoes subjected to HWT and VHT. The company ships one container van per week to China as loose cargo without pallets. The loading of mangoes in a container van for export will take 6–7 days which usually starts every Sunday or Monday, depending on the availability of fruit. They usually close the container van on Saturday, and it is brought to the Davao City port on the same day for shipping on Sunday.

There is a growing market in Shanghai as they initially exported by air but now also use sea freight. It is still a slow process, but the volume is increasing. They ship throughout the year, however, shipment is doubled (i.e. the container van is fully loaded) during the Chinese New Year which is around the third week of January.

Export process

The export company has technicians/field staff to monitor the trees from flower induction to harvesting and to provide technical support and assistance to farmers. Their source comes from mango farmers initially accredited to produce fruit for export.

Harvesting – The company only accepts mango fruit that are harvested within the last 24 hours. Mangoes are sorted, wrapped in newspaper and packed in second-hand banana boxes. The volume per box is around 18–25 kg. The minimum requirement for maturity is 105 days after flower induction while the TSS% Brix is 7.

Transportation – Mango fruit are transported via an open truck with a canvas cover or in a closed truck. The nearest source or farm is four hours away from the facility while the farthest is eight hours. Their sources include mangoes from the Island Garden City of Samal, Mati in Davao Oriental, Davao del Sur and Saranggani.

Receiving at the packing house – Upon receipt, mangoes are sorted according to quality grade and weight (Grades: 0–0, 0–1 = Korea/Japan/China, 0–2, 0–3 = Hong Kong; Sizes: XL = 631–850g, L = 501–630g, M = 381–500g, S = 270–80g, and SS 150–199g) (see Figure 3). TSS is measured using a refractometer for assessing the sweetness and the fruit are hand weighed or sometimes mechanically sorted. From boxes, fruit will be transferred to plastic crates with side ventilation holes.

Figure 3. Mango quality guide in SPFFC

Source: SPFFC

Disinfestation – Fruit are subjected to flotation in chlorinated water (100–150 ppm). Floaters and sinkers are separated. All fruit are subjected to HWT in a water bath at 52–55 ºC for 3–5 minutes. After HWT, fruit are immediately cooled in a water bath at ambient temperature. Fruit are then transferred to solid plastic crates. Sinkers are subjected next to VHT for 10 minutes at 46 ºC. Floaters are staged or conditioned at ambient conditions for approximately 16 hours or one day before VHT. The company keeps written records of temperature and time for the inspectors. Fruit is then cooled under a water shower for 40 minutes, dried with overhead fans and left until packing the next day.

Packing – The packing room is maintained at 20°C. Fruit are packed in single layer in carton boxes at 5 kg per box for China and in double layers at 12 kg per box for Japan. SPFFC ships mangoes with peel colour index 1 (green), or 2 (green with a trace of yellow) but not with peel colour index of 3 (green).

Sea transport – Mangoes are loaded into refrigerated containers and are usually stored at 10 ºC, but sometimes at 12–13 ºC. They ship mangoes at 10–12 ºC for 4–7 days depending on the market (Japan, Korea, Hong Kong, China). Transit time for Shanghai is seven days, Korea is 7–8 days, and Japan is five days. One single-use temperature data logger is placed in each container for monitoring purposes. For a 20-ft container van can hold 1,200 boxes and a 40-ft container van can hold 2,100 boxes. However, with exports to China, SPFFC only uses around 300 boxes.

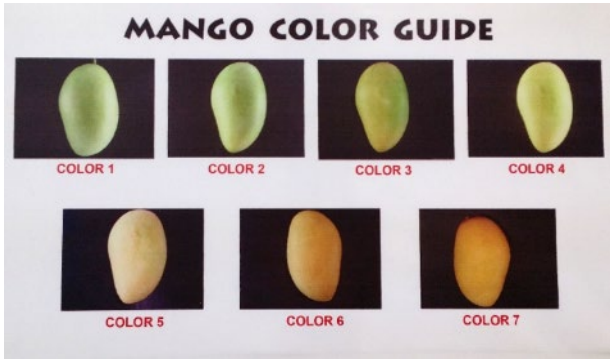

Figure 4. Mango colour guide in SPFFC

Source: SPFFC

Quarantine – Initially, the container van was held in the importer port for 21 days (2012). However, this timeframe was reduced to seven days and if there was no problem in the shipment, the van was released within three days. This is different to the report from the Chinese authority who stated that they held the container van for only 24 hours.

Delivery at the importer – SPFFC has a partnership with the importer. The company owns the ripening facility, but the importer has the overall control of mangoes once received.

Ripening – The importer and their staff are trained by SPFFC regarding how to ripen the mangoes using only temperature control not ethylene gas. Previously, SPFFC tried to use ethephon (Ethrel®) but they observed that it only changed the colour to yellow and it did not properly ripen the flesh/pulp.

Sorting in SPFFC is done in two stages: upon arrival and during packing

Rejects after sorting at receiving area – During the sorting stage in the receiving area, rejects from pre-sorted mangoes total around 30–50%. After sorting, rejected fruit are returned to the supplier/grower or sold to the local market by the supplier or SPFFC. The supplier delivers the rejected fruit to the local market in Bankerohan, Davao City or to the Manila market via air freight, or to the local processing company. If the mangoes come from an SPFFC-owned farm the fruit will be delivered to the local market in Bankerohan, Davao City. Upon arrival in the packing house, the fruit are sorted to identify rejects according to sap/latex burn, scab and insect damage.

Rejects after packing – The amount of rejected fruit after packing is approximately 3–7%. The causes of rejection include bumps, fruit at colour no. 3 (see Figure 4), distinct lenticel spotting, and more intense and obvious sap/latex burn. Fruit is automatically rejected once it is dropped by the packer/sorter. Rejected fruit is delivered to the local market in Bankerohan, Davao City.

5 Results and discussion

5.1 Testing the mango quality manual

The mango quality manual was tested in two locations: (1) the mango farm and (2) in the export company. In the farm, optimal assessment was conducted on whole fruit, while in the export company both whole fruit and cut fruit were assessed. Four researchers used the manual in the field and laboratory while one researcher used the manual in the export company and on the import consignment.

5.1.1 Mango quality assessment (in the farm and export company)

Using the manual, the quality of mangoes from different farm locations and from an export company was assessed. Fruit harvested in Banaybanay, Davao Oriental were of poor visual quality due to excessive defects (such as scab) that limited the market acceptability of fruit (see Table 1). This quality of fruit resulted in a short shelf life of four days due to stem end rot, anthracnose and other diseases. On the other hand, good quality fruit on Samal Island was observed with only minor defects resulting in a longer shelf life of seven days. Optional assessment of mango fruit from the two farms was conducted in the laboratory (see Table 2). Fruit from Banaybanay, Davao Oriental where firmer while greener fruit was observed in the lot from Samal Island as indicated by more negative a* values. TSS of fruit from the two farms were similar at around 7%.

Fruit assessment using the mango quality manual in the export company was completed at two stages: (1) during receival or delivery of mangoes and (2) during packing after VHT. Excellent fruit with only slight defects were observed in the export company; however, after treatment, some internal defects were observed (see Table 3). Riciness was observed in fruit after VHT. Fruit colour slightly changed during packing wherein traces of yellow in the mango peel was already evident. Higher TSS was recorded from 8.2% in the receiving stage to 8.8% in the packing stage.

For the researchers, using the manual was very easy to somewhat easy in terms of instructions. The scoring was very easy to neutral as the researchers were familiar with other methods of scoring (see Table 4). The manual was considered to be useful by the researchers, except for assessing blush, firmness and aroma. This is because Carabao mangoes do not develop blush on the peel, have no strong aroma and the skin is so thin that repeated handling of the fruit may damage it. It took the researchers 15–30 minutes to assess most of the quality (whole, cut and optional) parameters in one mango fruit sample using the mango quality manual.

Table 1. Whole fruit quality assessment of Carabao mango using the mango quality manual at harvest

Field/Farm	Visual quality	Skin defects	Skin colour	Days to end of shelf life	Reason for end of shelf life
Island Garden City of Samal, Davao del Norte, n=60 fruit	4.1	4.1	1.0	7.2	Diseases (stem end rot and anthracnose)
Banaybanay, Davao Oriental n=60 fruit	2.0	2.0	1.0	4.0	Diseases (stem end rot, anthracnose and other diseases that developed on scabbed peel)

Source: Authors' analysis

Table 2. Optional assessment of quality of Carabao mango using the mango quality manual at harvest

Field/farm	Firmness (kg)	TSS (% Brix)	L*	a*	b*	Chroma	Hue
Island Garden City of Samal, Davao del Norte, n=6 fruit	6.20	7.00	69.30	-18.30	34.50	38.30	115.90
Banaybanay, Davao Oriental n=6 fruit	9.84	7.02	64.32	-14.16	31.30	34.27	114.34

Source: Authors' analysis

Table 3. Assessment on the quality of Carabao mango in the export consignment

	At receiving	At packing	Arrival in China	Three days from arrival	Six days from arrival
	Whole fruit assessment				
Visual quality	5	5	4	4	3
Skin defects	4	4	4	3	3
Skin colour	1	1	2	5	5
Firmness	1	1	2	5	5
Aroma	3	3	3	3	4
	Cut fruit assessment				
Flesh defects	4.8	4.7	4.2	4.1	3.7
Flesh colour	1.5	1.5	1.5	1.5	1.5
	Optional assessment				
TSS, % Brix	8.1	8.4	16.7	19.3	19.2
Firmness, kgf	6.4	4.5	3.3	1.1	0.6
	Colour assessment using Nix Pro				
L*	68.0	68.5	74.7	78.7	79.3
a*	–12.2	–11.3	–5.5	0.5	4.4
b*	34.1	34.9	38.0	43.1	46.3
H	109.7	107.9	98.3	89.4	84.6
C	36.2	36.7	38.6	43.1	46.7

Source: Authors' analysis

Table 4. Assessment on the application of the manual

Questions	Ripening	Consumer	Others: Post-harvest research	
(1) Area of operation (s) within the mango supply chain (some are combination of answers)			✓✓✓✓	
	Whole fruit assessment	Cut fruit assessment	Optional assessmen t	Others
(2) Current assessment of mango	Skin colour, Skin defects, Visual quality,	Flesh colour, Flesh defects	TSS, Firmness, TA	Weight loss, % of marketable fruit, Disease incidence, Shriveling
(3) Assessments conducted using the manual	Skin colour, Skin defects, Visual quality, Library trays	Flesh colour, Flesh defects, Flesh Smell	Skin colour using Nixpro, TSS, Firmness, TA	
	Very easy	Somewhat easy	Neutral	Somewhat difficult
(4) Relevance of instruction	✓✓ (2 researchers)	✓✓ (2 researchers)		
(5) Relevance of scoring system	✓✓✓ (3 researchers)		✓ (1 researcher)	
	<15 min	15–30 min	31–60 min	>60 min
(6) Duration to complete assessment for one sample	✓ (1 researcher)	✓✓ (2 researchers)	✓ (1 researcher)	
	Whole fruit assessment	Cut fruit assessment	Optional assessmen t	
(7) Least useful part	Blush, firmness, aroma	None	None	
(8) Most useful part	All, except blush, firmness and smell	All	All	
(9) Comments	The manual is useful but will take time if all assessments were to be done. Skin colour assessment can be modified for Carabao mango using the 1–6 scale, assessing firmness by hand may affect fruit quality.			

Source: Authors' analysis

5.1.2 Manual testing and survey in the farm, wholesale/retail market and processing company

The mango quality manual was introduced and explained to the different supply chain stakeholders. The respondents were asked to test the manual by assessing one mango. Afterwards, the respondents were asked some additional questions regarding the application of the manual. The respondents were able to use the mango quality manual by conducting whole and cut fruit assessments. The results of their assessments on fruit quality using the manual are shown in Table 5.

Table 5. Assessment of mango quality by the respondents using the mango quality manual

Assessment	Respondent	Mean
Visual quality	Harvester	2.4
	Wholesaler/retailer	3.0
	Consumer	3.5
	Processor/exporter	3.0
Skin defects	Harvester	2.1
	Wholesaler/retailer	2.8
	Consumer	3.2
	Processor/exporter	3.0
Peel colour	Harvester	1.1
	Wholesaler/retailer	3.0
	Consumer	4.3
	Processor/exporter	4.0
Blush	Harvester	1.0
	Wholesaler/retailer	1.0
	Consumer	1.1
	Processor/exporter	1.0
Firmness	Harvester	1.0
	Wholesaler/retailer	1.9
	Consumer	3.8
	Processor/exporter	3.0
Smell	Harvester	3.3
	Wholesaler/retailer	3.6
	Consumer	4.3
	Processor/exporter	3.5
Flesh defect	Harvester	4.2
	Wholesaler/retailer	3.8
	Consumer	4.6
Flesh colour	Harvester	1.8
	Wholesaler/retailer	2.8
	Consumer	3.3
Flesh aroma	Harvester	4.2
	Wholesaler/retailer	3.0
	Consumer	4.0

Source: Authors' analysis

Visual quality ranging from fair to poor was observed by the respondents. Low visual quality was due to the higher degree of moderate to severe skin defects. Peel colour was green at harvest and turned half-yellow and half-green when delivered to the wholesale/retail market. Some respondents in the wholesale/retail market assessed green mangoes while others assessed yellow mangoes (see Table 6). Fruit for consumers was observed to be more yellow than green or full yellow. Newly harvested fruit were hard (no 'give'). In the wholesale/retail market, fruit were chosen for consumers when the fruit was firm-soft or soft. Only slight to moderate flesh defects were noticed, while flesh colour was observed from white-yellow to light-yellow in the farm and bright-yellow at the wholesale and retail market. Newly harvested fruit seemed to exhibit a good aroma; however, no smell was detected at the wholesale/retail market. At the consumer level, a good aroma was detected by the respondents. Some consumers used the sweet smell near the stem as an indication of fruit sweetness. On the farm the smell from mangoes may be attributed to the sap produced by newly harvested fruit. Carabao does not have a strong smell but upon cutting the fruit at the table-ripe stage, the fruit exhibits a pleasant aroma.

Most of the respondents assessed the quality of mangoes based on their physical appearance such as colour, fruit firmness and skin defects. The harvesters assessed flesh colour to determine the fruit maturity. They usually harvested the fruit when the flesh colour was light yellow. This assessment was also completed by some wholesalers/retailers upon delivery of fruit to determine its maturity. In the processing company, as well as whole and cut fruit assessments, respondents also assessed the TSS, TA and sensory profiling of fruit.

Table 6. Percentage of respondents who currently assess their mango quality according to specific quality parameters

Quality parameter	Farmer	Wholesaler/retailer	Worker at processing/ export company	Consumer
Skin colour	80	100	100	97.0
Fruit firmness	90	50	100	84.8
Skin defects	100	100	100	90.9
Dry matter	0	0	0	0
TSS	0	0	100	0
Smell	0	15	86	84.8
Flesh colour	80	25	14	48.5
Flesh defects	0	15	0	6.1
TA	0	0	100	0
TSS:TA	0	0	0	0
Library trays	0	0	0	0
Sensory profiling	0	0	100	0
Consumer acceptance	0	0	0	0

Source: Authors' analysis

Table 7. Assessments conducted by various supply chain stakeholders using the mango quality manual

Assessment	Farmer	Wholesaler/retailer	Worker at processing/export company	Consumer
Skin colour	✓	✓	✓	✓
Fruit firmness	✓	✓	✓	✓
Skin defects	✓	✓	✓	✓
Dry matter				
TSS				
Smell	✓	✓	✓	✓
Flesh colour	✓	✓	✓	✓
Flesh defects	✓	✓	✓	✓
TA				
TSS:TA				
Library trays				
Sensory profiling				
Consumer acceptance				
Other: Visual quality, flesh smell	✓	✓	✓	✓

Source: Authors' analysis

All respondents from the farmers/harvesters to the consumers evaluated the fruit using the whole and cut fruit assessments in the manual (see Table 7). For most of the consumers and respondents from the processing company, the instructions and scoring system in the manual were very easy to use while the farmers found them somewhat easy (see Figure 5). Most of the traders considered the scoring system to be very easy but not the instructions. Only a few respondents said that the scoring and instructions were somewhat difficult. It took less than 15 minutes for the farmers/harvesters to evaluate mango quality as they are already familiar with assessing fruit for sorting and packing (see Figure 6). Most of the wholesalers/retailers, processers and consumers finished their assessment of mangoes in less than 15 minutes but there were some that took more than 15 minutes (but less than 30 minutes).

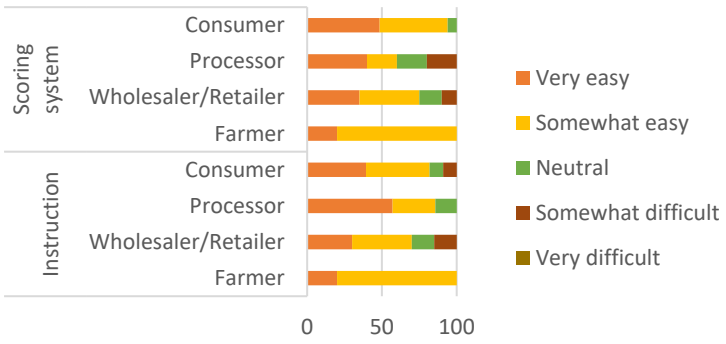

Figure 5. Responses of the respondents regarding how easy the instructions and scoring system in the manual were to follow

Source: Authors' analysis

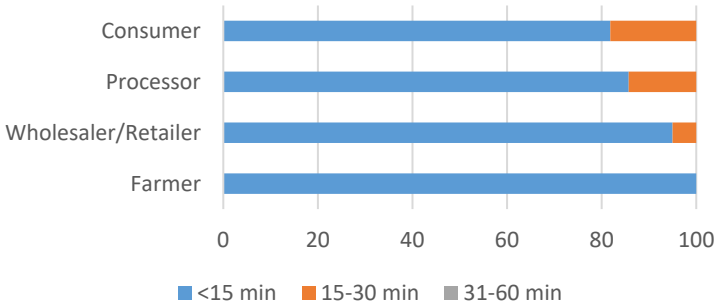

Figure 6. Responses of the respondents to the duration of completing an assessment of one sample

Source: Authors' analysis

For respondents, the manual was considered useful for assessing the quality of fruit, however, there were some parts they found were less important (see Table 8). For the farmers, the least important parts of the manual were the blush, aroma, optional assessment, flesh smell and flesh defects. For the wholesalers/retailers, the most useful part of the manual was the whole fruit assessment while the least important parts were the aroma, blush and firmness. In the processing company, the least important parts were consumer acceptance, blush and dry matter, while the important parts were the whole and cut fruit assessment, sensory profiling, TSS and flesh colour. For the consumer, all parts were useful while the least important were the blush, optional and cut assessment, aroma, and sensory profiling.

The farmers/harvesters usually assessed fruit quality on the farm; however, they could clearly understand the manual if it was written in Filipino. Since mango price is dependent on quality, the manual was deemed useful for wholesalers/retailers to learn from. However, for some wholesalers/retailers, the manual may not have been useful as they didn't always assess the mangoes delivered to them. The processors always checked the mango quality and for them, it would have been helpful to have a standard for size/weight, TSS, TA and maturity indices in the manual for their reference. The consumer respondents thought it would be good to add relevant images in the manual such as that for flesh colour. Respondents also suggested including images of the Carabao mangoes for each quality parameter for their reference. Figures 7 to 9 show the trial results of the manual along the supply chain from farmers through to import consignment.

Table 8. Respondents' response to usefulness of the manual

Remarks	Farmers	Wholesalers/ retailers	Workers at the processing/export company	Consumers
Least useful part of the manual	None, optional assessment, aroma and flesh defects	Aroma, blush, firmness	Consumer acceptance, blush, dry matter	Blush, optional, cut assessment, aroma, sensory profiling
Most useful part of the manual	All are useful, whole fruit and cut fruit assessment, visual quality, skin defects	Whole fruit assessment	Whole and cut fruit assessment Sensory profiling, cut and whole fruit, TSS, flesh colour	All are useful
Comments and suggestions on the manual	The manual is very useful but could be better understood if it were written in the Filipino language	The manual is useful, they can learn something new from it; mango price depends on the quality	Better to have standard for size and weight, TSS and TA Add maturity indices	It would be good to put picture for flesh colour

Source: Authors' analysis

Figure 7. Road testing the mango quality manual on the farm

Source: Authors' image

Figure 8. Road testing the mango quality manual with consumers

Source: Authors' image

Figure 9. Road testing the mango quality manual with an export company

Source: Authors' image

6 Philippine mango varieties

Aside from Carabao mango (which is the top export variety), there are several other varieties in the Philippines that are also of importance or are available in the local market. These include the Golden Queen, Pico, Katchamitha, Kinabayo, Apple, Tommy Atkins, Piget, Kensington, '12-070', '12-103', '12-049', Florida and '12-003'. Figure 10 shows a collection by Alcasid et al. (2015) of mango varieties with variations in fruit shape that are grown in different locations. The identification and characterisation of other varieties available will allow production that, in turn, will provide consumers with other choices more suitable to their preferences, especially during lean months of Carabao mango production (Alcasid et al., 2015). This will also provide market opportunities to smallholders who produce other varieties such as the Florida mango. This mango variety has become popular in recent years and is also exported to South Korea.

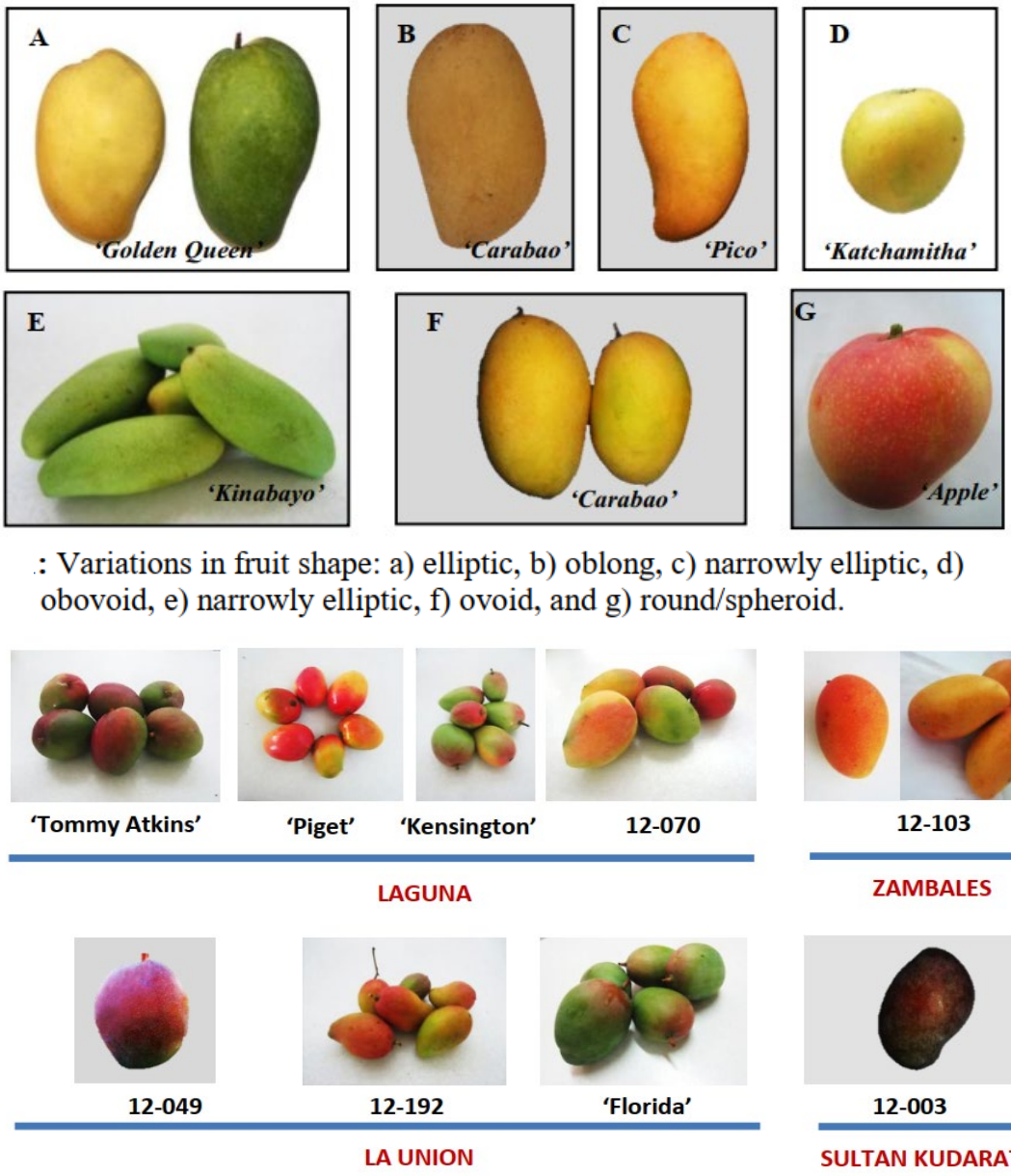

Figure 10. Philippine mango varieties

Source: Alcasid et al., 2015
Note: Mango collections from different locations exhibit various shades of red blush on the skin

Figure 11 shows the various mango varieties collected from the local market of Davao City. Different varieties have varying external and internal characteristics that contribute to differences in consumer acceptability. Carabao and Pico are two mango varieties that exhibit colour change upon ripening. These varieties are sold in the market mainly as ‘ripe’, while other varieties are sold as ‘unripe’. Blush in the peel is observed only in Florida and Apple mangoes. However, not all procured fruit from both varieties showed blush. Farmers cultivating Florida mangoes observed that only those fruit exposed to sunlight exhibited blush in the skin.

Next to Carabao mango, Pico is an important variety in the domestic market. This medium-sized variety has a green colour when unripe and turns to yellow-orange at the table-ripe stage. Another important variety is the ‘Indian’ mango, which is of medium size and remains green, even at the ripe stage where the flesh changes from white-yellow to yellow-orange. Carabao and Pico are two varieties that exhibit colour change upon ripening, from green to yellow and from green to a more intense yellow to orange colour. These varieties are sold in the market mainly as ‘ripe’ while other varieties are sold as ‘unripe’. Blush in the peel was present only in Florida and Apple mangoes, though not necessarily in all fruit. Aside from Carabao mangoes, the Florida variety is also exported to Korea. Using the mango quality manual, TSS and skin and flesh colour of whole and cut fruit were assessed using Nix Pro (see Tables 9 to 13).

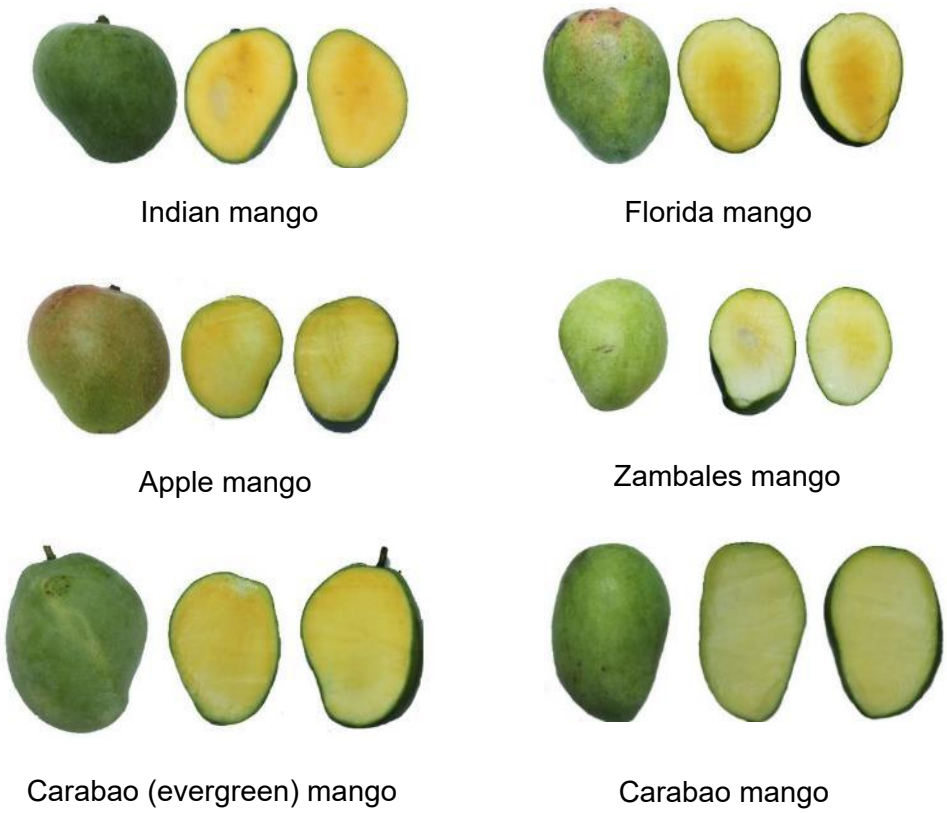

Figure 11. Mango varieties purchased from the local wholesale/retail markets

Source: Authors’ image

Table 9. Whole fruit quality of different mango varieties purchased from the local wholesale/retail market

Mango variety	Whole fruit assessment					
	VQR*	Skin defects*	Peel colour*	Blush*	Firmness*	Aroma*
Carabao (green)	3.33	2.17	1.33	1.00	1.00	3.00
Carabao (ripe)	2.17	1.67	5.00	1.00	5.00	5.00
Pico (ripe)	1.83	1.50	4.67	1.00	4.33	3.00
Carabao (evergreen)	3.83	2.17	1.00	1.00	1.00	2.67
Indian	4.00	4.00	1.00	1.00	1.00	1.00
Apple (ripe)	3.83	3.83	1.17	2.50	1.00	3.00
Apple (unripe)	4.00	3.33	1.00	3.67	1.00	3.00
Zambales	4.00	2.33	1.00	1.00	1.00	1.00

Source: Authors' analysis
Note: significant using Kruskal-Wallis test at p<0.05.

Table 10. Flesh quality of different mango varieties purchased from the local wholesale/retail market

Mango variety	Cut fruit assessment		
	Flesh defects^{ns}	Flesh colour*	Flesh aroma*
Carabao (green)	5.00	1.67	5.00
Carabao (ripe)	4.83	3.67	5.00
Pico (ripe)	4.20	3.80	4.40
Carabao (evergreen)	5.00	1.80	5.00
Indian	4.60	1.60	3.20
Apple (ripe)	5.00	3.80	4.60
Apple (unripe)	5.00	1.00	4.33
Zambales	5.00	1.00	3.40

Source: Authors' analysis
*Notes: * = significant using Kruskal-Wallis test at p<0.05*
ns = not significant

Table 11. TSS and weight of different mango varieties purchased from the local wholesale/retail market

Mango variety	TSS (Brixº)	Weight (g)
Carabao (green)	9.18^{c}	293.72^{a}
Carabao (ripe)	14.92^{a}	191.96^{bc}
Pico (ripe)	12.12^{b}	126.20^{d}
Carabao (evergreen)	9.86^{bc}	278.18^{a}
Indian	9.44^{bc}	125.76^{d}
Apple (ripe)	7.50^{c}	208.34^{b}
Apple (unripe)	9.50^{bc}	285.92^{a}
Zambales	9.76^{bc}	135.46^{cd}

Source: Authors' analysis
Note: In each column, means with the same letters are not significantly different using Tukey's HSD test (P>0.05)

Table 12. Skin colour (L*, a* b*, C*- chroma, H*- hue) of different mango varieties purchased from the local wholesale/retail market

Mango variety	Peel colour				
	L*	a*	b*	C*	H*
Carabao (green)	63.32^{bc}	–12.77^{de}	37.17^{bc}	39.31^{bc}	108.97^{ab}
Carabao (ripe)	72.54^{a}	8.25^{b}	51.84^{a}	52.52^{a}	81.00^{c}
Pico (ripe)	68.19^{ab}	18.26^{a}	50.17^{a}	53.46^{a}	70.00^{d}
Carabao (evergreen)	56.13^{de}	–13.47^{e}	35.95^{bc}	38.40^{bc}	110.53^{ab}
Indian	52.17^{e}	–16.21^{e}	34.01^{c}	37.69^{bc}	115.52^{a}
Apple (ripe)	59.24^{cd}	–6.88^{d}	35.40^{bc}	36.11^{c}	100.81^{b}
Apple (unripe)	43.44^{f}	1.44^{c}	29.62^{d}	30.55^{d}	86.65^{c}
Zambales	57.90^{cd}	–16.19^{e}	37.57^{b}	40.92^{b}	113.32^{a}

Source: Authors' analysis
Note: In each column, means with the same letters are not significantly different using Tukey's HSD test (P>0.05).

Table 13. Flesh colour (L*, a* b*, C*- chroma, H*- hue) of different mango varieties purchased from the local wholesale/retail market.

Mango Varieties	Flesh colour				
	L*	a*	b*	C*	H*
Carabao (green)	77.72^{a}	0.30^{c}	44.35^{b}	44.36^{bc}	89.65^{b}
Carabao (ripe)	58.42^{d}	15.56^{a}	60.21^{a}	62.20^{a}	75.51^{d}
Pico (ripe)	61.44^{cd}	15.92^{a}	52.08^{ab}	54.66^{ab}	73.57^{d}
Carabao (evergreen)	72.32^{ab}	2.27^{bc}	42.99^{b}	43.25^{c}	87.91^{bc}
Indian	73.37^{a}	2.74^{bc}	44.28^{b}	44.87^{bc}	88.02^{bc}
Apple (ripe)	66.60^{bc}	9.28^{ab}	56.47^{a}	57.33^{a}	80.89^{cd}
Apple (unripe)	78.17^{a}	–4.50^{c}	23.66^{c}	24.09^{d}	100.91^{a}
Zambales	76.21^{a}	–1.63^{c}	31.17^{c}	31.23^{d}	93.10^{b}

Source: Authors' analysis
Note: In each column, means with the same letters are not significantly different using Tukey's HSD test (P>0.05).

6.1 Consumer acceptance of the different mango varieties at the buying stage

Sensory testing of mangoes was undertaken with a total of 51 consumers. Consumers assessed acceptability of the flesh, aroma, texture, flavour and overall sensory quality of the various mango varieties (see supporting documents). Most of the fruit used were at the buying stage, whereas only Carabao and Pico were sold at yellow colour. Other varieties were assessed at the unripe stage as this was the stage of purchase in the retail market. The unripe characteristics of other mango varieties have contributed to the acceptability scores of consumers. Carabao mango at yellow colour consistently garnered the highest acceptability (i.e. 'like very much') on all sensory parameters. Though Pico was tested at the ripe stage, its overall acceptability was lower than the Florida variety. Florida mangoes had the second-highest overall acceptability rating as they also recorded higher acceptability in texture and flavour next to Carabao mangoes.

7 Conclusion and recommendations

7.1 Conclusion

Mango is a premium export fruit crop in the Philippines, next to bananas and pineapples. The highest export variety is the Carabao mango, which is also known as the 'Super Manila' mango and is one of the best mango varieties in the world because of its unique taste and aroma. This advantage has continually provided the impetus for the Philippines to expand its market. The increasing demand of fresh and processed mango in the domestic and export markets pose both opportunities and challenges. In recent years, the Philippines experienced a decline in export volume due to a decreased production of mangoes and the total area planted/harvested. Improvements on the pre-harvest and post-harvest protocols must be continuously extended since one of the major reasons hindering the expansion of the market is the low production volume and low quality of fruit.

Unlike the other top export fruits of the Philippines, mango is produced by more smallholder farmers who do not have sufficient resources to finance their production. The contractors or traders provide financial support and manage the farm. At harvest, 'all-in' pricing is commonly practiced whereby fruit are sold under a single price regardless of quality. The traders then sell the fruit to different buyers according to quality which, in turn, dictates different prices. Some of the traders opt to deliver the fruit to a processing company which accepts lower quality fruit. Fruit that cannot meet the export quality standards is sent to the local market or to other cities. The exporter provides technical support in farm management to ensure good fruit quality at harvest. However, the exporters still encounter problems such as high rejection rate with 30–50% of mangoes failing to meet the export quality standard.

Mangoes at the different levels of the supply chain were assessed using the mango quality manual. In the farm, fruit were assessed to be of good to poor quality. In the export company, excellent fruit were observed, while good to fair fruit quality in the wholesale/retail market were assessed corresponding to the good to lower limit of marketability. Better fruit quality after harvest followed sorting into the quality dictated by the buyer. Slight to moderate flesh defects were observed by the different supply chain stakeholder who participated in road testing the manual. The aroma of the mangoes was detected only upon harvest (i.e. smell of newly harvested mangoes) and at the customer level. Carabao mangoes do not have a strong aroma. It is only when the ripe fruit is harvested at full maturity that the pleasant smell becomes apparent.

The mango quality manual is very useful at the farm level, processing and for fresh export companies when sorting and grading of mangoes into various qualities is strictly done. However, at the farm level, though sorting of fruit according to quality dictates a higher price, farmers still receive a lower price since traders buy the fruit as 'all-in' under a single price regardless of quality. Thus, given a choice, most opt to enter into a contract with financiers or traders.

The instructions and scoring system were easy and the manual was useful except for when determining blush, firmness and aroma. Not all Carabao mangoes at the ripe stage produce a pleasant smell. These mangoes have thin skin at the fully-yellow stage that may be damaged by repeated handling. Using the manual, optional assessment of one sample would take 15–30 minutes when whole or cut, while whole and cut fruit assessments would take <15 minutes.

The quality manual may not be useful in the Philippine retail market as retailers don't always assess the mangoes delivered to them. However, it could still help them sort fruit for quality and consequent price assignment. It would be easier for the farmer/harvester to use the manual if the instructions/descriptions were written in the local dialect (i.e. Filipino). The respondents would also like to see images of Carabao mangoes in the manual as a reference for assessing colour quality. For the consumers, it would be

beneficial to add relevant images of Carabao mangoes for visual quality, skin defects, and flesh colour assessment. The processing company would like to include some standards for Carabao mangoes such as the weight, size, TSS, TA and maturity indices. These standards and indices would help them to distinguish mature fruit.

The quality of different mango varieties purchased from the local market was assessed using the manual. Identification and characterisation of other available mango varieties provide options that suit the preferences of consumers. This can also provide an opportunity for farmers to expand their share in the local, and even in the international, market. For instance, the Florida mango is now becoming popular in the marketplace. It is also being exported to South Korea. In the consumer acceptance test, Florida registered 'like very much' or high acceptability of texture and flavour next to Carabao mangoes.

7.2 Recommendations

Through key interviews with farmers, wholesalers, retailers, traders, processors, exporters and importers, the domestic and international mango supply chains were validated. Some issues and opportunities along the chain were identified. There is an expanding market for the Philippine mangoes. However, producing high volumes of export-quality fruit is limited by various problems in the production and post-harvest processes. Hence, there is a need to help smallholder farmers by means of efficient and effective technologies that will reduce losses due to pests and diseases and thus obtain better yield and fruit quality.

Most of the farmers do not have enough resources to manage their farms so they enter into contracts with traders or contractors/sprayers. The government can help the farmers improve their profitability by discouraging the 'all-in' pricing at the farm level. The trader or buyer should buy the fruit from the farm according to quality which dictates a higher price.

Using the manual, mango quality was assessed through the different stages of the supply chain. A high rejection rate of around 30–50% in the export company, mainly caused by bumps and sap/latex burn, can be reduced by educating stakeholders in the supply chain about proper post-harvest management. Careful handling must be done from the farm to the export facility as it was observed that during transport, some people sat on the top of mango boxes in the delivery truck.

Modifications in the manual can be made to address some of the suggestions or preferences of supply chain stakeholder, such as the inclusion of images of the Carabao mango (specifically of flesh colour and defects) for reference purposes. Standards and maturity indices can be included in the manual as these are useful for determining the standard quality as dictated by the market. A 1–6 skin colour scale for Carabao mangoes showing other colour changes in the fruit (such as the breaker stage in which green fruit shows some tinge of yellow and yellow fruit with trace of green) may be added. The manual was easy to use and found to be useful except for when determining blush, firmness and aroma. The Carabao mango variety does not have a strong aroma and the skin is so thin that when ripe, repeated pressing of the fruit by hand may damage it. The traders in the Philippines usually use the colour changes to assess the ripeness of mangoes. Severity of anthracnose and stem end rot which are two of the most important post-harvest diseases in mangoes may also be included. Farmers and traders suggested using the native language in the manual for greater understanding.

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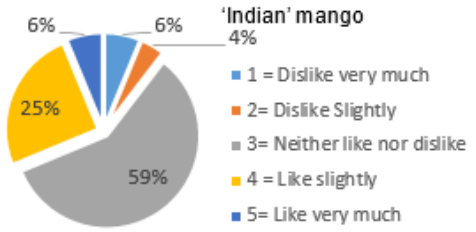
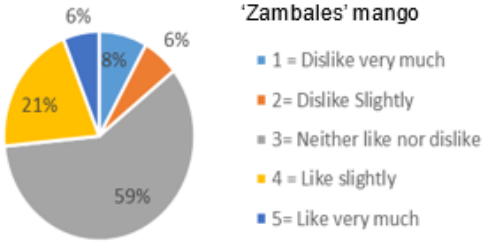
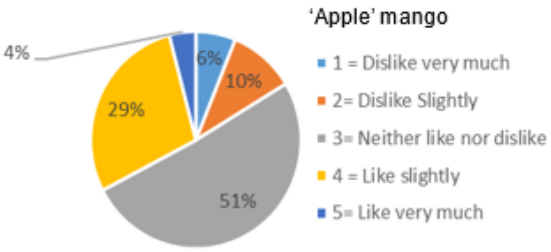
9 Supporting documents

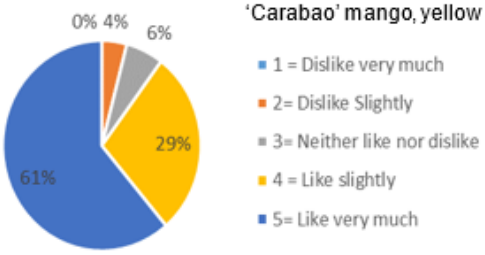
9.1 Sensory testing of the different mango varieties

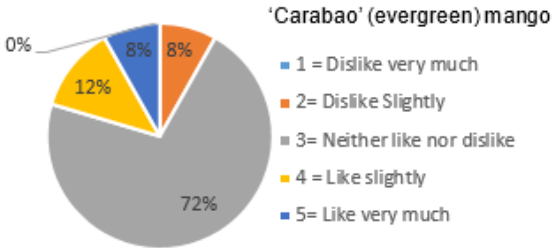
9.1.1 Consumer acceptance regarding the aroma of different mango varieties

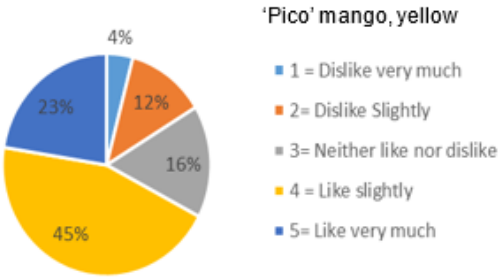


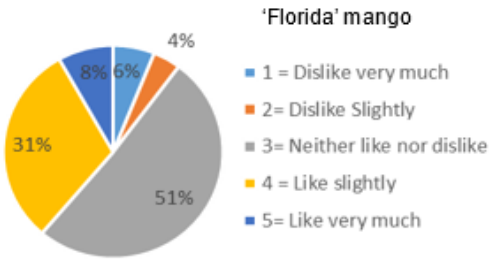




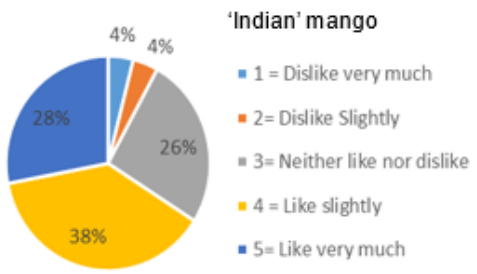


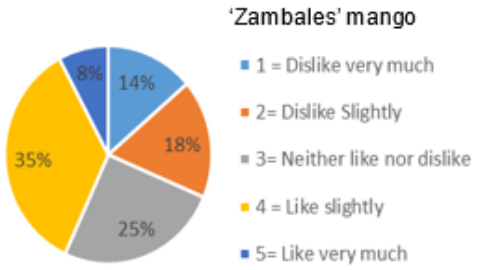


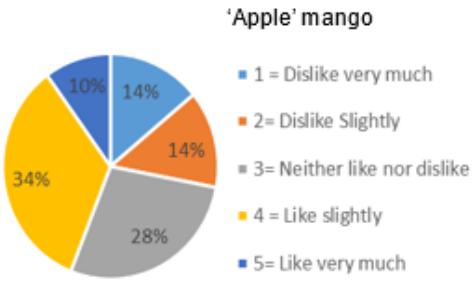


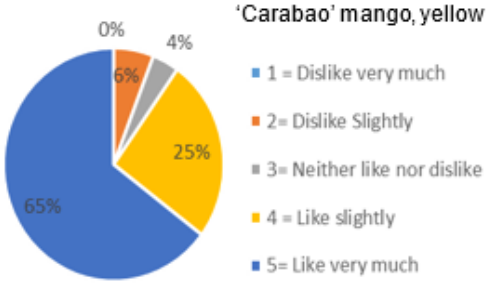


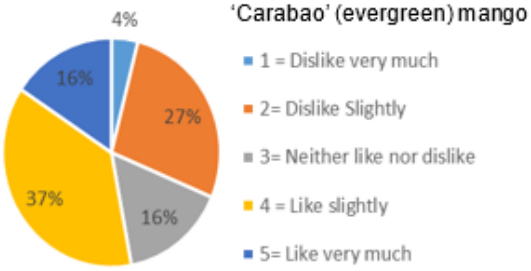
9.1.2 Consumer acceptance regarding the flesh texture of different mango varieties

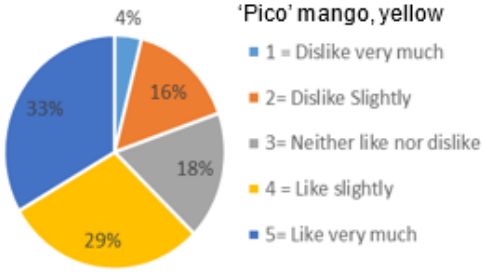


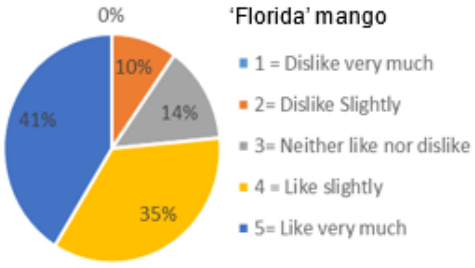




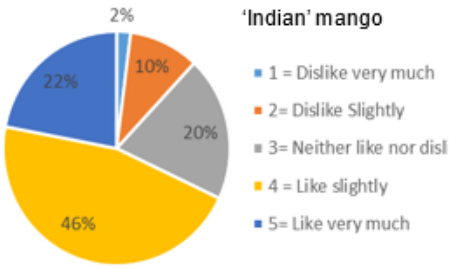


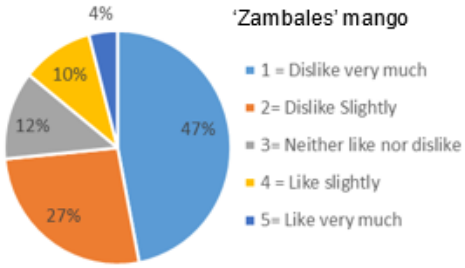


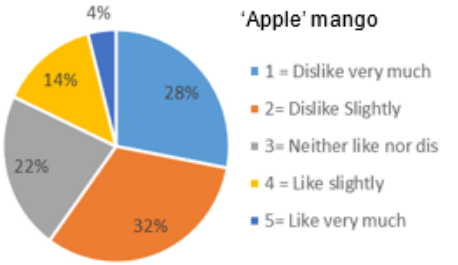


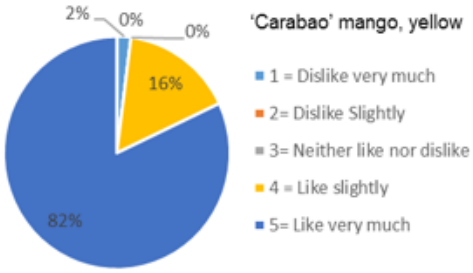


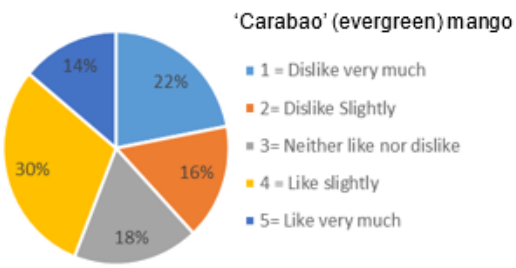
9.1.3 Consumer acceptance regarding the flavour of different mango varieties

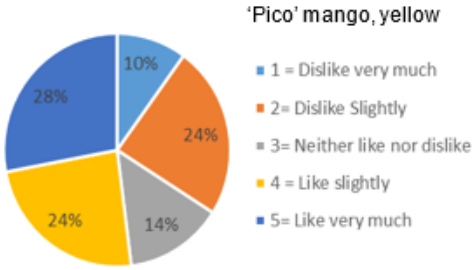


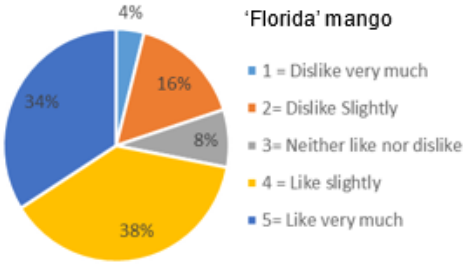




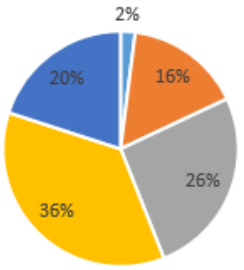






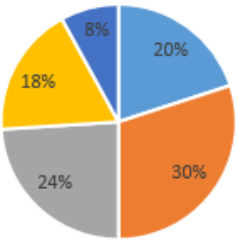


9.1.4 Overall consumer acceptance of different mango varieties



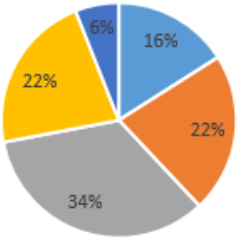
'Indian' mango

- 1 = Dislike very much
- 2= Dislike Slightly
- 3= Neither like nor dislike
- 4 = Like slightly
- 5= Like very much



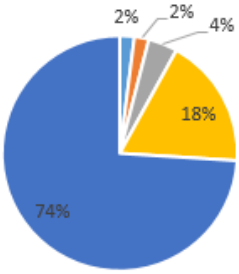
'Zambales' mango

- 1 = Dislike very much
- 2= Dislike Slightly
- 3= Neither like nor dislike
- 4 = Like slightly
- 5= Like very much



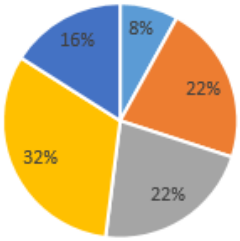
'Apple' mango

- 1 = Dislike very much
- 2= Dislike Slightly
- 3= Neither like nor dislike
- 4 = Like slightly
- 5= Like very much



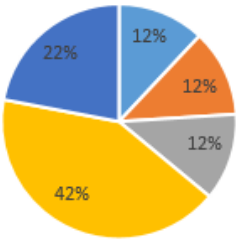
'Carabao'' mango, yellow

- 1 = Dislike very much
- 2= Dislike Slightly
- 3= Neither like nor dislike
- 4 = Like slightly
- 5= Like very much



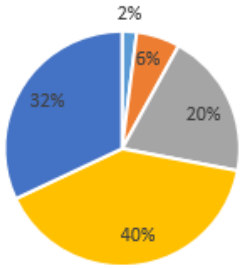
'Carabao' (Evergreen)

- 1 = Dislike very much
- 2= Dislike Slightly
- 3= Neither like nor dislike
- 4 = Like slightly
- 5= Like very much



'Pico' mango, yellow

- 1 = Dislike very much
- 2= Dislike Slightly
- 3= Neither like nor dislike
- 4 = Like slightly
- 5= Like very much



'Florida' mango

- 1 = Dislike very much
- 2= Dislike Slightly
- 3= Neither like nor dislike
- 4 = Like slightly
- 5= Like very much