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ECONOMIC ANALYSIS OF MAJOR FRUITS IN MIDDLE GUJARAT INDIA

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ABSTRACT

India, as the second largest producer of fruits, enjoys a comparative advantage in horticultural production due to its diverse agro-climatic conditions and varietal richness. However, rising production costs, marketing inefficiencies, and systemic constraints pose significant challenges to sustainability. The present study examines four major fruit crops, banana, mango, papaya, and lime, in the Middle Gujarat region. Primary data were collected from 120 fruit growers across different districts to assess crop-wise profitability and marketing patterns. Among the major fruits, papaya was the most profitable crop with the highest cost-benefit ratio (2.58) and net income (Rs.3,07,965.93/ha), followed by banana (2.06), whereas mango (1.64) and lime (1.46) were comparatively less profitable. The study also revealed that Channel-II was most preferred for banana (69.17%) and mango (55.00%), while papaya (82.50%) and lime (92.50%) producers favored Channel-I (direct sale). Efficiency analysis revealed that shorter channels, like Channel III and IV, resulted in a higher producer's share and lower price spreads. For example, banana's Channel-IV had an efficiency index of 1.23 and mango's Channel-III recorded the highest producer share of 58.70 per cent. Labour shortages, rising input costs, and delayed input availability were major production constraints. In marketing, farmers faced low price realization, delayed payments, and high transportation costs. Post-harvest challenges included lack of storage facilities, improper handling, and inadequate technical knowledge. The study highlights the need for improved infrastructure and efficient marketing systems.

Keywords: Fruit crops, cost-benefit ratio, marketing efficiency, constraints, post-harvest losses

Introduction

India, with its diverse agro-climatic conditions, ranks as the second-largest producer of fruits and vegetables globally, next to China. According to the National Horticulture Database (2021-22), India produced 107.24 million metric tonnes of fruits and 204.84 million metric tonnes of vegetables, with fruit cultivation spread across 7.5 million hectares and vegetables over 11.35 million hectares. The country dominates the global production of certain fruits, contributing 43.6 per cent of papayas, 40.4 per cent of mangoes (including guava) and 25.7 per cent of bananas (CMIE, 2023; DOH, 2023). Major fruit exports include grapes, pomegranates, mangoes, bananas and oranges, while onions, potatoes, tomatoes and green chillies dominate the vegetable export segment (www.apeda.gov.in).

Despite having just, a 1 per cent share in the global market, India enjoys a competitive advantage in horticultural production due to its varietal diversity and favorable growing conditions (Rani and Rohtas, 2021). Improvements in cold chain logistics and quality control have further enhanced the country's export potential (Sagar *et al.*, 2015; Singh and Nandi, 2021). Among the major horticultural crops, fruits like banana, mango, papaya and lime are widely cultivated in Gujarat, especially in the Middle Gujarat region, due to favorable soil and climatic conditions.

During the years 2015-16 and 2020-21, the cultivation and production of major fruit crops, papaya, lime, banana and mango, showed notable trends at the Middle Gujarat, Gujarat and India levels. In Middle Gujarat, papaya cultivation increased from 5.28 to 5.98 thousand hectares, with production rising from 305.45

to 348.64 thousand metric tonnes. Lime expanded from 13.63 to 14.27 thousand hectares, with production increasing from 172.19 to 184.50 thousand metric tonnes. Banana cultivation rose from 25.10 to 27.69 thousand hectares, with production growing from 1600.15 to 1816.24 thousand metric tonnes. Mango cultivation remained almost stable with a slight increase in area from 15.36 to 15.39 thousand hectares and production rising from 86.68 to 96.35 thousand metric tonnes (www.doh.gujarat.gov.in).

At the state level in Gujarat, papaya cultivation declined slightly from 20.17 to 18.18 thousand hectares, with production also decreasing from 1241.27 to 1107.88 thousand metric tonnes. Lime saw growth in both area (43.27 to 48.50 thousand hectares) and production (562.49 to 625.83 thousand metric tonnes). Banana cultivation dropped marginally from 64.69 to 59.25 thousand hectares, with production also decreasing from 4185.52 to 3907.21 thousand metric tonnes. Mango area increased from 153.18 to 163.77 thousand hectares, but production declined from 1241.59 to 997.83 thousand metric tonnes (www.doh.gujarat.gov.in; Horticulture Statistics at a Glance 2021).

At the national level in India, papaya cultivation rose from 132 to 146 thousand hectares, although production decreased slightly from 5667 to 5540 thousand metric tonnes. Lime showed significant expansion with area increasing from 245 to 327 thousand hectares and production rising from 2438 to 3548 thousand metric tonnes. Banana cultivation increased from 841 to 924 thousand hectares, and production grew from 29135 to 33062 thousand metric tonnes. Mango area rose from 2209 to 2317 thousand hectares, with production increasing from 18643 to 20386 thousand metric tonnes (Horticulture Statistics at a Glance 2021).

However, one of the major challenges faced by fruit growers in Middle Gujarat is the high cost of production and the inefficiencies in the marketing system. Farmers often struggle with fluctuating market prices, exploitative middlemen, high transportation costs and lack of access to organized marketing channels, leading to reduced profit margins. Therefore, the present study focuses on major fruits cultivated in Middle Gujarat with the objectives of estimating cost and returns, identifying marketing channels and analyzing constraints.

Materials and Methods

The study was conducted purposively in the Middle Gujarat region, focusing on four major fruit crops: banana, mango, papaya, and lime. A multistage

sampling technique was adopted to ensure representative coverage across different districts. For banana, a total of 240 farmers were surveyed, with 80 farmers each selected from Anand, Vadodara and Chhotaudepur districts. Correspondingly, 60 commission agents or village-level traders, 60 wholesalers or pre-harvest contractors and 30 retailers were interviewed. In the case of mango, 120 farmers were surveyed, 30 each from Anand, Vadodara, Panchmahal and Dahod, along with 40 commission agents, 40 wholesalers and 40 retailers. For papaya, 60 farmers each were selected from Anand and Vadodara, totalling 120 farmers with 20 commission agents, 20 wholesalers and 20 retailers. For lime, 20 farmers each were sampled from Anand, Kheda and Ahmedabad, making a total of 60 farmers and supported by 15 commission agents, 15 wholesalers and 15 retailers. Primary data were collected during 2016-17 using a pre-tested structured interview schedule administered through personal interviews. Secondary data were obtained from published literature, government reports and official statistical sources to support trend analysis and contextual interpretation.

Table 1: Distribution of sample farmers and market intermediaries selected for the study

Crops	Districts	No. of farmers	No. of commission agents / village-level traders	No. of wholesalers/ pre-harvest contractors	No. of retailers
Banana	Anand	80	20	20	10
	Vadodara	80	20	20	10
	Chhotaudepur	80	20	20	10
	Total	240	60	60	30
Mango	Anand	30	10	10	10
	Vadodara	30	10	10	10
	Panchmahal	30	10	10	10
	Dahod	30	10	10	10
	Total	120	40	40	40
Papaya	Anand	60	10	10	10
	Vadodara	60	10	10	10
	Total	120	20	20	20
Lime	Anand	20	5	5	5
	Kheda	20	5	5	5
	Ahmedabad	20	5	5	5
	Total	60	15	15	15

Cost concepts

The Commission for Agricultural Costs and Prices (CACP) concept was used to calculate cost and return analysis (Pundir *et al.*, 2025). The details of the cost concepts used in this study are as follows:

Cost A: It includes all actual expenses incurred by the farmer in cash as well as in kind during the production process. It consists of the following components:

1. Value of hired human labour
2. Value of hired bullock labour
3. Value of owned bullock labour
4. Value of tractor charges
5. Value of seed/seedlings (both farms produced and purchased)
6. Value of manure and cakes (owned farm and purchased)
7. Value of fertilizers
8. Value of insecticides and pesticides
9. Irrigation charges
10. Depreciation on farm buildings and farm implements
11. Interest on working capital
12. Other paid out expenses, if any.

Cost B includes Cost A along with the rental value of owned land and interest on the value of owned fixed capital (excluding land).

Cost A + Rental value of owned land + Interest on value of owned fixed capital (excluding land) (1)

Cost C₁ is obtained by adding the imputed value of family labour to Cost B.

Cost B + imputed value of family labour (2)

Cost C₂ is calculated by adding managerial charges to Cost C₁.

Cost C₁ + 10 % of cost C₁ as managerial charges
.... (3)

Gross returns or **Gross income** represent the total monetary value obtained from both the main product and by-products of the selected spice.

Net income indicates the actual profit earned by the farmer after covering all production costs.

Net income = Gross returns - Cost C₂ (4)

Per unit cost of production represents the average cost incurred for cultivating one hectare of land.

Per hectare cost of production = (Total cost) / (Area under crop (ha)) (5)

Cost-benefit ratio measures the economic efficiency of spice production.

Cost-benefit ratio = Gross income / Cost C₂ (6)

Marketing analysis

For marketing analysis, the following formulas suggested by Acharya and Agrawal (2003) were employed:

(i) Producer's share in consumer's rupee

The producer's share is the price received by the producer expressed as a percentage of the retail price.

The producer's share in various marketing channels was calculated as follows:

$$P_s = P_f / P_r \times 100 \quad \dots (7)$$

Where,

P_s = Producer's share in consumer's rupee

P_f = Price received by the producer

P_r = Price paid by the consumer

(ii) Marketing costs

Total marketing costs include all expenses incurred in cash or in kind by the producer and intermediaries involved in moving the produce from the point of production to the ultimate consumer. The total cost was computed as:

$$C = C_F + C_{m1} + C_{m2} + \dots + C_{mi} \quad \dots (8)$$

Where,

C = Total marketing cost per quintal of spice

C_F = Cost incurred by the producer on marketing

C_{mi} = Cost incurred by the i th middleman

(iii) Marketing margins

Marketing margin is the difference between the total payments (costs + purchase price) and receipts (sale price) of the middlemen. The absolute and percentage margin of the middleman involved in marketing were calculated as follows:

Absolute marketing margin of i th middleman

$$= P_{ri} - (P_{pi} + C_{mi}) \quad \dots (9)$$

Percentage margin of i th middleman

$$= [P_{ri} - (P_{pi} + C_{mi})] / P_{ri} \times 100 \quad \dots (10)$$

Where,

P_{ri} = Sale price of the i th middleman

P_{pi} = Purchase price of the i th middleman

C_{mi} = Cost incurred on marketing by the i th middleman

(iv) Modified measure of marketing efficiency (MME)

A higher ratio indicates greater marketing efficiency.

$$MME = RP / [(MC + MM)] - 1 \quad \dots (11)$$

$$RP = FP + MC + MM \quad \dots (12)$$

Where,

RP = Prices paid by the consumer

MC = Total marketing costs

MM = Net marketing margins

FP = Prices received by the producer

(v) Price spread

Price spread is the difference between the price paid by the consumer and the price received by the producer. For example,

$$\text{Price spread} = P_1 - P_2 \quad \dots (13)$$

Where,

P_1 = Price at one level or stage in the market

P_2 = Price at another level

Constraint analysis

Garrett's Ranking technique and Weighted Average Mean (WAM) were used to identify and prioritise the major constraints faced by farmers.

In Garrett's Ranking technique, the percentage score is calculated as,

$$\text{Percent score} = 100 \times (R_{ij} - 0.50) / N_j \quad \dots (14)$$

Where,

R_{ij} = Rank given for the i th constraint by the j^{th} individual

N_j = Number of constraints ranked by the j^{th} individual

The percent position of each rank was converted into scores using Garrett's Table. For each constraint, the scores of individual respondents were summed and divided by the total number of respondents. The mean score for each constraint was then ranked in descending order.

Weighted Average Mean was used as a supplementary method in some parts of the analysis to assess the relative importance of constraints by assigning weights to each rank.

Results and Discussion

Cost of cultivation of major fruits in Middle Gujarat

Table 2 presents the average cost of cultivation per hectare for major fruit crops such as banana, mango (up to 15 years), papaya and lime. Among various cost components, including planting material,

labour, manures & fertilizers, plant protection chemicals, irrigation, interest on working capital & fixed investment, rental value & revenue of land and total costs categorized as Cost A, B, C_1 and C_2 . Lime incurred the highest cost of planting material (Rs. 1,35,000/ha) followed by banana, papaya and mango. Labour costs were also significantly higher for lime and banana, indicating their labor-intensive nature. Manures & fertilizers contributed substantially to the cost in banana cultivation (Rs. 75,008.60/ha), showing its nutrient-intensive nature.

The irrigation cost was relatively higher in lime and banana due to their water requirements, while depreciation and fixed costs remained somewhat consistent across crops like mango and lime due to their longer orchard lifespan. When analyzing total cost categories, lime showed the highest total economic cost (Cost C_2) at Rs. 5,56,515.74/ha followed by banana, whereas papaya had the lowest cultivation cost. In terms of productivity, banana and papaya showed significantly higher yields (863.80 and 810.97 quintals/ha, respectively) compared to mango and lime. Despite having the highest market price per quintal (Rs. 3,491), the mango yielded lower total income due to its lower productivity.

The total income generated per hectare was highest for banana (Rs. 8,14,770.71) and lime (Rs. 8,10,000), with papaya also showing strong returns. However, when net income and cost-benefit ratio are considered, papaya emerged as the most profitable crop with a net income of Rs. 3,07,965.93 and a cost-benefit ratio of 2.58, indicating that for every Rs. 1 invested, Rs. 2.58 was returned. Banana also showed good profitability with a cost-benefit ratio of 2.06, while mango and lime had relatively lower profitability ratios of 1.64 and 1.46, respectively. This analysis reveals that short-duration crops like papaya and banana offer higher profitability and lower risk, whereas long-duration crops like mango and high-input crops like lime require larger investments and result in comparatively moderate returns.

Table 2: Average cost of cultivation of major fruits in Middle Gujarat (Rs./ha)

Sr. No.	Particulars	Banana	Mango (Up to 15 years)	Papaya	Lime
1	Planting material per ha	48888.84	5600.00	17750.5	135000.00
2	Labour (hired + family)	101064.60	39200.00	38618.8	154285.71
3	Manures & fertilizers	75008.60	28290.00	20420	37120.00
4	Plant protection chemicals	10200.00	21520.00	2097.29	27800.00
5	Irrigation	16659.62	14000.00	14580.85	24685.71
6	Interest on working capital @ 12%	30218.60	13033.20	11216.09	45466.97
7	Depreciation charges up to 5 years	8857.05	13700.00	4180.06	13700.00

8	Rental value of land	61700.00	60000.00	61700	60000
9	Revenue of land	450.00	450.00	450.00	450.00
10	Fixed cost	71007.05	74150.00	66330.06	74150.00
11	Interest on fixed investment@10%	7100.71	7415.00	6633.01	7415.00
12	Cost A	282040.26	121643.20	104683.53	424358.40
12	Cost B	360148.01	203208.20	177646.60	505923.40
14	Cost C ₁	360148.01	203208.20	177646.60	505923.40
15	Managerial charges @10%	36014.80	20320.82	17764.66	50592.34
16	Cost C ₂	396162.82	223529.02	195411.26	556515.74
17	Average yield (quintal/ha)	863.80	105.00	810.97	540
18	Average price received	943.24	3491.00	620.71	1500
19	Total income	814770.71	366555.00	503377.19	810000.00
20	Net income	418607.90	143025.98	307965.93	253484.26
21	Cost-benefit ratio	2.06	1.64	2.58	1.46

Source: Field survey (2017)

Disposal of produce through different supply chain by farmers

The disposal of produce through different supply chains by farmers in Middle Gujarat indicates crop-wise variations in marketing practices. For banana, the majority of farmers (69.17%) preferred Channel-II, while 19.17 per cent used Channel-I, and smaller shares used Channels-III and IV. In mango, Channel-II was also dominant (55.00%) followed by Channel-I (38.33%) and Channel-III (6.67%). For papaya, a significant majority (82.50%) was sold through Channel-I, indicating reliance on traditional market routes, while 17.50 per cent used Channel-II. In lime, Channel-I was the most preferred with 92.50 per cent of farmers using it and only 7.50 per cent using Channel-II, highlighting a strong dependence on APMC-regulated markets for citrus crops.

Table 3: Disposal of produce in different supply chain

Particular	Banana	Mango	Papaya	Lime
No. of farmers	240	120	120	120
Channel-I	46 (19.17)	46 (38.33)	99 (82.50)	111 (92.50)
Channel-II	166 (69.17)	66 (55.00)	21 (17.50)	9 (7.50)
Channel-III	12 (5.00)	8 (6.67)	-	-
Channel-IV	16 (6.67)	-	-	-

Marketing channels of banana in Middle Gujarat

As banana cultivation is increasing, it is necessary to know the backward linkages of this crop. In this context, to know marketing aspects of this crop, including existing marketing channels, marketing costs, marketing margins, price spread and marketing efficiency, were presented below.

Table 4: Marketing channels of banana in Middle Gujarat

Channel No.	Channels
Channel-I	Producer - Wholesaler - Retailer - Consumer (Short distant market)
Channel-II	Producer - Commission Agent - Wholesaler - Retailer - Consumer (Long-distance market)
Channel-III	Producer - Exporter - Consumer
Channel-IV	Producer - Retailer - Consumer

Source: Field survey (2017)

Banana was marketed through four channels involving commission agents, wholesalers, retailers, and exporters (Table 4). Channel I and Channel II were the most commonly used, accounting for about 90 per cent of the total produce. Commission agents played a crucial role, operating in both local and distant markets, with a large volume of produce marketed through them. The presence of exporters and processors was relatively limited in the study area. Channel IV (producer–retailer–consumer) was mainly used for B-grade bananas due to their highly perishable nature. In contrast, Channel II was preferred for A-grade bananas, as better-quality produce was transported to distant markets such as Delhi, Punjab, Rajasthan, and Madhya Pradesh. Channel I, involving wholesalers and retailers, was primarily used for short-distance markets within the state.

Channel-wise marketing cost of banana in Middle Gujarat

In Channel-I, the total marketing cost was Rs. 496.58/q, with the wholesaler bearing the highest share (55.12%), followed by the retailer (24.35%) and the producer (20.53%). Channel-II, used for long-distance marketing, recorded a higher total cost of Rs. 572.30/q, with the wholesaler accounting for the largest share (52.40%), followed by the producer (24.01%) and retailer (23.59%). In Channel-III, the total cost was

highest (Rs. 2539.15/q), primarily due to the exporter's share (94.55%) arising from grading, packing, labour, and transportation, while the producer's share was minimal (5.45%). In contrast, Channel-IV, a short-distance channel, had the lowest cost (Rs. 182.93/q), shared between the producer (44.24%) and retailer (55.76%). Across all channels, post-harvest losses formed a significant component of marketing costs, particularly for wholesalers and exporters, indicating a critical area for improvement.

Table 5: Channel-wise marketing cost of banana in Middle Gujarat (Rs./q)

Marketing cost	Marketing channels of the banana			
	Channel -I	Channel -II	Channel -III	Channel -IV
Cost incurred by the producer				
i) Labour cost	24.93 (5.02)	24.93 (4.36)	30.00 (1.18)	24.93 (13.63)
ii) Packing material	-	-	-	-
iii) Commission	-	25.00 (4.37)	-	-
iv) Post-harvest loss	77.00 (15.51)	87.50 (15.29)	108.50 (4.27)	56.00 (30.61)
Total (i to iv)	101.93 (20.53)	137.43 (24.01)	138.50 (5.45)	80.93 (44.24)
Cost incurred by the wholesaler cum processor				
i) Transportation	33.33 (6.71)	45.00 (7.86)	-	-
ii) Loading & cleaning	46.66 (9.40)	25.00 (4.37)	-	-
iii) Packing material	19.56 (3.94)	28.67 (5.01)	-	-
iv) Processing	66.66 (13.42)	66.66 (11.65)	-	-
v) Post-harvest loss	107.52 (21.65)	134.54 (23.51)	-	-
Total (i to v)	273.73 (55.12)	299.87 (52.40)	-	-
Cost incurred by the retailer				
i) Transportation	55.00 (11.08)	55.00 (9.61)	-	55.00 (30.07)
ii) Packing material	-	-	-	15.00 (8.20)
iii) Post-harvest loss	65.92 (13.27)	80.00 (13.98)	-	32.00 (17.49)
Total (i to iii)	120.92 (24.35)	135.00 (23.59)	-	102.00 (55.76)

Cost incurred by the exporter				
i) Cleaning /Grading/Packing	-	-	200.00 (7.88)	-
ii) Packing material	-	-	500.00 (19.69)	-
iii) Processing	-	-	200.00 (7.88)	-
iv) Transportation	-	-	800.00 (31.51)	-
v) Commission	-	-	100.00 (3.94)	-
vi) Labour cost	-	-	400.00 (15.75)	-
vii) Post-harvest loss	-	-	200.65 (7.90)	-
Total (i to vii)	-	-	2400.65 (94.55)	-
Total marketing cost	496.58 (100.00)	572.30 (100.00)	2539.15 (100.00)	182.93 (100.00)

Source: Field survey (2017)

**Figures in parentheses are the percentage of the total marketing cost*

Price spread and marketing margin in the supply chain of banana in Middle Gujarat

Table 6 presents the price spread and marketing margins across four banana marketing channels in Middle Gujarat. In Channel-I, the consumer price was Rs. 2240.83/q, with the producer receiving Rs. 1075.07/q (47.17%). Marketing costs and margins accounted for Rs. 496.58/q (22.16%) and Rs. 687.18/q (30.66%), respectively, with wholesalers and retailers earning Rs. 275/q and Rs. 412.18/q. Channel-II, used for long-distance markets, recorded a higher consumer price (Rs. 2560.62/q), while the producer's share declined to 43.45%. The total marketing cost was Rs. 572.30/q (22.35%) and the highest margin of Rs. 875.75/q (34.20%) was distributed among commission agents, wholesalers, and retailers. In Channel-III (export), the consumer price was highest (Rs. 4725.65/q), but the producer's share was lowest (29.87%). The exporter incurred substantial costs (Rs. 2400.65/q; 53.73%) and earned a margin of Rs. 775/q. In contrast, Channel-IV, the most direct channel, had the lowest consumer price (Rs. 1302/q) and the highest producer share (55.23%). It also recorded the lowest marketing cost (Rs. 182.93/q; 14.05%) and a retailer margin of Rs. 400/q.

Table 6: Price spread and marketing margin in the supply chain of banana in Middle Gujarat (Rs./q)

Particular	Marketing channels of the banana			
	Channel-I (PSCR (%))	Channel-II (PSCR (%))	Channel-III (PSCR (%))	Channel-IV (PSCR (%))
Net price received by producer	1075.07 (47.17)	1112.57 (43.45)	1411.50 (29.87)	719.07 (55.23)
Marketing cost of the producer	101.93 (4.54)	137.43 (5.37)	138.50 (2.93)	80.93 (6.22)
Marketing cost of the wholesaler	273.73 (12.21)	299.87 (11.71)	-	-
Marketing cost of the retailer	120.92 (5.39)	135.00 (5.27)	-	102.00 (7.83)
Marketing cost of the exporter	-	-	2400.65 (50.80)	-
Total marketing cost	496.58 (22.16)	572.30 (22.35)	2539.15 (53.73)	182.93 (14.05)
Marketing margin by the commission agent	-	62.50 (2.44)	-	-
Marketing margin by the wholesaler	275.00 (12.27)	328.13 (12.81)	-	-
Marketing margin by the retailer	412.18 (18.39)	485.12 (18.95)	-	400.00 (30.72)
Marketing margin by the exporter	-	-	775.00 (16.40)	-
Total marketing margin	687.18 (30.66)	875.75 (34.20)	775.00 (16.40)	400.00 (30.72)
Price paid by the consumer	2240.83 (100.00)	2560.62 (100.00)	4725.65 (100.00)	1302.00 (100.00)

Source: Field survey (2017)

*Figures in parentheses are the percentage of producer's share in consumer's rupee

PSCR = Producer's Share in Consumer Rupee

Marketing efficiency of banana in Middle Gujarat

The marketing efficiency of banana in Middle Gujarat was highest in Channel-IV (1.23) due to the lowest price spread (Rs. 582.93) followed by Channel-I (0.97), where farmers sell directly to nearby wholesalers. Channel-II (0.77) includes commission

agents, increasing the price spread (Rs. 1448.05), while Channel-III (0.43) was the least efficient due to high costs for export-related packaging and transport. The presence of intermediaries across channels reduces farmer returns.

Table 7: Marketing efficiency of banana in Middle Gujarat (Rs./q)

Sr. No.	Particular	Channel-I	Channel-II	Channel-III	Channel-IV
1	Consumer price/Retailer's selling price	2181.83	2560.62	4725.65	1302.00
2	Total marketing cost	419.58	572.30	2539.15	182.93
3	Total marketing margin	687.18	875.75	775.00	400.00
4	Net price received by farmers	1075.07	1112.57	1411.50	719.07
5	Price spread	1106.76	1448.05	3314.15	582.93
6	Marketing efficiency $[4 / (2 + 3)]$	0.97	0.77	0.43	1.23

Source: Field survey (2017)

Marketing channels of mango in Middle Gujarat

Mango is the second most cultivated fruit crop after banana in Middle Gujarat, with major cultivation in Padra, Anand, and Dahod. As shown in Table 8, mangoes are marketed through three channels (Channel-I, II, and III), with marketing largely dominated by pre-harvest contractors who fix prices at the flowering stage, ensuring assured returns and reducing post-harvest risks. This system is preferred due to labour shortages during harvesting and yield uncertainties caused by climatic variations. The produce is then distributed to nearby markets such as Vadodara, Ahmedabad, Surat, and Rajkot, as well as distant markets including Delhi, Punjab, and Rajasthan, depending on demand.

Table 8: Marketing channels of mango in Middle Gujarat

Channel No.	Channels
Channel-I	Producer - Pre-harvest Contractor - Retailer - Consumer (Short distant market)
Channel-II	Producer - Wholesaler - Retailer - Consumer (Long distant market)
Channel-III	Producer - Retailer - Consumer

Source: Field survey (2017)

Channel-wise marketing cost of mango in Middle Gujarat

In Channel-I, the total marketing cost was highest at Rs. 1233.47/q with major contributions from the producer (Rs. 315.15/q), wholesaler (Rs. 523.50/q) and retailer (Rs. 394.83/q). Channel-II, primarily used for long-distance markets and involving a pre-harvest contractor, incurred a slightly lower total marketing cost of Rs. 1197.18/q. Here, the pre-harvest contractor incurred Rs. 393.60/q, the wholesaler Rs. 442.38/q and the retailer Rs. 361.20/q. Channel-III had the lowest total marketing cost at Rs. 707.73/q, where the producer and retailer incurred Rs. 280.54/q and Rs. 427.19/q, respectively. Among all channels, post-harvest losses and transportation remain significant cost components, particularly for wholesalers and retailers.

Table 9: Channel-wise marketing cost of mango in Middle Gujarat (Rs./q)

Marketing cost	Marketing channels of mango		
	Channel-I	Channel-II	Channel-III
Cost incurred by the producer			
i) Labour cost for grading, sorting	118.30 (9.59)	-	122.20 (17.27)

ii) Packing material	42.80 (3.47)	-	71.35 (10.08)
iii) Loading, unloading, weighing	12.50 (1.01)	-	
iv) Miscellaneous	90.92 (7.37)	-	38.22 (5.40)
v) Post-harvest loss	50.63 (4.10)	-	48.77 (6.89)
Total (i to v)	315.15 (25.55)	-	280.54 (39.64)
Cost incurred by the pre-harvest contractor			
i) Transportation	-	60.00 (5.01)	-
ii) Labour cost for harvesting	-	130.25 (10.88)	-
iii) Loading-unloading	-	25.25 (2.11)	-
iv) Packing material	-	80.60 (6.73)	-
v) Miscellaneous	-	16.50 (1.38)	-
vi) Post-harvest loss	-	81.00 (6.77)	-
Total (i to vi)	-	393.60 (32.88)	-
Cost incurred by the wholesaler			
i) Packing material	14.67 (1.19)	15.40 (1.29)	-
ii) Loading, unloading, grading	11.25 (0.91)	8.60 (0.72)	-
iii) Transportation	202.45 (16.41)	172.30 (14.39)	-
iv) Mandi fee	25.00 (2.03)	25.00 (2.09)	-
v) Miscellaneous	168.32 (13.65)	111.35 (9.30)	-
vi) Post-harvest loss	101.81 (8.25)	109.73 (9.17)	-
Total (i to vi)	523.50 (42.44)	442.38 (36.95)	-
Cost incurred by the retailer			
i) Packing material	10.12 (0.82)	9.25 (0.77)	36.35 (5.14)
ii) Transportation	24.40 (1.98)	14.40 (1.20)	112.42 (15.88)
iii) Loading, unloading, grading	4.25 (0.34)	4.49 (0.38)	10.08 (1.42)
iv) Miscellaneous	90.92 (7.37)	70.50 (5.89)	88.72 (12.54)
v) Post-harvest loss	265.13 (21.49)	262.55 (21.93)	179.62 (25.38)
Total (i to v)	394.83 (32.00)	361.20 (30.17)	427.19 (60.36)
Total marketing cost	1233.47 (100.00)	1197.18 (100.00)	707.73 (100.00)

Source: Field survey (2017)

*Figures in parentheses are the percentage of the total marketing cost

Price spread in the marketing of mango in Middle Gujarat

Table 10 presents the margins added by intermediaries across different marketing channels. Channel-I provided the highest net price to producers (Rs. 2025.25/q), followed by Channel-III (Rs. 1950.80/q) and Channel-II (Rs. 1800.00/q). Total marketing cost was highest in Channel-I (Rs. 1233.46/q), slightly lower in Channel-II (Rs. 1197.19/q), and lowest in Channel-III (Rs. 707.73/q). Channel-II, involving multiple intermediaries (pre-harvest contractor, wholesaler, and retailer), recorded the highest marketing margin (Rs. 1531.23/q), followed by Channel-I (Rs. 1351.66/q), while Channel-III had the lowest margin (Rs. 664.63/q). Consumer prices were highest in Channel-I (Rs. 4610.37/q), followed by Channel-II (Rs. 4528.41/q), and lowest in Channel-III (Rs. 3323.17/q). Overall, Channel-III emerged as the most efficient due to lower costs and a higher producer share, whereas Channel-I provided the highest absolute returns to farmers.

Table 10: Price spread in marketing of mango in Middle Gujarat (Rs./q)

Marketing cost	Marketing channels of mango		
	Channel -I (PSCR (%))	Channel -II (PSCR (%))	Channel -III (PSCR (%))
Net price received by the producer	2025.25 (43.93)	1800.00 (39.75)	1950.80 (58.70)
Marketing cost by the producer	315.15 (6.84)	-	280.54 (8.44)
Marketing cost by the pre-harvest contractor	-	393.60 (8.69)	-
Marketing cost by the wholesaler	523.50 (11.35)	442.38 (9.77)	-
Marketing cost by the retailer	394.82 (8.56)	361.20 (7.98)	427.19 (12.85)
Total marketing cost	1233.46 (26.75)	1197.19 (26.44)	707.73 (21.30)
Marketing margin by the pre-harvest contractor	-	329.04 (7.27)	-
Marketing margin by the wholesaler	429.58 (9.32)	296.50 (6.55)	-
Marketing margin by the retailer	922.07 (20.00)	905.68 (20.00)	664.63 (20.00)
Total marketing margin	1351.66 (29.32)	1531.23 (33.81)	664.63 (20.00)
Price paid by the consumer	4610.37 (100.00)	4528.41 (100.00)	3323.17 (100.00)

Source: Field survey (2017)

*Figures in parentheses are the percentage of producer's share in consumer's rupee

Marketing efficiency of mango in Middle Gujarat

Channel-III emerged as the most efficient with the lowest price spread of Rs. 1372.37/q and the highest marketing efficiency index of 1.42. It involved only the producer and retailer, minimizing intermediary costs. Channel-I, which served nearby markets and excludes commission agents, showed moderate efficiency with a price spread of Rs. 2585.12/q and an efficiency index of 0.78. Channel-II, which included a pre-harvest contractor and targets distant markets, had the lowest efficiency (0.66) due to the highest price spread of Rs. 2728.41/q, driven by additional costs in packing and handling.

Table 11: Marketing efficiency of mango in Middle Gujarat (Rs./q)

Sr. No.	Particular	Channel-I	Channel-II	Channel-III
1	Consumer price/Retailer's selling price	4610.37	4528.41	3323.17
2	Total marketing cost	1233.46	1197.19	707.73
3	Total marketing margin	1351.66	1531.23	664.63
4	Net price received by farmers	2025.25	1800.00	1950.80
5	Price spread	2585.12	2728.41	1372.37
6	Marketing efficiency $[4 / (2 + 3)]$	0.78	0.66	1.42

Source: Field survey (2017)

Marketing channels of papaya in Middle Gujarat

In recent years, papaya production in Middle Gujarat has declined compared to its earlier prominence. Currently, two marketing channels operate in the region. Channel-I is the dominant route, where farmers enter into contracts with pre-harvest contractors who market the produce to short- and long-distance markets through wholesalers and retailers. Channel-II is a local and limited channel, mainly used for second-grade or leftover produce not procured by contractors. In this case, retailers directly collect papaya from farms and sell it to consumers. Thus, Channel-I handles the bulk of marketable produce, while Channel-II serves the local market with surplus or lower-quality fruits.

Table 12: Marketing channels of papaya in Middle Gujarat

Channel No.	Channels
Channel-I	Producer-Pre-Harvest Contractor-Wholesaler-Retailer-Consumer
Channel-II	Producer-Retailers-Consumer

Source: Field survey (2017)

Channel-wise marketing cost of papaya in Middle Gujarat

In Channel-I, which involved multiple intermediaries, the total marketing cost was Rs. 738.23/q, distributed among the producer (Rs. 27.83/q), pre-harvest contractor (Rs. 216.52/q), wholesaler (Rs. 249.58/q) and retailer (Rs. 244.30/q). The highest share of cost was incurred by the wholesaler (33.81%) followed closely by the retailer (33.09%). Major cost components include damage/spoilage, transportation and market fees. In contrast, Channel-II, being a local and short-distance channel, had a significantly lower total marketing cost of Rs. 264.78/q, involving only the producer (Rs. 20.48/q) and retailer (Rs. 244.30/q). Here, retailers borne over 92% of the marketing cost, mainly due to spoilage (70.64%) and transportation (20.77%).

Table 13: Channel-wise marketing cost of papaya in Middle Gujarat (Rs./q)

Marketing Cost	Marketing channels of papaya	
	Channel-I	Channel-II
Cost incurred by the producer		
i) Cleaning /Grading/Packing	2.25 (0.30)	1.50 (0.57)
ii) Loading-unloading	1.85 (0.25)	-
iii) Transportation	2.35 (0.32)	-
iv) Damage/Spoilage	18.98 (2.57)	18.98 (7.17)
v) Weighing	1.55 (0.21)	-
vi) Storage	0.85 (0.12)	-
Total (i to vi)	27.83 (3.77)	20.48 (7.73)
Cost incurred by the pre-harvest contractor		
i) Sorting /Grading/Packing	52.00 (7.04)	-
ii) Loading & cleaning	37.50 (5.08)	-
iii) Transportation	70.50 (9.55)	-
iv) Damage/Spoilage	56.52 (7.66)	-
Total (i to iv)	216.52 (29.33)	-
Cost incurred by the wholesaler		
i) Loading & cleaning	25.00 (3.39)	-
ii) Weighing	5.50 (0.75)	-
iii) Market fee	73.83 (10.00)	-
iv) Transportation	65.50 (8.87)	-
v) Damage/Spoilage	79.75 (10.80)	-

Total (i to v)	249.58 (33.81)	-
Cost incurred by the retailer		
i) Transportation	55.00 (7.45)	55.00 (20.77)
ii) Loading-unloading	2.25 (0.30)	2.25 (0.85)
iii) Damage/Spoilage	187.05 (25.34)	187.05 (70.64)
Total (i to iii)	244.30 (33.09)	244.30 (92.27)
Total marketing cost	738.23 (100.00)	264.78 (100.00)

Source: Field survey (2017)

*Figures in parentheses are the percentage of the total marketing cost

Price spread in the marketing of papaya in Middle Gujarat

The price spread analysis of papaya in Middle Gujarat revealed that Channel-II was more efficient, with the producer receiving Rs. 659.77/q (60.27%) and the consumer price being Rs. 1094.61/q. It involved only the producer and retailer, resulting in a lower total marketing cost (Rs. 264.78/q) and retailer margin (Rs. 170.06/q). While Channel-I with multiple intermediaries, pre-harvest contractor, wholesaler and retailer, showed a higher consumer price of Rs. 2669.98/q, but the producer received only Rs. 1022.17/q (38.28%). The marketing cost (Rs. 738.23/q) and total margin (Rs. 909.58/q) in Channel-I were significantly higher, indicating a wider price spread and lower farmer share, emphasizing the need to promote direct or local marketing models for better farmer realization.

Table 14: Price spread in marketing of papaya in Middle Gujarat (Rs./q)

Marketing cost	Marketing channels of papaya	
	Channel-I (PSCR (%))	Channel-II (PSCR (%))
Net price received by the producer	1022.17 (38.28)	659.77 (60.27)
Marketing cost by the producer	27.83 (1.04)	20.48 (1.87)
Marketing cost by the pre-harvest contractor	216.52 (8.11)	-
Marketing cost by the wholesaler	249.58 (9.35)	-
Marketing cost by the retailer	244.30 (9.15)	244.30 (22.32)
Total marketing cost	738.23 (27.65)	264.78 (24.19)
Marketing margin by the pre-harvest contractor	210.00 (7.87)	-

Marketing margin by the wholesaler	295.30 (11.06)	-
Marketing margin by the retailer	404.28 (15.14)	170.06 (15.54)
Total marketing margin	909.58 (34.07)	170.06 (15.54)
Price paid by the consumer	2669.98 (100.00)	1094.61 (100.00)

Source: Field survey (2017)

**Figures in parentheses are the percentage of producer's share in consumer's rupee*

Marketing efficiency of papaya in Middle Gujarat

The marketing efficiency of papaya in Middle Gujarat was highest in Channel-II with an efficiency index of 1.52, due to the lowest price spread of Rs. 434.84/q. This channel involves direct sale from producer to retailer, minimizing costs and intermediaries. While Channel-I, which included a pre-harvest contractor, wholesaler and retailer, showed lower efficiency (0.62) because of a higher price spread (Rs. 1647.81/q) caused by increased marketing costs and margins. Although Channel-I operates without commission agents, the presence of multiple intermediaries reduces the producer's share.

Table 15: Marketing efficiency of papaya in Middle Gujarat (Rs./q)

Sr. No.	Particular	Channel-I	Channel-II
1	Consumer price/Retailer's selling price	2669.98	1094.61
2	Total marketing cost	738.23	264.78
3	Total marketing margin	909.58	170.06
4	Net price received by farmers	1022.17	659.77
5	Price spread	1647.81	434.84
6	Marketing efficiency $[4 / (2 + 3)]$	0.62	1.52

Source: Field survey (2017)

Marketing channels of lime in Middle Gujarat

Table 16 shows the different marketing channels of lime in the Middle Gujarat. Around 92.50 per cent, lime passed through APMC channels, and in channel-II, farmers sold directly to the retailer from the farm.

Table 16: Marketing channels of lime in Middle Gujarat

Channel No.	Channels
Channel-I	Producer - Wholesaler cum Commission Agent - Retailer - Consumer (Short distant market)
Channel-II	Producer - Retailers - Consumer

Source: Field survey (2017)

Channel-wise marketing cost of lime in Middle Gujarat

The channel-wise marketing cost analysis of lime in Middle Gujarat indicates that Channel-I, involving the producer, commission agent cum wholesaler and retailer, incurred a higher total marketing cost of Rs. 811.78/q, while Channel-II, a direct route from producer to retailer, had a lower cost of Rs. 581.75/q. In Channel-I, the producer incurred the highest cost at Rs. 418.29/q (51.53%) followed by the retailer at Rs. 251.43/q (30.97%) and the wholesaler at Rs. 142.06/q (17.50%). Major cost components include labour, spoilage and commission. In Channel-II, the producer's share of the cost was Rs. 339.82/q (58.41%), and the retailers were Rs. 241.93/q (41.59%), with spoilage and commission being significant contributors.

Table 17: Channel-wise marketing cost of lime in Middle Gujarat (Rs./q)

Marketing cost	Channel-I	Channel-II
Cost incurred by the producer		
i) Labour cost	232.22 (28.61)	180.40 (31.01)
ii) Packing material	20.50 (2.53)	12.35 (2.12)
iii) Transportation	47.00 (5.79)	28.50 (4.90)
iv) Spoilage cost	118.57 (14.61)	118.57 (20.38)
Total (i to iv)	418.29 (51.53)	339.82 (58.41)
Cost incurred by the commission agent cum wholesaler		
i) Inter-market transportation	12.50 (1.54)	-
ii) Loading & cleaning	12.00 (1.48)	-
iii) Packing material	18.20 (2.24)	-
iv) Market fee	16.16 (1.99)	-
v) Spoilage cost	83.20 (10.25)	-
Total (i to v)	142.06 (17.50)	-
Cost incurred by the retailer		
i) Transportation	35.50 (4.37)	30.50 (5.24)
ii) Packing material	12.75 (1.57)	10.25 (1.76)
iii) Commission	98.98 (12.19)	98.98 (17.01)
iii) Spoilage cost	104.20 (12.84)	102.20 (17.57)
Total (i to iii)	251.43 (30.97)	241.93 (41.59)
Total marketing cost	811.78 (100.00)	581.75 (100.00)

Source: Field survey (2017)

**Figures in parentheses are the percentage of the total marketing cost*

Price spread in the marketing of lime in Middle Gujarat

The price spread analysis for lime in Middle Gujarat reveals that Channel-II, where farmers sell directly to local retailers, offers a slightly higher producer's share in the consumer rupee (60.95%) compared to Channel-I (60.01%), which involves sales through APMC. The consumer price in Channel-I was higher at Rs. 4689.41/q, while in Channel-II it was Rs. 2419.09/q, mainly due to differences in quality and market destination. The total marketing margin was much greater in Channel-I (Rs. 1063.70/q) due to the involvement of both wholesaler cum commission agent and retailer, whereas in Channel-II, only the retailer's margin was present (Rs. 362.86/q). Moreover, marketing costs were lower in Channel-II (Rs. 581.75/q) compared to Channel-I (Rs. 811.78/q).

Table 18: Price spread in marketing of lime in Middle Gujarat (Rs./q)

Marketing cost	Marketing channels of lime	
	Channel-I (PSCR (%))	Channel-II (PSCR (%))
Net price received by the producer	2813.93 (60.01)	1474.48 (60.95)
Marketing cost by the producer	418.29 (8.92)	339.82 (14.05)
Marketing cost by the commission agent cum wholesaler	142.06 (3.03)	-
Marketing cost by the retailer	251.43 (5.36)	241.93 (10.00)
Total marketing cost	811.78 (17.31)	581.75 (24.05)
Marketing margin by the commission agent cum wholesaler	484.83 (10.34)	-
Marketing margin by the retailer	578.87 (12.34)	362.86 (15.00)
Total marketing margin	1063.70 (22.68)	362.86 (15.00)
Price paid by the consumer	4689.41 (100.00)	2419.09 (100.00)

Source: Field survey (2017)

*Figures in parentheses are the percentage of producer's share in consumer's rupee

Marketing efficiency of lime in Middle Gujarat

Channel-II was slightly more efficient with an efficiency index of 1.56, compared to 1.50 in Channel-I. Although Channel-I involved more intermediaries and a higher price spread (Rs. 1875.48/q) than Channel-II (Rs. 944.61/q), both channels still offer profitable returns to farmers, especially during the summer season, when demand and prices for lime were generally high.

Table 19: Marketing efficiency of lime in Middle Gujarat (Rs./q)

Sr. No.	Particular	Channel -I	Channel -II
1	Consumer price/Retailer's selling price	4689.41	2419.09
2	Total marketing cost	811.78	581.75
3	Total marketing margin	1063.70	362.86
4	Net price received by farmers	2813.93	1474.48
5	Price spread	1875.48	944.61
6	Marketing efficiency $[4 / (2 + 3)]$	1.50	1.56

Source: Field survey (2017)

Constraints of major fruits in Middle Gujarat

Fruit crops such as banana, mango, papaya, and lime play a significant role in enhancing farmers' income and contributing to the economic development of Gujarat. To identify the major constraints in the input, marketing, and post-harvest sub-systems, Weighted Average Mean and Garrett Ranking techniques were applied based on farmers' responses. The results are presented below.

Banana

Constraints in the input sub-system

Among the several constraints in the input sub-system, the most critical issue reported was the unavailability of labour, which often compelled farmers to engage in pre-harvest contracts with wholesalers and other intermediaries. This was followed by the rising cost of inputs, which placed a financial burden on production. Timely availability of inputs also emerged as a major challenge, affecting the efficiency of farm operations. Concerns about the quality of inputs and limited access to extension services were also noted. Other issues included inconsistent delivery of inputs and the relatively less impactful constraint of input sources being located far from farms.

Table 20: Constraints in the input sub-system

Sr. No.	Constraints	WAM	Rank
1	Unavailability of labour	4.64	1
2	Increasing prices	4.39	2
3	Availability on time	4.26	3
4	Quality of input	3.87	4
5	Less extension services	3.74	5
6	Long distance of the input market	2.93	7
7	Insufficient delivery	3.41	6

Source: Field Survey (2017)

Constraints in the marketing sub-system

In banana marketing, the major constraint was the lack of remunerative prices, significantly affecting farmers' income. Labour shortages for harvesting and

packaging further disrupted timely marketing operations. Commission charges by wholesalers and suppliers, along with delayed payments, also reduced net returns. Other constraints included spoilage due to improper harvesting practices, high transportation costs, and the requirement of large space for post-harvest handling. Less significant issues were market distance and lack of market information, as the banana supply chain often bypasses formal APMC markets. Improper infrastructure was reported but ranked lowest among the constraints.

Table 21: Constraints in the marketing sub-system

Sr. No.	Constraints	Garrett Score	Mean Value	Garrett Rank
1	Do not get the proper price	19023	79.26	1
2	Unavailability of labour	16828	70.12	2
3	Commission problem	15373	64.05	3
4	Delayed payment	13970	58.21	4
5	Spoilage of fruits	12582	52.43	5
6	Higher cost of transportation	11083	46.18	6
7	Large space required for post-harvest handling	9707	40.45	7
8	Distance market	8567	35.70	8
9	Lack of market information	7470	31.13	9
10	Improper infrastructure	4917	20.49	10

Source: Field Survey (2017)

Constraints in post-harvest management

In banana cultivation, significant post-harvest losses were reported due to several key constraints. The foremost constraint was the lack of pre-cooling and cold storage facilities, making proper preservation difficult. Improper harvesting techniques by labourers ranked next followed by poor handling practices after harvest, such as bulk packaging and stacking that cause fruit damage. Inappropriate packaging materials and inconsistent grading & standardization, especially for distant and export markets, also contributed to quality and value loss. Concerns included inadequate post-harvest technology, limited awareness among stakeholders and excess market supply. The least priority was given to lack of training and awareness programs.

Table 22: Constraints in post-harvest management

Sr. No.	Constraints	Garrett Score	Mean Value	Garrett Rank
1	Absence of pre-cooling and storage facility	18391	76.63	1
2	Improper harvesting method	16701	69.59	2
3	Improper handling after harvesting	14513	60.47	3
4	Unsuitable packaging materials	13464	56.10	4
5	Grading & standardization problem	13132	54.72	5

6	Excess supply in markets	11716	48.82	6
7	Awareness related to post-harvest management	10443	43.51	7
8	Inadequate post-harvest technology	8614	35.89	8
9	Wide gap in technology available and awareness	7342	30.59	9
10	Lack of training problems and awareness campaign	5204	21.68	10

Source: Field Survey (2017)

Mango

Constraints in the input sub-system

In the mango cultivation input sub-system, the most critical constraint was the unavailability of labour, compelling farmers to depend on pre-harvest contractors. This was followed by the long distance of input markets, which increased time and effort for procurement. Rising input prices and delays in timely availability, especially fertilizers, further added to the challenges. Other concerns included insufficient delivery and issues with input quality. The least severe constraint reported was limited extension support from government agencies.

Table 23: Constraints in the input sub-system

Sr. No.	Constraints	WAM	Rank
1	Unavailability of labour	4.58	1
2	Long distance of the input market	4.37	2
3	Increasing prices	3.67	3
4	Availability on time	3.11	4
5	Insufficient delivery	2.91	5
6	Quality of input	2.73	6
7	Less extension service	2.08	7

Source: Field Survey (2017)

Constraints in the marketing sub-system

In the marketing sub-system, the major constraint reported was the inability of farmers to receive fair prices for their produce. This was followed by delays in payment from pre-harvest contractors and market intermediaries. High transportation costs due to distant market access added to the farmers' burden. Other notable issues included labour shortages, spoilage during handling and the requirement of large space for post-harvest operations. Constraints like lack of market information, commission issues and poor infrastructure were considered less severe.

Table 24: Constraints in the marketing sub-system

Sr. No.	Constraints	Garrett Score	Mean Value	Garrett Rank
1	Do not get the proper price	9319	77.66	1
2	Delayed payment	8136	67.80	2
3	Higher cost of transportation	7506	62.55	3
4	Distance market	7008	58.40	4
5	Unavailability of labour	6526	54.38	5

6	Spoilage of fruits	5827	48.56	6
7	Large space required for post-harvest handling	4833	40.28	7
8	Commission problem	4180	34.83	8
9	Lack of market information	3448	28.73	9
10	Improper infrastructure	2977	24.81	10

Source: Field Survey (2017)

Constraints in post-harvest management

In mango post-harvest management, the most pressing constraint identified was the lack of appropriate post-harvest technology for harvesting and handling. This was followed by a significant gap in awareness about available technologies and limited knowledge of proper post-harvest practices. Other key challenges included improper harvesting methods and inadequate understanding of grading & standardization. Less critical constraints were unsuitable packaging, lack of storage facilities and issues like oversupply or poor handling, which were less impactful due to the seasonal nature of mango production.

Table 25: Constraints in post-harvest management

Sr. No.	Constraints	Garrett Score	Mean Value	Garrett Rank
1	Inadequate post-harvest technology	8847	73.73	1
2	Wide gap in technology available and awareness	7792	64.93	2
3	Awareness related to post-harvest management	7639	63.66	3
4	Improper harvesting method	7021	58.51	4
5	Grading & standardization problem	6076	50.63	5
6	Unsuitable packaging materials	5814	48.45	6
7	Excess supply in markets	5056	42.13	7
8	Improper handling after harvesting	4422	36.85	8
9	Absence of pre-cooling and storage facility	4123	34.36	9
10	Lack of training problems and awareness campaign	2970	24.75	10

Source: Field Survey (2017)

Papaya

Constraints in the input sub-system

In papaya cultivation, the major constraint faced by farmers was the rising cost of fertilizers and pesticides, which are used extensively in fruit farming. This was followed by inadequate extension services, which limited access to technical support and guidance. Labour shortages further added to the challenges during various stages of cultivation. Farmers also reported difficulties in obtaining inputs on time and highlighted the inconvenience of sourcing

them from distant markets. Concerns were raised about the quality of inputs, while insufficient delivery was considered a relatively minor issue due to the general availability of input suppliers.

Table 26: Constraints in the input sub-system

Sr. No.	Constraints	WAM	Rank
1	Increasing prices	4.44	1
2	Less extension service	3.83	2
3	Unavailability of labour	3.18	3
4	Availability on time	2.92	4
5	Long distance of the input market	2.59	5
6	Quality of input	2.01	6
7	Insufficient delivery	1.78	7

Source: Field Survey (2017)

Constraints in the marketing sub-system

In papaya marketing, the major constraint was the lack of remunerative prices, which discouraged continued cultivation. Labour shortages further affected harvesting and handling operations, while delayed payments created financial uncertainty. Other constraints included long distances to markets and commission charges by suppliers and pre-harvest contractors, which reduced farmers' net returns. Spoilage due to pest damage and poor post-harvest handling also contributed to losses. Less prominent issues were inadequate infrastructure, limited market information, high transportation costs, and the requirement of large space for post-harvest management.

Table 27: Constraints in the marketing sub-system

Sr. No.	Constraints	Garrett Score	Mean Value	Garrett Rank
1	Do not get the proper price	9580	79.83	1
2	Unavailability of labour	8296	69.13	2
3	Delayed payment	7617	63.48	3
4	Distance market	6939	57.83	4
5	Commission problem	6155	51.29	5
6	Spoilage of fruits	5749	47.91	6
7	Higher cost of transportation	5018	41.82	7
8	Large space required for post-harvest handling	4465	37.21	8
9	Lack of market information	3274	27.28	9
10	Improper Infrastructure	2667	22.23	10

Source: Field Survey (2017)

Constraints in post-harvest management

The major constraint in post-harvest management was the lack of adequate technology to minimize spoilage and maintain quality. This was followed by low awareness among farmers and market intermediaries regarding proper post-harvest practices. Limited knowledge of grading and standardization further affected the market value of produce. Improper

handling by labourers and the use of unsuitable packaging materials also contributed to quality deterioration. Other constraints included the absence of pre-cooling and storage facilities, excess market supply, improper harvesting methods, and limited training and awareness programs.

Table 28: Constraints in post-harvest management

Sr. No.	Constraints	Garrett Score	Mean Value	Garrett Rank
1	Inadequate post-harvest technology	8252	68.77	1
2	Awareness related to post-harvest management	8193	68.28	2
3	Grading & standardization problem	7414	61.78	3
4	Improper handling after harvesting	6547	54.56	4
5	Unsuitable packaging materials	6098	50.82	5
6	Wide gap in technology available and awareness	5699	47.49	6
7	Excess supply in markets	5249	43.74	7
8	Absence of pre-cooling and storage facility	5222	43.52	8
9	Improper harvesting method	3863	32.19	9
10	Lack of training problems and awareness campaign	3223	26.86	10

Source: Field Survey (2017)

Lime

Constraints in the input sub-system

In lime cultivation, the major constraint in the input sub-system was the rising cost of inputs, which significantly affected production. This was followed by labour shortages, creating difficulties during critical farm operations. Limited extension services further restricted farmers' access to timely technical guidance. Other constraints included delays in input availability, concerns regarding input quality, and the long distance to input markets. However, insufficient delivery was considered a minor issue, as input outlets were generally accessible in most villages.

Table 29: Constraints in the input sub-system (n = 60)

Sr. No.	Constraints	WAM	Rank
1	Increasing prices	4.66	1
2	Unavailability of labour	3.49	2
3	Less extension service	3.38	3
4	Availability on time	2.92	4
5	Quality of input	2.04	5
6	Long distance of the input market	1.91	6
7	Insufficient delivery	1.33	7

Source: Field Survey (2017)

Constraints in the marketing sub-system

In the marketing sub-system of lime, the primary constraint was the lack of remunerative prices, which has led many farmers to shift towards more profitable vegetable crops. Labour shortages, coupled with rising wage rates, further reduced the viability of lime cultivation. High transportation costs, particularly due to compulsory sales through APMC markets, added to farmers' financial burden. Commission charges by wholesalers in both local and distant markets also reduced net returns. Other constraints included inadequate cold storage facilities, spoilage during handling and transit, lack of timely market information, and delayed payments. Although APMCs provide immediate payment, the prices offered are often lower, discouraging farmers.

Table 30: Constraints in the marketing sub-system

(n = 60)

Sr. No.	Constraints	Garrett Score	Mean Value	Garrett Rank
1	Do not get the proper price	4707	78.45	1
2	Unavailability of labour	4304	71.73	2
3	Higher cost of transportation	3797	63.28	3
4	Commission problem	3473	57.88	4
5	Distance market	3118	51.97	5
6	Delayed payment	2827	47.12	6
7	Large space required for post-harvest handling	2540	42.33	7
8	Lack of market information	2081	34.68	8
9	Spoilage of fruits	1865	31.08	9
10	Improper Infrastructure	1168	19.47	10

Source: Field Survey (2017)

Constraints in post-harvest management

Although lime is harvested at an unripe stage, resulting in relatively low post-harvest losses, several constraints affect its management. The major constraint was inadequate post-harvest technology, limiting efficient handling, storage, and quality maintenance. Limited awareness among farmers and market intermediaries further aggravates the problem. Issues such as lack of grading and standardization, seasonal oversupply leading to price fluctuations, and use of unsuitable packaging materials contribute to inefficiencies. Moreover, gaps between available technologies and awareness, along with improper handling by labourers, were commonly reported. The absence of proper storage and pre-cooling facilities, improper harvesting methods, and lack of training programs further constrain effective post-harvest management.

Table 31: Constraints in post-harvest management
(n = 60)

Sr. No.	Constraints	Garrett Score	Mean Value	Garrett Rank
1	Inadequate post-harvest technology	4548	75.80	1
2	Awareness related to post-harvest management	4205	70.08	2
3	Grading & standardization problem	3723	62.05	3
4	Excess supply in markets	3355	55.92	4
5	Unsuitable packaging materials	3183	53.05	5
6	Wide gap in technology available and awareness	2911	48.52	6
7	Improper handling after harvesting	2472	41.20	7
8	Absence of pre-cooling and storage facility	2374	39.57	8
9	Improper harvesting method	1649	27.48	9
10	Lack of training problems and awareness campaign	1460	24.33	10

Source: Field Survey (2017)

Conclusion

The findings of the study revealed that short-duration crops such as papaya and banana offer higher profitability and quicker returns, with papaya emerging as the most economically viable crop, followed by banana. In contrast, mango and lime, being long-duration or input-intensive crops, exhibited relatively lower profitability. The analysis of marketing channels indicates that the presence of multiple intermediaries significantly increases marketing costs and price spread, thereby reducing the producer's share in consumer's rupee. Shorter and more direct marketing channels were found to be more efficient across all crops, ensuring higher returns to farmers and lower prices for consumers. Constraint analysis highlights that rising input costs, labour shortages, lack of remunerative prices, and inadequate post-harvest infrastructure are the key challenges affecting the sustainability of fruit cultivation in the region. Post-harvest losses, driven by poor handling, lack of storage facilities, and limited awareness of improved technologies, further reduce farm profitability. The

study underscores the need to promote direct marketing channels, strengthen cold chain and storage infrastructure, improve access to market information, and enhance extension services. Adoption of these measures can significantly improve marketing efficiency, reduce losses, and enhance the income and sustainability of fruit growers in Middle Gujarat. Strengthening local markets, digital platforms and farmer-consumer linkages, along with promoting high-return crops like papaya and banana, can significantly enhance the economic sustainability of fruit growers in Middle Gujarat.

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