



Mapping of supply chain and assessment of pre and postharvest losses of Alphonso mango in India

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ARTICLE INFO	ABSTRACT
<p>Received : 12 February 2023 Revised : 18 May 2023 Accepted : 18 June 2023</p> <p>Available online: 16 August 2023</p> <p>Key Words: Domestic Export Marketing Spongy tissue Stakeholders.</p>	<p>One of the most popular commercial varieties of mango in India is the Alphonso variety. Due to its limited and specialised production zone, this cultivar attracts interest for its supply chain management research. Only a few studies on the management of the mango supply chain in India could be discovered in the literature. In order to better understand supply chain management and pre- and post-harvest losses for the Alphonso mango, a survey was conducted. To acquire the data, 123 observations from farmers, FPOs, retailers, exporters, and government officials were recorded. A socioeconomic study revealed that farmers who were young and educated (less than 50 years old and graduates) produced mangoes of higher quality and were more committed to exporting mangoes. The findings indicate that preharvest losses are primarily caused by variables including climate change, global warming, numerous illnesses and pests, spongy tissue, and fruit fly problem. During the harvest season, spongy tissue and abrupt, unseasonal rain have a negative impact on mango quality and supply. Mechanical damage, storage conditions, transportation, and mango handling all had a major impact on postharvest losses. According to the study, pre-harvest factors were responsible for 30 to 40% of mango loss, and post-harvest handling was found to be responsible for 15 to 20% of mango loss. The revenue of farmers is remains poor due to the current trading channels and lack of facilities for value addition. The results of this study provide insight on the current state of the supply chain and Alphonso mango losses. Researchers, governmental organisations, and policymakers can benefit from this study's findings by taking the appropriate actions to boost farmers' incomes, balance the market's supply and demand, and lower losses in other perishable fruits.</p>

Introduction

Mango (*Magnifera indica* L.) is an important tropical fruit grown majorly in countries like India, China, Brazil, and Thailand. India is the world's largest producer of mango contributing 50% of the total mango production with an annual production of 21.38 million MT from an area of about 2.296 million ha (National Horticulture Board, 2018-19). Due to its delicious taste, pleasant aroma, excellent flavor, low calories, and high nutritional value, Indian mango has huge demand in the domestic as well as world market and is commonly called the

king of fruits (Jha *et al.* 2012). India's mango is mostly exported to European and Arabian countries. In 2019-20 India exported about 49658 MT of mango and fetches about 400.21 cr rupees from the world market (APEDA 2021). In order to meet consumer's demands a consistent supply of fresh foods should have high quality, safefor consumption, and nutritious. In India, many mango varieties are cultivated, but varieties like Alphonso, Kesar, and Banganapalle have high demand in the local market and for export. Due to the favorable hot

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climate, volcanic soil conditions, coastal region, etc., Alphonso mango is typically grown in the Konkan region of Maharashtra, India. In the local language, it is called *Hapus Amba*. The Indian government's Ministry of Commerce awarded the Alphonso mango a Geographical Indication (GI) designation in 2003 to those mangoes coming from the 200 km coastal line of Ratnagiri and Sindhudurg districts of Maharashtra. Due to its thin and saffron-colored skin, thick, yellow, creamy, sweet pulp, and fibreless texture. Quality control plays important role in fruit export (Lawson *et al.* 2019). In India, harvested mango are subject to many unit operations like pretreatment, cooling, packaging, handling, etc. before reaching the consumer. From the production stage to the consumption stage many physiological changes occur in mango. Several factors such as time and season of harvest, the effect of mulching, location, high temperature, low fruit transpiration, and biological factors are known to influence the internal quality of mango fruit (Janave and Sharma, 2008; Oak *et al.* 2019;). Indian mangoes were prohibited by the United States (US) and the European Union (EU) due to the overuse of pesticides and the threat of spongy tissue, jelly seed, fruit flies, and stone weevil invasion from previous years. A supply chain of mango is described as the flow of activities, information, and resources connected to commodities from the producer to the consumer. Millions of individuals working in rural and urban areas, including farmers, wholesalers, logistics partners, and retailers involved in supply chains, the food supply chains are essential in reducing waste and cutting down costs while maximizing overall values and generating money (Gebreet *et al.* 2020).

So, the Konkan region in Maharashtra of India (shown in Fig. 1), which is regarded as the country's top producer of Alphonso mangoes, has received little attention in the literature. Additionally, no study has examined the challenges faced by the Alphonso mango industry, which plays a key role in the nation's export of mangoes and foreign exchange. This study's goals include identifying the difficulties that farmers, stakeholders, and policymakers face in producing, maintaining the quality, and authenticating Alphonso mangoes, as well as how to manage their

supply chains at various levels (local markets, export, supermarkets, etc.), and study of losses occurred due to unavailability of various facilities for safeguarding the quality of Alphonso mangoes for enhancing marketing and identifying gaps through conducting the survey.

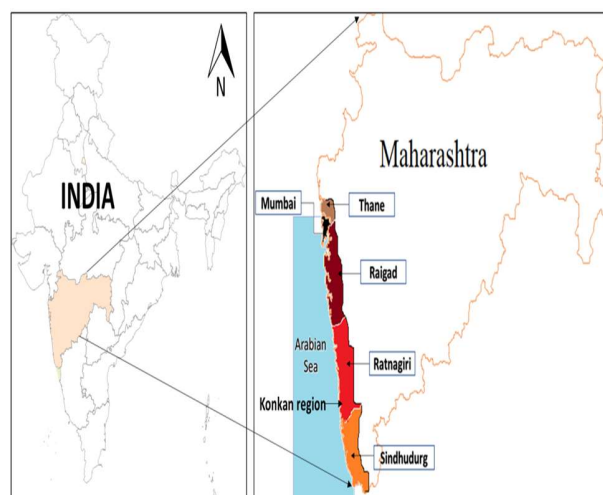


Figure 1: Map of study area

Material and Methods

Sampling methods and sample size

This study followed a stratified multistage sampling procedure for the collection of data. The purposive sampling was used because most of the farmers and growing area of Alphonso mango are concentrated in Ratnagiri and Sindhudurg districts from Maharashtra state, India shown in Fig. 2. From these two districts purposively two blocks from each district were selected, and from each block, three villages were selected on basis of high quality and authentic production, well-known, and famous for Alphonso mango for collection of information. So, primary data was collected from 123 stakeholders includes farmers, Farmer's Producers Organizations (FPO), contractual farmers, retailers, and logistics partners were collected from these districts. Information from retailers, wholesalers, cold storage agencies, APMC members, and export companies were collected from Agriculture Produce Marketing Committee (APMC) Vashi, Mumbai. A survey was conducted in 2022 to gather data over the months of mid-April to June because the Alphonso harvesting season was at its peak at that time.

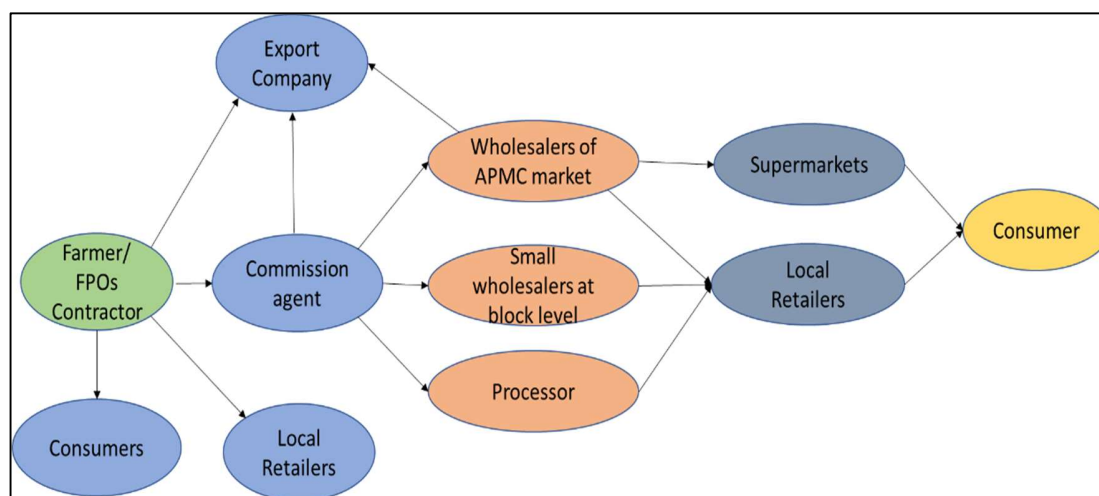


Figure 2: Stakeholders participated and marketing channels in supply chain of Alphonso mango in Konkan region

Table 1: Socio-economic characteristics of respondents

Stakeholder		Variable										
		Sex		Age (Year)			Experience (Year)		Education			
		Male	Female	<30	31-50	>51	<10	≥10	Illiterate	Primary	High. Sec	Graduate
Farmers	No.	49	6	8	38	9	25	30	4	5	16	30
	%	88.9	11.1	14.7	69.7	15.5	45.5	54.5	7.2	9	29	54.5
Wholesalers & retailers	No.	48	0	6	25	17	18	30	9	11	16	12
	%	100	0	12.5	52.0	35.5	37.5	62.5	18.7	22.9	33.3	25

Method of data collection

All stakeholders involved in the supply of mangoes were active in the state during the month of April, data collecting was initiated then. Different methods of gathering data were employed, including group conversations among farmers as well as observation, standardised questionnaires, checklists, and personal interviews. Table 1 lists the respondents' socioeconomic characteristics. Direct field visits and interactions with workers involved in the handling and processing of mangoes were conducted in addition to the aforementioned methods. Questionnaire created with the assistance of specialists in agricultural processing, fruit science, social sciences, and statisticians on the basis of the present issue related to the mango supply chain. Information gathering from farmers and neighbourhood merchants in the local tongue with the aid of an agent (a local educated individual well-known in English) and from other sources. Further data analysis is necessary because the stakeholder data were mixed in nature. Following

that, data were divided into groups according to the type of information sources, such as farmers, dealers, exporters, logistic partners, agriculture officers, and APMC members, among others. Then, additional data analysis was performed using Excel and descriptive statistics including central tendency and frequency distribution. To visually depict the complete Alphonso mango chain in India, chain mapping was done.

Results and Discussion

Marketing and distribution system for Alphonso mango

Various stakeholders participate in the trading of mango shown in Fig. 2 during the operating supply chain, which is typically over long and fragmented and in which intermediaries take a substantial cost of what consumers pay for the fruit. There were primarily two supply chains that occurred during the distribution of Indian Alphonso mango: the first was the export supply chain, and the second was the domestic supply chain.

Export supply chain: Numerous parties are involved and given responsibilities for conforming to the formal specifications for quality export in compliance with the importing nations. Only grade 1 and 2 Alphonso mangoes are selected for export. Farmers that register their orchards with the Agriculture and Processed Food Products Export Development Authority (APEDA) in India, which is the supreme authority of the Indian government for overseeing and managing the import and export of agricultural commodities, sell their mangoes to export corporations. Following an assessment of the field, mango quality, maximum residue limit, pests, and diseases, export farms begin purchasing mangoes. In Fig. 3, the complete export supply

chain is displayed. Send the sample for residue analysis, sanitary and phytosanitary certification, and Agmark quality assessment after obtaining it. Additionally, precautions are required to prevent fruit flies or spongy tissue disorders from infecting the farms or fruits. Young farmers (50 years old) were found to be more interested in exporting mangoes than older farmers during the survey. Nowadays, it was seen that more youthful farmers were working in the Alphonso mango industry. Table 1 shows that there were 84.4 and 15.6%, respectively, of younger and older farmers. The export of mangoes was found to be significantly impacted by the literacy rate.

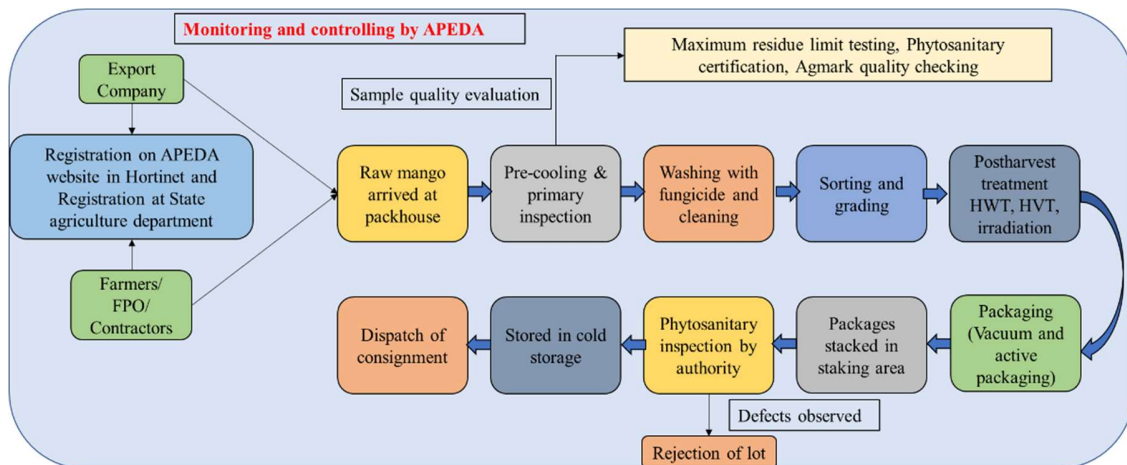


Figure 3: Export supply chain of Alphonso mango

In the study area, it was found that more literate farmers or business owners generate higher-quality product than illiterate individuals. More farmers and business owner i.e., 54.5 and 29%, respectively graduated or passed higher education. The biggest issue with older farmers is that they cannot adapt to changing circumstances or contemporary methods that are available on the market for high-quality produce. These findings more corroborate with results recorded by (Tadesse *et al.* 2018) they found that age, education, and experience significantly affect the quality of produce during value chain. Similarly, (Balyan *et al.* 2015) examined dynamics of Indian mango export from 1990 to 2012. They noted that the Indian mango export business had a difficult time adopting the norms due to the high standards of sanitary and phytosanitary precautions

from the importing countries. Truong and Sidique, (2022) investigated the specific cost structure, key supply chain players, and comparative advantage of Vietnam's Chu mango export supply chain. Similar study the impact of post-harvest practices on the quality of Ghana's mango export industry was studied by (Aboagye, 2009). They studied post-harvest practices, handling, value chain, and export chain in Ghana country.

Domestic supply chain: All of the leftover grades of mango were sold in the neighbourhood market. Farmers sorted and graded their products for the home market to get a better price from wholesalers. The APMC markets in Mumbai and Pune received Alphonso mangoes from farmers in the Sindhudurg and Ratnagiri districts. Each mango box was marked with the names of the farmer and the trader

who purchased the fruit from the farmer. Fig. 4 depicts the domestic supply chain and unit activities. Sending mangoes to wholesalers with government-issued licences was the initial and most popular method of distribution. After mangoes are

delivered to the APMC market, wholesalers continue to compete for them with local retailers and others who bid higher prices to buy them. Mango prices were set through bidding, depending on the quantity and quality available. Wholesalers

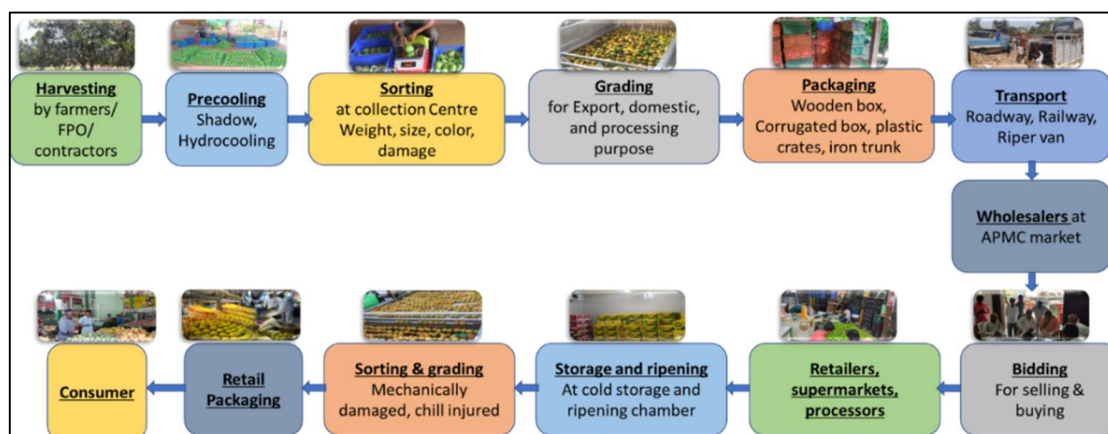


Figure 4: Domestic supply chain of Alphonso mango

occasionally offer farmers set pricing. Mango is sold by wholesalers to shops, supermarkets, restaurants, eateries, and even individual customers. After selling the mangoes, wholesalers reimburse the growers by reducing their own commissions by a certain proportion. The commissions range from 2 to 5% of the mango's overall cost. After purchasing the mangoes from the market, APMC market additionally charges the customers. Mango processors occasionally participate in the bidding process. Mangoes are a well-known fruit that is sold by seasonal small fruit vendors. There are a number of seasonal vendors who sell mangoes throughout the mango harvesting seasons. When selling the fruits to customers, they make a 10 to 15 percent profit. The second method of distribution involved certain local merchants contacting farmers or FPOs directly to purchase the mango in accordance with their needs. As a result, local shopkeepers benefited from higher pricing compared to those they received from wholesalers. then adhere to the same process as before. Farmers/FPOs selling mangoes directly to customers made up the third channel. Many people travelled to the tourist areas of Ratnagiri and Sindhudurg to visit these locations. As a result, farmers and FPOs have the chance to conduct business with consumers directly. Farmers that gather their own produce also keep some mango at

their farmhouses before selling the fruits to the market. Traditionally, mangoes are stored for a week to ripen before being sold directly to clients. Customers receive authentic, fresh, and high-quality mangoes at a discount compared to market prices. With this kind of distribution strategy, farmers make more money. Social media allows them to share their contact information with clients and directly solicit orders from them. That claims to offer courier services for home deliveries. The fourth channel involved processors or the food industry purchasing mangoes directly from farmers or FPOs through commission agents. Mangoes that were rejected by the market or had mechanical damage, sap damage, or other defects were used for processing. The price of mango that processors acquire is determined by the weight of the mangoes. However, the first three distribution channels for mangoes are assessed on a count basis, or per dozen (12 pieces). Some public and private organizations offered the cold storage facilities. The cost for mango ripening is determined by the quantity of boxes and the number of days needed for ripening. They charge between 50 and 60 rupees a box for a box of four dozen, and between 20 and 30 rupees per box for a box of one or two dozen, according to the survey. Divide wholesale boxes into retail bundles of 1, 2, 3, or 4 dozen as well. Different sorts of mangoes are in high demand by

consumers. Some want completely ripe mangoes that are ready to use, others prefer mid-ripe mangoes that are ready for use in 3 to 5 days, while yet others prefer to purchase immature mangoes and use them once they have matured. Due to the process of handling and sale to customers, the retail sale of mangoes requires 7 to 10 days. Wooden or cardboard boxes with cushion made of paddy straw are chosen for retail packaging. Table 2 lists the packaging material along with its approximate losses and capacity. Found were wooden boxes with a capacity of 5–6 dozen and an iron trunk with a capacity of 7–8 dozen. About 42.5% of farmers in the Konkan region utilized wooden boxes to pack their mangoes, followed by 35.5% of farmers who used iron trunks, as shown in Fig. 5. Similar studies

Table 2: Packaging material used for Alphonso mango packing for marketing with its probable losses

Material	Capacity (dozen)		Losses (%)
	Wholesale	Retail	
Wooden box	5-6	3,4,5	5-6
Iron trunk	7-8	-	8-7
Plastic crate	5-6	2-3*	5-6
Cardboard box	3-4	1-2	10-12
Plastic bag	-	1-2	10-15

*Explains use & throw type crates

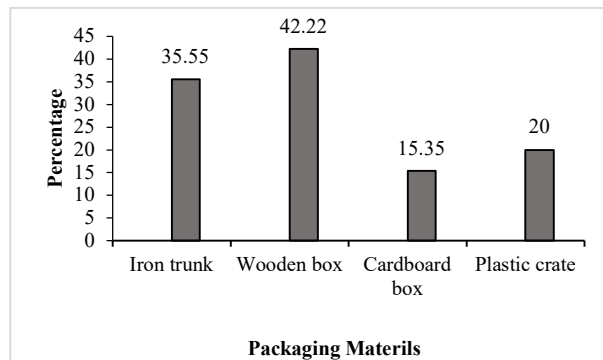


Figure 5: Packaging material used for Alphonso mango

were conducted for mango value chain in Ethiopia (Tarekegn and Kelem, 2022), for supply chain of grapes in Fiji (Morris *et al.* 2014). They found that two or more channels observed in domestic supply chain. Same experiment conducted by (Alam, 2018) for supply chain and value chain of different varieties of mangoes in Bangladesh by. They

discovered that wholesalers and retailers dominated the mango supply chain and hold 54.6 and 23.29% share in total value, whereas producers holding the smallest part i.e., 22.35 only.

Factors affecting fruit losses at various levels

Preharvest losses (Fruit development and maturation)

One of the most fundamental and crucial elements that affects both the amount and quality of mango production is climate change. Since both the timing and quality of flowering are entirely dependent on the temperature. Storms, rainfall, temperature, and other factors all had a significant impact on the number of fruits produced per tree, management of the harvesting season, and fruit quality. Farmers sustained significant losses over the past three years as a result of the unpredictable rainfall patterns, rapid global warming, and frequent hailstorms. Because of natural events, these losses cannot be prevented. Hailstorms cause mango to sustain mechanical damage and experience a heat shock that alters the fruit's physiology. The quality and financial losses are accelerated by the fruit fly infestation and the abnormally spongy tissue, which is specifically seen in Alphonso mangoes. Spongy tissue issues greatly increased when the local temperature rose above 35 to 36 C. In the survey, it was found that pre-harvest losses in Alphonso mangos were largely caused by spongy tissue and fruit flies, accounting for about 30 to 35% of losses, followed by infestations with insects, pests, and illnesses, accounting for about 12% of losses (Fig. 6).

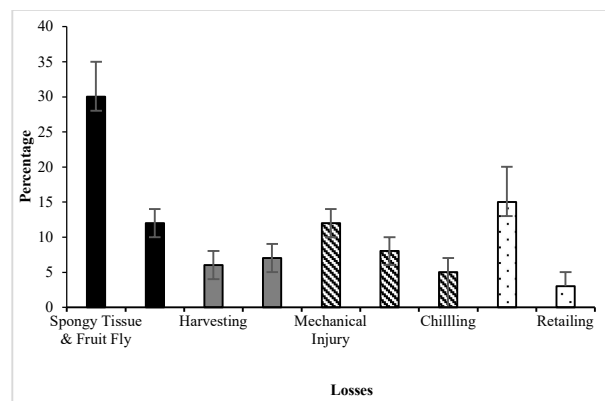


Figure 6: Share of each factor in pre and postharvest losses in Alphonso mango supply chain

Farmers overused fertilizers, pesticides, manures, and compost, which negatively impacted the nutritional value and internal quality of the crops. Mango growers now heavily rely on cultar to improve production, which has an adverse effect on the physiology of the tree and the fruit's quality. Farmers did not receive accurate and consistent weather forecasts, advice on fertilizer application rates, or market supply and demand data. Due to the aforementioned issues, the quality of Alphonso mangos declined, which decreased consumer demand and caused the export supply chain to collapse. Similar results recorded by (Bantayehu *et al.* 2019) in Ethiopia for tropical fruits and found similar reasons responsible for pre-harvest losses of agricultural commodities. Similar results were recorded by (Tarakegn and Kelem, 2022) for pre-harvest losses observed in mango supply chain of Ethiopia.

At the harvesting stage

Mango plantations were trained and pruned to achieve optimal yield that was simple to harvest and spray. However, some farmers do not follow these procedures, which causes difficulties when harvesting. In addition to scientific procedures like shaking trees, throw-and-catch methods were occasionally employed, which led to greater harvesting losses of 8 to 10% over modern techniques that only recorded 3 to 5% losses. Mangoes in the bottom part of the tree were picked by hand, and fruits in the top of the tree were harvested using cutting-edge equipment such blades coupled to nets and stick setups. The mango has a strong impact when it hits the ground immediately. As a result, the mango's physiology suffered a significant alteration, and the dropped mango rotted during ripening. The possibility of mangoes on the tree ripening rose due to the high temperatures, therefore growers kept constant surveillance on each tree to prevent losses. In order to minimize mechanical damage, Alphonso mangoes are typically harvested between 70 and 80% of their full ripeness before being sold to consumers. Similar observations were recorded by (Tian *et al.* 2010; Gianguzziet *al.* 2021). Sometimes very immature mangoes were harvested to reach in good condition and with minimum damage. But harvesting at an early-stage flavor and taste of mango badly affects because there was no proper retention of calories and production of acids for

imparting a good taste to mango. During harvesting, fruits were kept in open spaces so they were exposed to sunlight which significantly contribute to postharvest losses. Similar reasons found for losses due to the field heat. There were high chances of bruising, impact, and mechanical injury during carrying mango from the farm to the collection center/ packhouse due to rough handling by laborers. So, the harvesting losses mostly depend upon literacy and experience of farmers. These results were highly correlated with (Ullah *et al.* 2010; Siddiq *et al.* 2017; Trounget *al.* 2022) they showed that higher harvesting losses were estimated in developing countries due to the improper harvesting management and similar results observed in this study.

At the producers' stage (Handling)

The Konkan region had high relative humidity and temperatures reaching up to 39 to 42 °C during the Alphonso mango harvesting season. Because of these weather factors, precooling is essential for eliminating field heat. However, there are no pre-cooling facilities for farmers in Ratnagiri and Sindhudurg. They pre-cooled using hydro cooling or shadow cooling. However, these approaches lacked significant effectiveness. Farmers occasionally begin packaging right away after harvesting. It causes a rise in respiration rate and activity related to ripening. Fungicides were applied to mango to protect it from fungal infections, however some growers used unlicensed fungicides, endangering human health. Mechanical damage, cuts, and punctures happened when handling fruits for sorting, grading, and packaging. Worker observations of rough handling due to a rush to get the produce ready for marketing include bypassing cleaning and washing, packing without padding, etc. Table 3 displays the weight-based sorting of mangoes and their approximate market prices in India. Due to a lack of ripening chambers, producers may sell mangoes directly to nearby stores or consumers. Sometimes they employed the conventional method of ripening, which involved enclosing the mango in paddy straw for seven to nine days. because to poor ventilation and fungus and pathogen attacks. According to the conventional procedure depicted in Fig. 7, ripening losses of up to 15% were noted. 10 to 12% of the mangoes handled at the collecting centre were wasted, as indicated in Fig. 6. As a result,

substantial losses were seen at this time. Similar results were witnessed by (Yahia, 1999; Baltazari *et al.*, 2020) for postharvest losses of mango in Egypt and Tanzania. They showed that handling of mango after harvesting is very crucial stage and impacts the further postharvest life of mango fruit. Similar results regarding postharvest disease losses were recorded by (Prabakar *et al.* 2005).

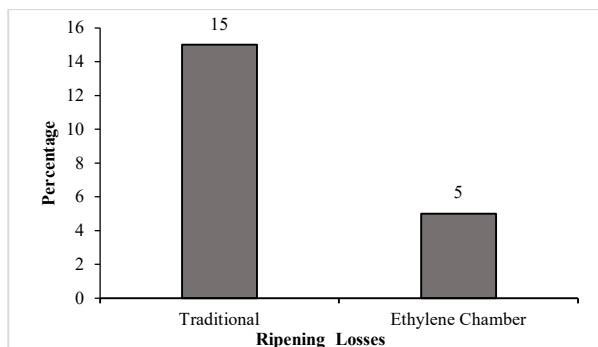


Figure 7: Losses observed in different ripening methods

Marketing stage losses

The transport department's job was to gather mango boxes from collector centres or packhouses and put them onto vehicles to be sent to the APMC market. Mountainous coastal districts with considerable rainfall include Ratnagiri and Sindhudurg. Due to these, there were winding roads across the highlands that were in poor shape and slowed down traffic. Due to traffic and poor roads, it took 10 to 12 hours to travel 300 to 400 kilometres to the Mumbai and Pune APMC markets to purchase mangoes. The hot, humid conditions during mango harvesting season also causes an increase in respiration rate and physiological weight loss (PLW) while handling and transit, both of which have a negative impact on the mango's quality. Trucks that were not ventilated were typically employed for transportation. According to Fig. 8, 75% of mangoes were transported by non-ventilated trucks, 15% by reefer vans, and 7% by railroads. For getting more profit transporters to put more loads out of capacity in each vehicle which increases injury and bruising to mango. Similar results were recorded by (Malik *et al.* 2015). They found that due to overloading of boxes in vehicles significant quality losses were occurred. During the marketing of mango highest losses were observed

due to mechanical injury followed by transport losses followed chilling injury 12, 8 and 5% respectively shown in Fig 6. Similar study in Ethiopia was conducted by (Desalegn *et al.* 2016) and found that due limited infrastructure and improper postharvest handling had limits for processing. Alam, (2018) reported similar reasons for losses in mango on Bangladesh and recorded about 20 to 25% losses during marketing.

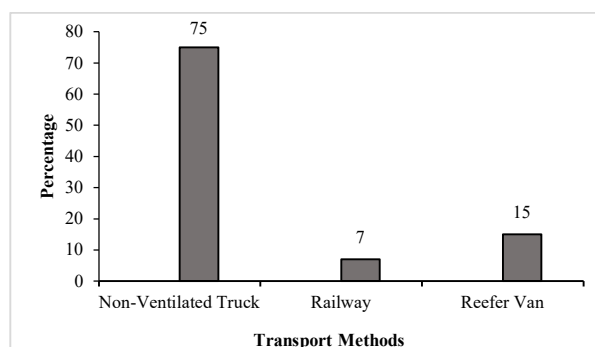


Figure 8: Transport methods used for marketing of mango.

At retail trading stage losses

Small business owners who buy mango directly from growers or occasionally through wholesalers during retailing. Retailers purchase unripe mango from farmers or wholesalers to lower the risk of bruising and mechanical damage. The primary challenge for retailers is the availability of transportation facilities to get goods from farms or marketplaces to cold storage or ripening chambers. Back to their businesses from the ripening room. As a result, produce is loaded and unloaded two to three times, resulting in higher postharvest losses of up to 12 to 15%, as shown in Fig. 6. There were no ripening chambers available for ripening or storing mango up to reach consumers during the peak season. This, given its perishable nature, raises the likelihood of losses and degradation. Fig. 9 depicts several ripening techniques applied throughout the supply chain. Mango ripening chambers were mostly utilized by retailers. There were no ripening chambers accessible at the busiest times for ripening or storing mangoes up to reach consumers. due to its perishable nature, it raises the risk of losses and degradation. In Fig. 9, various supply chain ripening techniques are depicted. Ripening chambers were mostly utilized by retailers for

mango ripening. Similar results were observed by (Yasunaga *et al.* 2012; Yasunaga *et al.* 2018) showed that elevated temperature during distribution accelerate the losses of mango. Retailers also suffered costs as customers rejected mangoes that were sometimes overripe due to consumer preferences. Mango losses owing to senescence and handling by consumers were up to 15% and 3%, respectively. Produce in the mango supply chain passes via a number of stakeholders before reaching consumers. Therefore, due to unclean conditions while handling, packaging, and selling, product suffers mechanical damage and is attacked by bacteria, which causes the quality of mangoes to rapidly decline. These findings are

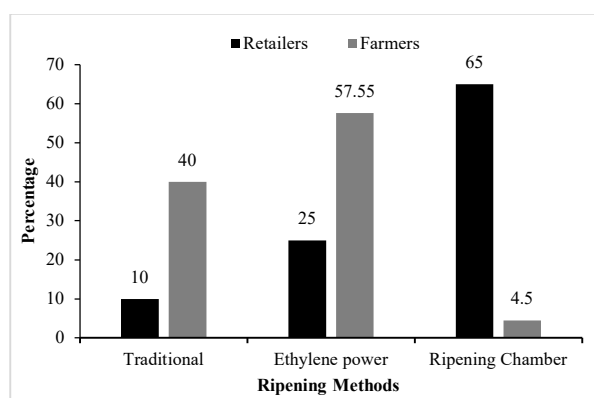


Figure 9: Ripening techniques used in supply chain of Alphonso mango

Table 3: Quality grades of Alphonso mango according to weight

Grade	A1	1	2	3	4	5	6
Weight	>300	250-300	225-250	200-225	175-200	150-175	<150
Average selling price (Rs/dozen) in the year 2022	>800	700-800	550-700	400-500	350-400	300-400	300-350

more in line with research by Siddiq *et al.* (2017). Challenges faced by mango farmers and stakeholders in Gamo zone of Ethiopia studied by (Tarekegn and Kelem, 2022). They evaluate the post-harvest losses along the mango value chain as well. Proper orchard management methods, harvesting techniques, packing techniques, postharvest treatments, temperature control,

transportation and storage conditions, and destination ripening are just a few of the variables that affect mango fruit quality and shelf life along the supply chain. (Truong *et al.* 2022).

Conclusion

According to the findings of this study, if more efforts are made to reduce diseases and postharvest losses, all supply chain participants will profit more and farmers' income will also rise. Major actions including reduced production costs, integrated pest, nutrient, and water management, infrastructure building, and efficient marketing should be combined to develop FPOs in order to reap greater benefits. Because it was discovered during the survey that participating FPO farmers received higher benefits than independent farmers. Farmers lost their rights to fair pricing as a result of intense haggling between them and traders. Farmers should get training through field demonstrations, training, and seminars offered by exporters, APEDA, government departments, etc. in order to preserve the export quality of mangoes and raise awareness about GAP, phytosanitary requirements, and postharvest treatment. Spongy tissue and fruit flies were found to be the biggest impediments to a reliable export supply chain during the survey. To strengthen the supply chain for Alphonso mangoes, more study and effort are needed to identify and eradicate spongy tissue and fruit fly problems. Farmers had to contend with a variety of issues, including climate change (heavy and erratic rainfall and hail storms, high temperatures, etc.), adulterated or duplicate input materials (fertilisers, pesticides, fungicides, etc.), insufficient knowledge of marketing tactics, and a lack of infrastructure facilities, such as modern packhouses, ripening chambers, cold storage, logistic facilities, etc. Produce quality and hygiene are directly impacted by the absence of the aforementioned facilities. Postharvest losses were quite significant in developing nations like India. For farmers and FPOs to adopt new and highly recommended techniques and expand infrastructure, the government should offer subsidies and funding. For the domestic supply chain to run well, basic amenities like cleanliness, storage space, cold storage, and knowledge of daily rates for mangoes must be made available in the APMC market.

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Conflict of interest

The authors declare that they have no conflict of interest.

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