Asian Journal of Agricultural Extension, Economics & Sociology

Volume 42, Issue 9, Page 121-132, 2024; Article no.AJAEES.122679
ISSN: 2320-7027

An Economic Analysis of Production and Marketing of Banana in Middle Gujarat

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ajaees/2024/v42i92547

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/122679

Original Research Article

Received: 23/06/2024
Accepted: 01/09/2024
Published: 05/09/2024

ABSTRACT

India is the second largest producer of fruits in the world (horticultural statistics at a glance 2018) and area, production and productivity of banana has increased over the years in Gujarat as well as in middle Gujarat also. In middle Gujarat, banana is one of the major fruit crop which is economically viable to the farmers as it gives higher return, so there is need to study the economics of fruit cultivation. Different cost for banana cultivation was calculated using cost concept. Different

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Cite as: *Pundir, R. S., D. R. Vahoniya, Ritambhra Singh, and Alvira Rajwadi. 2024. "An Economic Analysis of Production and Marketing of Banana in Middle Gujarat". Asian Journal of Agricultural Extension, Economics & Sociology 42 (9):121-32. https://doi.org/10.9734/ajaees/2024/v42i92547.*

marketing channel was identified and marketing efficiency was calculated using Acharys's formula. The study revealed that the cost A was ₹ 278397.31 per ha and cost C_2 was ₹ 396162.82 per ha for banana cultivation and benefit cost ratio over cost C_2 was 2.06. There were three marketing channels identified in middle Gujarat region. Marketing efficiency was higher in channel IV, which was 1.23. Unavailability of labour, increasing prices of inputs and unavailability on time of inputs were the major production constraints faced by farmers. Not getting proper price for produce, unavailability of labour and higher commission charges were the major marketing constraints faced by farmers. They suggest to focus on to strengthen supply chain through formation of FPOs, so the problems related to inputs and output prices can be solved. And with the help of new mechanical advancement problem of post-harvest losses and labour shortage can be solved.

Keywords: Banana; cost concept; marketing efficiency.

1. INTRODUCTION

The varied climate of India enables the availability of fresh fruits and vegetables. In terms of global fruit and vegetable output, it comes in second place to China. India produced 204.84 million metric tonnes of vegetables and 107.24 million metric tonnes of fruits in 2021–2022, according to the National Horticulture Database (apeda.gov.in). Fruit farming accounted for 7.5 million hectares, whilst vegetables were grown on 11.35 million hectares (apeda.gov.in).

In terms of fruit production, the nation leads in the production of bananas (25.7%), papayas (43.6%), and mangoes (which include guavas and mango teenagers) (40.4%) [1,2]. The majority of fruits exported from the nation are grapes, pomegranates, mangoes, bananas, and oranges, whilst the majority of vegetables exported are onions, mixed vegetables, potatoes, tomatoes, and green chilies (apeda.gov.in).

Currently, India has only 1% market share worldwide, but the horticultural products of the country are more popular. Concurrent advancements in cutting-edge cold chain infrastructure and quality control procedures are to blame for this [3-5]. In addition to significant investments made by the private sector, the government has also taken the initiative, and with the help of APEDA, a number of integrated post-harvest handling facilities and centres for perishable cargo have been established across the nation [6-9]. Initiatives aimed at increasing capacity among farmers, processors, and exporters have also aided in this endeavour (apeda.gov.in).

1.1 Fruits: Overall Scenario

The National Horticulture Board released data showing that between 2001–02 and 2016–17, the area under cultivation in India expanded by 61 per cent, from 4010 thousand hectares to 6480 thousand hectares, while in Gujarat, the rise was 236 percent, from 198 thousand hectares to 420 thousand hectares. Production and productivity rose by 115 and 33 per cent, respectively, in India during the same period. In Gujarat, fruit crop production jumped by 236 per cent to 8953 thousand tonnes between 2001-02 and 2016-17 [10-13]. Gujarat's fruit production increased at double the national average rate. Gujarat's fruit productivity increased from 13.43 t/ha in 2001–02 to 21.31 t/ha in 2016–17 (apeda.gov.in).

1.2 Banana

Table 1 shows a comparative picture of area, production, productivity of banana between Gujarat, and all India from 2005-06 to 2021-22. It reveals a comparative situation of area, production and productivity of banana in state of Gujarat as a whole and India from 2005-06 to 2021-22.

All India area under banana increased by 69.03 per cent, whereas for the state of Gujarat as a whole banana area increased by 22.15 per cent. In terms of banana production, the production of banana increased from 18927 thousand tonnes in 2005-06 to 34527 thousand tonnes in 2021-22, whereas for the state of Gujarat banana production increased by 58.94 per cent (2498.80 thousand tonnes in 2005-06 to 3971.60 thousand tonnes in 2021-22). All India productivity of banana increased by 7.92 per cent to 35.87 t/ha in 2021-22 from 33.23 t/ha in 2005-06. While state as a whole it decreased by 30.13 per cent (50.79 t/ha in 2005-06 to 66.09 per cent in 2021-22).

Table 2 exhibited the area, production and productivity of banana in Middle Gujarat from

2005-06 to 2021-22. It can be seen from the table that in middle Gujarat area under banana cultivation increased by 55.36 per cent from 17970 hectares to 27918 hectares. Production of banana increased from 829270 tonnes to 1683069 tonnes with a CAGR of 4.03 per cent over a period of time. Productivity of banana in Gujarat also showed an increasing trend. The productivity of banana was increased by 42.71 per cent over the years.

Table 1. Area, Production and Productivity of Banana over the years 2005-06 to 2021-22

Year	Gujarat			All India		
	Area ('000 ha)	Production ('000 t)	Productivity (t/ha)	Area ('000 ha)	Production ('000 t)	Productivity (t/ha)
2005-06	49.2	2,498.80	50.79	569.5	18,927.00	33.23
2006-07	53.4	2,912.60	54.54	604	20,998.00	34.76
2007-08	57.7	3,157.70	54.73	657.8	23,823.00	36.21
2008-09	60.9	3,571.60	58.68	708.8	26,217.20	36.99
2009-10	61.9	3,779.80	61.04	770.3	26,469.50	34.36
2010-11	64.7	3,978.00	61.50	830.5	29,779.90	35.86
2011-12	65	4,047.80	62.24	796.5	28,455.10	35.73
2012-13	70.6	4,523.50	64.09	776	26,509.10	34.16
2013-14	66.5	4,225.50	63.54	802.6	29,724.50	37.04
2014-15	67	4,324.40	64.52	821.8	29,221.50	35.56
2015-16	64.7	4,185.50	64.70	841.2	29,134.80	34.64
2016-17	66.3	4,293.20	64.75	860	30,477.20	35.44
2017-18	68.1	4,472.30	65.63	883.8	30,807.50	34.86
2018-19	70.2	4,610.60	65.70	866.3	30,459.70	35.16
2019-20	69.5	4,627.50	66.55	896.8	32,596.90	36.35
2020-21	59.3	3,907.20	65.94	924.1	33,061.80	35.78
2021-22	60.1	3,971.60	66.09	962.6	34,527.90	35.87
% Change	22.15	58.94	30.13	69.03	82.43	7.92
CAGR (%)	1.12	2.55	1.41	2.70	2.84	0.14

Source: Commodities.cmie

Table 2. Area, Production and Productivity of Banana over the years 2005-06 to 2016-17 in Middle Gujarat

Year	Middle Gujarat		
	Area (ha)	Production (t)	Productivity (t/ha)
2005-06	17970	829270	46.15
2006-07	19950	961070	48.17
2007-08	21510	1074190	49.94
2008-09	23480	1356410	57.77
2009-10	23990	1459710	60.85
2010-11	24670	1495220	60.61
2011-12	24940	1520060	60.95
2012-13	27820	1749720	62.89
2013-14	25490	1606670	63.03
2014-15	24750	1579340	63.81
2015-16	25110	1599940	63.72
2016-17	25480	1619700	63.57
2017-18	26178	1683069	64.29
2018-19	27240	1764950	64.79
2019-20	27617	1822630	66.00
2020-21	27686	1816086	65.60
2021-22	27918	1838541	65.86
% Change	**55.36**	**121.71**	**42.71**
CAGR (%)	**2.08**	**4.03**	**1.91**

Source: doh.gov.in

As mentioned, banana is one of the major fruit crop of country as India is the largest producer of it. In Gujarat state also the area, production and productivity of the crop has increased over the years. In Middle Gujarat region also, the area, production and productivity has increased over the years. These shows that farmers were shifting to banan cultivation as the return from the crop was higher. This leads to study the economic ananlysis and marketing channel of the crop to identify the most efficient channel and to measure the economic viability of banana crop.

2. MATERIALS AND METHODS

2.1 Area of Survey

The study was conducted in Middle Gujarat which comprises of nine districts namely, Anand, Kheda, Vadodara, ChhotaUdepur, Ahmedabad, Botad, Dahod, Panchmahal and Mahisagar. For banana, the data was collected from Anand, Vadodara, and Chhota Udepur district as they were having highest area and production of banana.

2.2 Source of Data

Primary Data was collected through survey method with the help of well-structured pre-tested schedule. For banana, marketing channels were found during the primary data collection. The secondary data in respect of area and production of banana crop were collected from the records and reports of the Directorate of Horticulture and statistics, Government of Gujarat.

2.3 Period of Study

Primary data was collected in agricultural year 2016-17. Farmers, commission agents, village-level traders, pre-harvest contractors, wholesalers, traders and retailers from Middle Gujarat selected as sampling unit. Table 4 shows the numbers of farmers, traders, wholesalers and retailers, which were selected as sample from the selected districts.

Table 3. Distrcit wise area and production of banana in Middle Gujarat in 2015-16

Sr. No.	Name of Districts	Area (Ha)	Production (MT)
1	Ahmedabad	163	7884
2	**Anand**	**12560**	**778092**
3	Panchmahal	520	19760
4	Dahod	0	0
5	**Vadodara**	**5842**	**397080**
6	Kheda	801	44839
7	Mahisagar	112	4720
8	Botad	5	210
9	**ChhotaUdepur**	**5100**	**347565**

Source: Directorate of Horticulture, 2015-16

Table 4. Sampling unit

Crop	Districts	No of Farmers	No of Commission Agents/Village level Traders	Wholesalers/Pre-Harvest Contractors	Retailers
Banana	Anand	80	20	20	10
	Vadodara	80	20	20	10
	Chhota Udepur	80	20	20	10
	Total	**240**	**60**	**60**	**30**

3. ANALYTICAL TOOLS AND TECHNIQUES

3.1 Cost Concepts

The cost concept (CACP approach) was used to calculate cost and return analysis. Here, Cost A is also referred as operating cost or paid out cost and Cost C_2 is also referred as total cost.

Cost A=	Value of hired human labour + Value of bullock labour (owned / hired) + Value of seeds (owned / purchased) + Value of manure (owned / purchased) + Value of fertilizer + Value of pesticides and insecticides + Irrigation charges + Charges for machineries (owned / hired) + Other paid out expenses if any + Depreciation on farm building and implements + Interest on working capital
Cost B=	Cost A + Rental value of owned land + Interest on fixed capital assets (excluding land)
Cost C_1=	Cost B + Imputed value of family labour
Cost C_2=	Cost C_1 + 10 per cent of the Cost C_1 as a managerial charges

3.2 Marketing Efficiency

Marketing efficiency was calculated using Acharya's Modified measure of Marketing Efficiency (MME), which states;

$$MME = [RP \div (MC+MM)]-1$$

Where, ME is Index of marketing efficiency, RP is price paid by the consumer, MC is total marketing cost, MM is net marketing margin.

3.3 Producer Share in Consumer Rupee (PS) was Calculated as Below

$$PS = (PF/PR)*100$$

Where,

PF is net price received by the producer,
PR is retail price (price paid by the consumer)

3.4 Price Spread

It is the difference between the two prices, *i.e*., the price paid by the consumer and the price received by the producer. e.g. P_1-P_2,

Where,
P_1 is price at one level or stage in the market,
P_2 is price at another level

3.5 Garrett's Ranking Technique

To find the most significant constraint influencing the stakeholders in the existing fruits commodity system, Garrett's Ranking Technique was employed. It was calculated as percentage score and the scale value was obtained by employing Scale Conversion Table given by Henry Garrett.

The Percentage Score is calculated as,

$$\text{Percent score} = 100(R_{ij}-0.50)/ N_{ij}$$

- Where, R_{ij} is Rank given for i^{th} constraint by j^{th} individual
- N_j is Number of constraints ranked by j^{th} individual

The percent position of each rank was converted into scores using Garrett's Table. For each constraint, scores of individual respondents were added together and were divided by total number of respondents who responded. Thus, mean score for each constraint was ranked by arranging them in descending order.

4. RESULTS AND DISCUSSION

The cost incurred by farmer in banana cultivation is shown in below Table 5. Table shows that among all working costs per hectare labour cost (hired + family) was higher (₹ 101064.60), followed by manures and fertilisers cost (₹ 75008.60) and planting material cost (₹ 48888.84). As the labour cost was found higher in banana cultivation, there is need to use new mechanical advancement.

Table 6 presents different cost of cultivation. Among them Cost A was ₹ 278397.31 per hectare. Cost B was ₹ 347648.02 per hectare and cost C_2 was ₹ 396162.82 per hectare. This shows that the initial working cost was higher in banana cultivation. These findings were similar

with Yadav et al. [14] and Kumar et al. [15]. The cost of cultivation was found higher in banana cultivation necessities farmers to avail different subsidies provided by the National Horticultural Board and central government.

Table 7 exhibits yield, average price and gross income of per hectare banana cultivation. The average yield of banana was 863.80 q per hectare. The average price received by farmers were ₹ 943.24 per quintal and Gross income was ₹ 814770.71 per hectare. In middle Gujarat region, farmers are advised to use prominent variety banana for higher yield.

The per hectare net return over different costs was higher in banana cultivation. Net return over cost A was ₹ 536373.40 per hectare and for cost B was ₹ 467122.70 per hectare. Net return over cost C_2 was ₹ 418607.89 per hectare (Table 8).

The benefit cost ratio over different costs were presented in below Table 9. The table shows that benefit cost ratio over different costs was more than 2, indicating that if farmer spent ₹ 1 in banana cultivation, he will get ₹ 2.06 in return, implies that banana cultivation is beneficial for farmers. The study on banana cultivation revealed the benefit-cost ratio of 1.91 [16].

Table 5. Average Cost of Cultivation (₹/ha)

Sr. No.	Particulars	Banana	Percentage to cost C_2
1	Planting material per Ha	48888.84	12.34
2	Hired labour	88564.60	22.36
3	Manures and fertilizers	75008.60	18.93
4	Plant Protection Chemicals	10200.00	2.57
5	Irrigation	16659.62	4.21
6	Total working capital	251821.66	63.57
7	Interest on working capital	30218.60	7.63
8	Depreciation charges upto 5 years	8857.05	2.24
9	Rental value of land	61700.00	15.57
10	Revenue of land	450.00	0.11
11	Family labour	12500	3.16
12	Fixed Cost	71007.05	17.92
13	Intrest on fixed capital	7100.71	1.79

Source: Filed survey

Table 6. Estimation of different costs (₹/ha)

Different costs	Banana	Percentage to cost C_2
Cost A	278397.31	70.27
Cost B	347648.02	85.75
Cost C_1	360148.02	90.91
Cost C_2	396162.82	100.00

Source: Filed survey

Table 7. Yield, weighted average price and gross income of banana (₹/ha)

Particulars	Banana
Yield (q)	863.80
Weighted average price (₹/q)	943.24
Gross Income (₹)	814770.71

Source: Field survey

Table 8. Net returns over different costs (₹/ha)

Net returns over different costs	Banana
Cost A	536373.40
Cost B	467122.70
Cost C_1	454622.70
Cost C_2	418607.89

Source: Field Survey

Table 9. Benefit Cost ratio over different costs

Input-output ratios	Banana
Cost A	2.93
Cost B	2.34
Cost C_1	2.26
Cost C_2	2.06

Source: Field survey

4.1 Marketing Channels of Banana in Middle Gujarat

As banana cultivation is increasing, it was necessary to know the forward linkages of this crop so in context to know marketing aspects of these crop existing marketing channels, marketing costs, marketing margins, price spread, marketing efficiency were presented in Table 10.

Banana is marketed through four different channels consisting of commission agents, wholesalers, retailers, exporters as intermediaries. The four channels being identified for marketing of banana in the study area is illustrated in Table 10. The most commonly used channels were Channel I and II. 90 percent of the produce was disposed through these channels. It needs to be mentioned that the commission agents play a very crucial role in the marketing of banana. They are spread throughout the area for both the local and distant markets. Large volume of produce is marketed to consumer via commission agents. The number of exporters and processors in banana marketing channels were less in number in the selected study area. The direct route (Channel-IV) from producer to consumer via retailer exists mainly for B grade banana as these are highly perishable in nature. For A grade banana Channel-II is more prevalent as good quality banana is transported to long distant markets like Delhi, Punjab, Rajasthan, Madhya Pradesh *etc*. Channel-I, from producer to consumer via wholesaler and retailer, is prevalent in short distance market (like within the state).

4.2 Channel wise Marketing Cost of Banana in Middle Gujarat

Under Channel-I the marketing cost incurred by different intermediaries *viz*. sample farmers, wholesaler and retailer were: ₹ 101.93/q, ₹ 273.73/q and ₹ 120.92/q, respectively. Channel-II is mostly used for long distance marketing and it includes commission agent also. The marketing costs incurred by different intermediaries were producer (137.43 ₹/q), wholesaler (299.87 ₹/q) and retailer (135.00 ₹/q). In Channel-III (Producer-Exporter-Consumer) the marketing cost incurred by producer was 138.50 ₹/q and exporter was 2400.00 ₹/q. Channel-IV is very short distance marketing and it includes only producers and retailers. The marketing cost incurred by intermediaries were producer (80.93 ₹/q) and retailer (102.00 ₹/q). This finding was similar with Naveen et al*.* [17].

4.3 Price Spread and Marketing Margin in Supply chain of Banana in Middle Gujarat

Margin added by intermediaries in all channels is shown in Table 12. Under Channel-I the marketing margin charged by wholesaler and retailers are ₹ 275/q and ₹ 412/q respectively. In Channel-II the marketing margins charged by commission agent was (62.50 ₹/q), wholesaler (328.13 ₹/q) and retailer (485.12 ₹/q). In Channel-III marketing margin charged by exporter was 775.00 ₹/q; the marketing cost being the highest as exporter charges a higher margin. The maximum expenditure is on transportation 800.00 ₹/q. Under Channel-IV

Table 10. 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 distant market)
Channel III	Producer-Exporter-Consumer
Channel IV	Producer- Retailer- Consumer

Source: Field survey

Table 11. Channel wise marketing cost of Banana in Middle Gujarat (₹/q)

Marketing Cost	Marketing Channels of Banana			
	Channel-I	Channel-II	Channel-III	Channel-IV
Cost Incurred by 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)

**Figures in parenthesis is percentage of total marketing cost*

there are only one intermediaries or it is direct channel from producer to consumer, marketing margin charged by retailer were less 400.00 ₹/q. This finding was similar with Patel et al. [18].

4.4 Marketing Efficiency of Banana in Middle Gujarat

Marketing efficiency is inversely proportional to price spread. Since the price spread (₹ 582.93) is lowest in case of Channel-IV, marketing efficacy is highest (1.23). The next efficient channel is Channel-I (0.97). This channel deals with marketing of produce in nearby areas. It does not include commission agent. Since the area is nearby so farmers directly sell their produce to the wholesaler. In Channel-II, due to the existence of commission agent, its marketing efficiency is 0.77 as the price spread (₹ 1448.05) was more than Channel-I. In Channel-III marketing efficiency is lowest (0.43) due to high marketing costs and margins. Since the produce is marketed to distant places, exporters paid due care towards the packing of the produce and spent more money than other channels to prevent damage and higher acceptance by foreign consumer. Study reveals that in all marketing channels, there is existence of intermediaries which leads to greater price spread. So there is need to strengthen the supply chain of banana through formation of FPO and by doing value addition. Now a days majority of the farmers were found of doing value addition in banana, so there is need to encourage their startups and provide them financial benefits by spreading awareness about existing startup schemes this way more farmers can participate in it.

4.5 Constraints in Banana Cultivation

Major constraints in banana input system reported unavailability of labour which forces farmers to contact pre-harvest contracts with wholesalers and other suppliers, second major problem was higher and increasing

Table 12. Price spread and marketing margin in supply chain of Banana in Middle Gujarat (₹/q)

Particular	Marketing Channels of 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 Producer	101.93 (4.54)	137.43 (5.37)	138.50 (2.93)	80.93 (6.22)
Marketing Cost of Wholesaler	273.73 (12.21)	299.87 (11.71)	-	-
Marketing Cost of Retailer	120.92 (5.39)	135.00 (5.27)	-	102.00 (7.83)
Marketing Cost of 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 Commission agent	-	62.50 (2.44)	-	-
Marketing Margin by Wholesaler	275.00 (12.27)	328.13 (12.81)	-	-
Marketing Margin by Retailer	412.18 (18.39)	485.12 (18.95)	-	400.00 (30.72)
Marketing Margin by 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 Consumer	2240.83 (100.00)	2560.62 (100.00)	4725.65 (100.00)	1302.00 (100.00)

**Figures in parenthesis is percentage of producers shares in consumers rupee*
PSCR= Producer Share in Consumer Rupee

Table 13. Marketing efficiency of Banana in Middle Gujarat (₹/q)

Sr. No.	Particular	Channel-I	Channel-II	Channel-III	Channel-IV
1	Consumer Price/Retailers 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
	Marketing efficiency (MME)				
A	Acharyas Method [1/(2+3)-1]	0.97	0.77	0.43	1.23

Table 14. Constraints in banana cultivation

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

Source: Field survey

the prices of inputs, third was input unavailability on time, while fourth major constraint was quality of inputs followed by less extension service, insufficient delivery and least affected constraint was input source far from farm. These findings were similar with Karamshibhai et al., [19] as they found the same constraint in banana production in Navi Mumbai. These constraints was directly focusing on formation of FPOs so that cheap inputs can be available at timely. The farmers needs to focus on using new mechanical instruments for harvesting so that the problem of labour scarcity can be solved. The post-harvest loss was higher in case of banana due improper handling while harvesting and transportation, this directly aims to use machine for harvesting and advanced packaging material.

4.6 Constraints in Marketing and Selling of Banana

Another aspect in supply chain is marketing sub system, in banana marketing channel there was constraints like spoilage of fruits while harvesting, unsuitable harvesting methods, space required for post-harvest handling, price and payment issue, distance market, high cost of transportation, labour problem for harvesting and packaging, lack of market information, commission taken by wholesalers and suppliers, insufficient market infrastructure as results shows in Table 15 most ranked constraint was price as farmers were unable to get fair price of their produce, second major constraint was insufficient labour for harvesting and packaging followed by

Table 15. Constraints in marketing and selling of banana

Sr. No.	Constraints	Garrett Score	Mean Value	Garrett Rank
1	Not getting proper price of produce	19023	79.26	1
2	Unavailability of labour	16828	70.12	2
3	Higher commission charges	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	Long Distance market	8567	35.70	8
9	Lack of market information	7470	31.13	9
10	Infrastructure problem	4917	20.49	10

Source: Field survey

commission taken by suppliers and wholesalers, delay in releasing of payments. Least ranked problems was lack of market information as farmers didn't require market information as banana channel was not following APMC channel, and distance of market as banana was taken from farm by suppliers. These findings were similar with Karamshibhai et al., [19].

5. CONCLUSIONS

It has been concluded that among different costs of cultivation the per hectare labour cost was higher (₹ 101064.60) in banana cultivation followed by manures and fertiliser cost (₹ 75008.60) and planting material charges (₹ 48888.84). Cost C_2 was ₹ 396162.82 per hectare for banana cultivation. The average price received by farmers was found to be at ₹ 943.24 per quintal and gross return was ₹ 814770.71 per hectare. The net return over cost C_2 was found to be ₹ 418607.90 while the benefit-cost ratio was 2.06. The study found the four-marketing channel in banana. Channel IV was found to be most efficient channel with efficiency of 1.23. The study also revealed that unavailability of labour and increasing prices of inputs identified as the major production problem faced by farmers, while not getting better price of produce, unavailability of labour and higher commission charges identified as the major marketing problem faced by farmers.

6. SUGGESTIONS

It was suggested that as net return and benefit cost-ratio was higher in banana cultivation. Farmers should be encouraged to grow more banana and marketed it through channel IV as it having higher marketing efficiency. The study suggests to use new mechanical measures for harvesting of banana to overcome the problem of labour shortage. In middle Gujarat, there are more numbers of storage units and ripening centres for banana, farmers needs to use them properly to reduce their losses and to improve quality of their produce. The study further suggests that, there is need to strengthen the supply chain of banana by formation of FPOs and by participating in contract farming. So the inputs can be made available at affordable rate and farmers can get better prices for their produce. Nowadays farmers of middle Gujarat has started the value addition in banana crop, so there is need to spread awareness regarding existing government schemes related to value addition and startup so more farmers can get benefit of it, for that extension services needs to be strengthen.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/122679