

Original Research Article

A Study of Supply Chain and Estimation of Post-Harvest Losses in Banana in Middle Gujarat

Abstract

The present study has examined the marketing efficiency and price spread of different existing channels and Post harvest losses in Banana. The shortest route to customers i.e. Channel IV was the most efficient channel. Channel III was less efficient than other channels as the marketing costs involved in this channel was higher. Channel I and II were mostly used for marketing of produce to local and distant markets. Marketing efficiency is inversely proportional to price spread. Since the price spread is lowest in case of Channel IV, marketing efficiency is highest (1.37). The next efficient channel is Channel I (0.93). As the number of intermediaries increases the channel becomes less efficient. To increase the efficiency the producer should be able to contact customers directly. Post-harvest losses is a matter of grave concern. It was found that PHL was higher at wholesaler level (7.23 percent) followed at producer's level (6.59 percent) and then at retailer's level (4.41 percent). Creation of cold storage structures, establishment of ripening centres and processing units, providing refrigerated trucks for long distance transportation etc. are required to strengthen the supply chain of Banana.

Key words- Post harvest loss, Market Efficiency, Price Spread, Supply chain, Channels

Introduction

Banana is the most popular fresh fruit all over the world and its name comes from the Arabic word 'banan', which means finger. The scientific name of Banana is *Musa acuminata* and *Musa balbisiana*. But the old scientific names of banana are *Musa sapientum* and *Musa paradisiacal*. Bananas are rich source carbohydrates and potassium.

Banana, cultivated in an area of 860 thousand ha with a total production of 30477 thousand MT is an important tropical and sub-tropical crop (APEDA 2017). The global production of Banana is around 102028.17 thousand tons. India's share in world production is 29.19 percent. Total fruit production in Gujarat is 9026.79 thousand MT from 415.34 thousand hectare area (APEDA, 2017). Main banana growing states are Tamil Nadu, Maharashtra, Gujarat, Andhra Pradesh and Karnataka.

Being perishable in nature, the post-loss is a matter of grave concern in fruit crops specially banana. Long distance transportation, lack of cold storage facilities and ripening centres etc. result in increase in losses. The prices fluctuate frequently hampering the efforts of growers. In this back drop, the study was conducted with following objectives:-

1. To investigate the existing supply chain and existing market infrastructure of Banana
2. To examine the efficient marketing channel of Banana
3. To identify the post-harvest losses in existing marketing channels of Banana

44 **Review Literature**

45 **Marketing efficiency**

46 **Gandhi and Namboodiri (2002)**, has studied that the poor efficiency in the
 47 marketing channels and poor marketing infrastructure leading to high and fluctuating
 48 consumer prices and only a small portion of the consumer rupee reaching the
 49 farmers. The study examined these aspects in regulated wholesale markets for fruits
 50 and vegetables in Ahmedabad City area. These regulated markets were established
 51 to improve the marketing efficiency. The system of sale followed in these markets
 52 indicated that open auction as a system of sale is yet to take roots in these markets
 53 and the marketing system was dominated by open auction or secret bidding resulting
 54 to significant erosion of marketing efficiency. Analysis of marketing costs indicated
 55 that on an average they hover around 8 percent of the consumer price for vegetables
 56 11 to 15 percent for fruits. On an average the share of in consumer rupee was hardly
 57 48 percent for vegetables and 37 percent for fruits. The study suggests that
 58 regulated wholesale markets can help in improving the marketing efficiency by
 59 promoting direct contact with the farmers, increasing the number of buyers and
 60 sellers in the market, promoting open auction system of marketing and strengthening
 61 or introducing facilities and services such as godown, cold storage, transparency and
 62 access to internal and external market environment.

63 **Chandrakar et al. (2015)**, examined the constraints in Banana production and
 64 supply chain management of Banana in Raipur district of Chhattisgarh. The study
 65 was based on the response collected personally from 30 Banana growers, selected
 66 purposely from four villages of Raipur district of Chhattisgarh state. It was found that,
 67 most of the respondent belonged to other backward caste, school educated and
 68 were having large size of land holding. They mostly performed irrigated agriculture
 69 with an average area of 2.17 ha. under Banana cultivation, overall on an average
 70 cropping intensity was observed to be 259.89 per cent. Consumption of Banana was
 71 found very low and farmers prefer to sell more than 99.08 per cent of their total
 72 produce in mostly through channel-I involving wholesaler. Charges were having
 73 highest share of marketing cost in both the channels of marketing. The producer
 74 receives same amount by selling through both the channels of marketing. High
 75 temperature and problem of electricity, lack of improved varieties for Banana
 76 cultivation were found as most important constraints faced by the Banana growers.
 77 Similarly, lack of processing industry, storage, fluctuation of price and regulated
 78 marketing system was reported as most important constraint faced by the farmers
 79 during supply chain management of Banana. During summer season due to high
 80 temperature the leaves of Banana is badly damaged due to sunstroke. Varieties
 81 which are capable to resist high temperature is to be evolved. An extensive survey is
 82 done to study the problem and suggestion are given here to improve the supply
 83 chain management of banana in Raipur district of Chhattisgarh.

84 **Post-Harvest Losses**

85 **Madan and Ullasa (1991)**, surveyed and conducted in mango orchards, markets
 86 and processing units in Karnataka, India, to determine the extent and causes of

87 postharvest losses in mango. The technology to reduce post harvest losses had not
88 been used by the farmers and other participants in the mango marketing system.

89 **Paull et al. (1997)**, reported that Papaya [pawpaw] fruit post harvest losses up to
90 75% have been reported to Hawaii shippers by mainland USA wholesalers and
91 retailers. These losses are often blamed on decay; this decay can be associated with
92 storing colour break fruits for more than 3 weeks at 10 degrees C or lower
93 temperatures. A number of non-pathological fruit disorders are seen in retail
94 markets, with some confusion amongst personnel as to the cause. 'Soft' fruit, for
95 example, can be caused by mechanical impact injury of ripening fruits. Evaluation of
96 postharvest losses is considered in relation to the variation and limitations in ripening
97 and storage facilities in the current handling system.

98 **Shivashankar (1999)**, studied and concluded that it is possible to select for longer
99 green life which would help in avoiding post-harvest losses in transportation and
100 storage. The identification of accessions with shelf life of 8- 10 days compared with 6
101 days in the control is a highly significant feature of the study, as commercialization of
102 such cultivars would significantly reduce the losses occurring in the post ripening
103 phase. Since the final choice of a variety for commercial production depends upon
104 many other factors like resistance to diseases, insect pests and nematodes,
105 agronomic yield and above all consumer preferences, more studies would be
106 needed in these directions.

107 **Gajanana (2002)**, analyzed the marketing practices of Poovan variety of banana in
108 Trichy district of Tamil Nadu state, India, and to estimate the losses at different
109 stages of handling in the major marketing channels. Data on marketing and
110 postharvest losses at field level, market level and at the retail level were collected
111 during March-April 2001 from the growers of Trichy and Lalgudi taluks of the study
112 district.

113 **Davara and Patel (2009)**, assessed the post harvest losses (at field, traders' and
114 processors' level) in Gujarat. The effect of various ripening methods on post harvest
115 losses in five varieties viz., Robusta, Grande Naine, Sona, Mahalaxmi and
116 Shreemanthi were determined. The study revealed that overall post harvest loss in
117 banana after harvesting till ripening was found to be 15.43%, which included losses
118 at field level (0.77%), at trader's level comprising of transportation and handling
119 losses (5.86%) as well as ripening losses (8.80%). Only negligible losses were
120 observed during processing of banana. The highest loss (16.00%) was observed in
121 the case of smoking + room temperature method of ripening, while the lowest
122 (4.66%) was observed under ethephon + air-cooled chamber method. Ethephon +
123 ice treatment method resulted in ripening loss to the tune of 7.43%, but the method
124 was most widely adopted in Gujarat owing to its convenience and better appearance
125 of bananas after ripening.

126 **Nath et al. (2014)**, found that post-harvest deterioration is the most important cause
127 of loss in banana production and this is mainly as a result of microbial invasion of the
128 fruits. The research was carried out to identify and control the fungal organism
129 responsible for post-harvest deterioration of banana fruits. Mancozeb, carbendazim,
130 propiconazole and SAAF at tested concentration were used as antifungal agents and

the susceptibility of four, of the isolated major pathogenic fungi to them was observed in culture. The tested organisms were Lasiodiplodia theobromae Pat.Griffth and Maubl, Fusarium moniliformae Sheld, Fusarium sp. and Aspergillus niger van Tiegh. Maximum disease control of 98.76 per cent and 98.67 per cent of fruit rot was observed in propiconazole and SAAF treated fruits, respectively followed by carbendazim (96.79%) under storage condition up to eating ripe stage.

Research Methodology

- i. **Sampling unit:** Farmers, Commission agents and Traders
- ii. **Sample Size:** 120 farmers, 20 commission agents, 20 traders
- iii. **Sampling Method :**Non-probability sampling
- iv. **Sampling Technique:** Purposive Sampling
- v. **Research Approach:** Survey
- vi. **Research Instrument:** Schedules
- vii. **Area of Survey:** Middle Gujarat (Anand, Vadodara and Chota Udaipur)

Analytical Tools

To work out the marketing efficiency of Banana, Acharya method was used. The marketing cost was estimated by using following formula:

$$C = C_f + C_{m1} + C_{m2} + C_{m3} + \dots + C_{mi}$$

where,

C = total cost of marketing of the commodity;

C_f = cost paid by the producer from the time the produce leaves the farm till sells and

C_{mi} = cost incurred by the ith middleman in the process of buying and selling of the product

$$\text{Marketing Efficiency (Acharya's Method)} = \frac{NP_F}{MC+MM}$$

where,

NP_F = Net price received by farmer

MC = Total marketing cost

MM = Total marketing margin

Results and Discussion

In Gujarat there are 753 cold storages with a capacity of 2875713 MT. In Middle Gujarat following is the list of cold storages:

Districts	Private	Public	Total
Ahmedabad	32	2	34
Kheda	70	3	73
Panchmahal	0	1	1
Vadodara	18	2	20
Total	120	8	128

Source- www.agriexchange.apeda.gov.in

Marketing Channels

Banana is marketed through four different channels consisting of commission agents, wholesaler, retailer, exporter as intermediaries. The four channels being identified for marketing of banana in the study area is illustrated in the following table:

Table: 1 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

The most commonly used channels were Channel II and III. 90 percent of the produce was disposed of 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 which is marketed to consumer is via commission agents. The number of exporters and processors in banana marketing channel were less in number in the selected study area. The direct route (Channel I) from producer to consumer via retailer exists mainly for B grade banana as these are highly perishable in nature. For A grade of banana Channel II is more prevalent as good quality of banana are transported to long distant markets like Delhi, Punjab, Rajasthan, MP etc.

Marketing Efficiency

Table 2: Marketing Costs, Margins and Price Spread for Banana

Marketing Cost (Rs/qtl)	Marketing Channel of Banana			
	Channel-I	Channel-II	Channel-III	Channel-IV
Net price received by the producer	998.07	1112.57	1411.50	719.07
i) Labour cost	24.93	24.93	30.00	24.93
ii) Commission	0.00	25.00	-	-
iii) Post Harvest Loss	77.00	87.50	108.50	56.00
Total (i to iv)	101.93	137.43	138.50	80.93
Commission agents price	1100.00	1250.00	-	-

Cost incurred by the commission agent				
Commission agents margin	0.00	62.50	-	-
Wholesaler cum processor price	1100.00	1312.50	-	-
Cost incurred by the Wholesaler cum processor				
i) Transportation	33.33	45.00	-	-
ii) Loading & Cleaning	46.66	25.00	-	-
iii) Packing material	19.56	28.67	-	-
iv) Labour cost	0.00	10.00	-	-
V) Processing	66.66	66.66	-	-
vi) Post Harvest Loss	107.52	134.54	-	-
Total (i to vi)	273.73	309.87	-	-
Wholesaler cum processor margin	275.00	328.13	-	-
Retailers price	1648.73	1950.50	-	800.00
Cost incurred by the Retailer				
i) Transportation	55.00	55.00	-	55.00
ii) Packing material	0.00	0.00	-	15.00
iii) Post Harvest Loss	65.92	80.00	-	32.00
Total (i to iii)	120.92	135.00	-	102.00
Retailers margin	412.18	487.62	-	400.00
Exporters Price	-	-	1550.00	-
Cost incurred by the Exporter				
i) Cleaning /Grading/Packing	-	-	200.00	-
ii) Packing material	-	-	500.00	-
iii) Processing	-	-	200.00	-
iv) Transportation	-	-	800.00	-
v) Commission	-	-	100.00	-
vi) Labour Cost	-	-	400.00	-
vii) Post Harvest Loss	-	-	200.65	-
Total (i to vii)	-	-	2400.65	-
Exporters margin	-	-	775.00	-
Consumers price	2181.83	2573.12	4725.65	1302.00
Total marketing cost	496.58	582.30	2539.15	182.93
Total marketing margin	687.18	878.25	775.00	400.00
Price Spread	1183.76	1460.55	3314.15	582.93
Producer's Share in Consumer's Rupee	0.46	0.43	0.30	0.55
Marketing efficiency (Acharya's Method)	0.93	0.86	0.47	1.37
Source- Primary Survey				

184

185 The marketing costs, marketing margin, post-harvest losses and marketing efficiency
186 are presented in table no. 1. It is observed that the most efficient is channel IV
187 although small volume of produce is transferred through this smallest channel. The
188 marketing costs is Rs.182.93 per quintal which is lowest as compared to other
189 channels. The producer's share in consumer rupee is highest (55 percent) in this

channel as the number of intermediaries involved is less. More the number of intermediaries less will be the share of producer in consumer's rupee and thus the efficiency of the channel will also be less. This channel is not that much prevalent because the price received by the farmer is less.

Under Channel I the marketing costs incurred by different intermediaries viz. sample farmers, wholesaler and retailer were: Rs.101.93/q, Rs.273.73/q and Rs.120.92/q respectively. The marketing margins charged by wholesaler and retailer are Rs.275/q and Rs.412/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 (Rs/q 137.43), wholesaler (Rs/q 309.87) and retailer (Rs.135.00). The marketing margins charged by commission agent was (Rs/q 62.50), wholesaler (Rs/q 328.13) and retailer (Rs/q 487.62). The share of wholesaler in consumer's rupee was 51 percent, retailer's share was 75.80 percent. In channel I wholesaler's share in consumer rupee was 50.42 percent whereas retailer's share was 75.57 percent. In Channel III (Producer-Exporter-Consumer) the marketing costs incurred by producer was Rs/q 138.50 and exporter was Rs/q 2400 with marketing margin of Rs/q 775.00. The marketing cost is highest as exporter charges a higher margin. The maximum expenditure is on transportation which accounts for 16.93 percent of share in consumer's rupee. The share of exporter in consumer's rupee is 32.80 percent. The lower percentage share is due to higher marketing costs.

Marketing efficiency is inversely proportional to price spread. Since the price spread is lowest in case of Channel IV, marketing efficiency is highest (1.37). The next efficient channel is Channel I (0.93). 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. The producer's share in consumer's rupee was 50.41 percent. In Channel II, due to the existence of commission agent, its marketing efficiency is 0.86 as the price spread was more than Channel I. In Channel III marketing efficiency is lowest (0.47) due to high marketing costs and margins. The producer's share in consumer's rupee was found to be 32.79 percent. Since the produce is marketed to distant places, exporters paid due care towards the packing of the produce and spent more money (14.81 percent of consumer's rupee) than other channels to prevent damage and higher acceptance by foreign consumers. Although the channel with the shortest link was most efficient the volume of produce that is disposed of is less due to high perishable nature of B and C grade banana and its limitation to handle large amount of produce efficiently. Place and form of the commodity are not the same in different channels. There is scope of making other channels more efficient by contracting the length of supply chain. In Channel II commission agents' share in consumers' rupee was 2.43 percent. This highlights the need of reducing the supply chain to increase its efficiency by providing suitable infrastructure like pack houses, ripening centres, cold storage facilities etc. and facilitating a direct link between farmers and ultimate consumers. The backward and forward linkages should be strengthened in such a way that the overall cost of marketing the produce get reduced. The retailers' margin in consumer rupee is nearly 19 percent which is approximately one-fifth of the

consumer's price. This margin can be reduced by promoting more organized supply chain and by providing a platform where farmers can directly contact their customers like e NAM.

Post-Harvest Loss of Banana

Table 3: Post harvest loss in marketing of banana

Stages of Handling	PHL (%)	Major Causes/Reasons of PHL
Field/Producer level	6.59	Harvesting injury, Immature and small fruits, Black spot due to latex, Cracks
Wholesaler level	7.23	Press damage, Separated bananas, Mechanical injury, Rotten fruits
Retail level	4.41	Overripe fruits, Crushed fruits

Source- Primary Survey

The table 3 depicts the post-harvest loss in supply chain of banana at different levels. It was found that PHL was higher at wholesaler level (7.23 percent). At producer's level PHL was 6.59 percent and at retailer's level it was 4.41 percent. This highlights the strengthening of infrastructure facilities like cold storage structures, ripening centres, pack houses etc. at all levels. Precise and timely availability of market information is also very necessary to improve the marketing efficiency of different channels by fetching good prices in market and timely movement of produce from one place to the other. Being a high perishable fruit banana needs proper infrastructural facilities and backward and forward linkages to avoid PHL. Good transportation facility like refrigerated trucks for transfer of produce to distant places and its quality distribution is another major area of great concern specially to boost up the export of fruit since the major share of marketing cost is spent on transportation. The development of cold chain network throughout the supply chain will help in reduction of PHL. Due to lack of these facilities at every end the volume and quality of produce is greatly affected.

Conclusions

Marketing of fruits especially Banana has always been a questionable issue due to its perishable nature. In this study marketing efficiency of different supply chains of banana was carried out. It is clear from the above discussion that efficiency of marketing channels can be increased by decreasing the spread of price among intermediaries. More the number of intermediaries more will be the price spread and less will be the efficiency of channel. The shortest route to customers via Channel IV was the most efficient one. Channel III was less efficient than other channels as the marketing costs involved in this channel was highest. Channel I and II was mostly used for marketing of produce to local and distant markets. Although the presence of commission agent in Channel II has decreased the marketing efficiency, but they play an important role while distributing produce to long distance places like Delhi, Rajasthan, Punjab etc. So their role in supply chain cannot be ruled out. This

highlights the need of efficient market information provision which will enable farmers to take their decisions in line to the demand and can facilitate them in directly contacting customers. Poor marketing efficiency and poor infrastructure leads to decrease in producer's share in consumer's rupee. Post-harvest deterioration is another matter of grave concern. At every level there is a loss of 4-7 percent which can be avoided by providing infrastructural facilities in the nearby areas of banana cultivation and promoting more value addition in the crop. Creation of cold storage structures, establishment of ripening centres and processing units, providing refrigerated trucks for long distance transportation etc. are need of the hour to strengthen the linkages of supply chain.

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