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Cost Efficiency and Profitability of Papaya Marketing Channels in North-eastern Karnataka, India

K Anushree [a*], B S Reddy [a], Vijayachandra Reddy S [a], Satishkumar M [a] and Ravi Pujari [b]

[a] Department of Agricultural Economics, University of Agricultural Sciences, Raichur, Karnataka – 584104, India.
[b] Department of Horticulture, University of Agricultural Sciences, Raichur, Karnataka – 584104, India.

Authors' contributions

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

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ABSTRACT

The study on the economic analysis of papaya marketing in North-Eastern Karnataka, focuses on identifying the existing marketing system for papaya and analyzes the marketing cost, margin, price spread and marketing efficiency of different marketing channels. The study was conducted in four districts of North-Eastern Karnataka region and employed multistage random sampling technique to gather data from 80 papaya cultivators and 20 market intermediaries. Three major marketing channels were identified, each showing distinct cost structures and preferences among farmers. The findings highlighted that channel I was the most preferred among farmers, but it also exhibited

**Corresponding author: E-mail: k9800196@gmail.com;*

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the highest price spread compared to other channels. Channel III recorded the highest producer's share in the consumer's rupee (60.60%) and was identified as the most efficient channel based on both the Shepherd's approach (3.84) and the Acharya and Agarwal approach (1.54). The selection of a marketing channel significantly affects profitability and the distribution of risk among stakeholders. It is suggested that, due to the higher marketing costs incurred by farmers, they often opt to sell through pre-harvest contractors (PHCs). Therefore, it is recommended that these intermediaries be regulated through the Agricultural Produce Market Committee (APMC) to streamline the supply chain and improve market access for papaya growers.

Keywords: Pre-harvest contractor; efficiency; price spread; marketing channels.

1. INTRODUCTION

Agriculture is the backbone of Indian economy, which dictates the livelihood system of millions of people in general and farmer in particular (Raju Kumar et al. 2018). India's diverse climatic condition ensures year-round availability of a wide range of fresh fruits and vegetables making it the second-largest producer in the world, after China. India achieved a remarkable production of 107.24 million metric tonnes of fruits, cultivated across 7.05 million hectares of land during 2021-22. According to FAO 2021, India is leading country in the production of bananas (26.45%), mangoes (43.80%) and papayas (39.30%).

Papaya (*Carica papaya*) is an important fruit of tropical and subtropical region of the world and is known as “Melon Tree.” Papaya belongs to the genus Carica of the family Caricaceae. Out of 48 species known the species *Carica papaya* L. is the most important and best known (Sanat Kumar et al. 2023). Green fruits are diuretic and mildly laxative and are used as vegetables. It has a high nutritive and medicinal value. The ripened fruits are a rich source of carbohydrates, minerals (Ca, P and Fe), Vitamin (carotene, thiamine, riboflavin, etc.) fibber and ascorbic acid (Anjali Singh et al. 2020). In addition, papaya is a source of the digestive enzyme papain, which is used as an industrial ingredient in brewing, meat tenderizing, pharmaceuticals, beauty products and cosmetics (Javedmiyan et al. 2017). According to the National Horticulture Board report (2022), India produced approximately 6.29 million metric tonnes of papaya, with Karnataka contributing over 15 per cent of the national output. The state's production is concentrated in regions such as North Eastern Karnataka, where favorable climatic conditions allow for year-round cultivation. Despite this substantial production, the papaya market faces several economic challenges, including price volatility, high post-harvest losses (estimated at 25-30%), and limited access to organized markets which prevent farmers from realizing optimal profits. Understanding the costs and returns of papaya cultivation is essential for farmers to evaluate their profitability. Market price information and credit availability are also vital for banks to determine the appropriate scale of crop loans and establish repayment schedules. Additionally, data on production costs and efficient resource utilization are critical for optimizing farming practices. An Efficient Agricultural marketing system is crucial for agricultural progress and development since it stimulates production, stables the output and prices (Dukpa et al. 2020). Without an efficient marketing system, agricultural development cannot progress and enhance production and price stability, which has been seen in many countries (Khalon et al. 1985). All operations such as collecting, grading, processing, preserving, transportation, and financing come under Agricultural marketing” (Dastagiri et al. 2013). Thus, Agricultural marketing can be defined as the study of all the activities, channels, cost etc., involved in the transfer of goods from the producer to the consumer. The agricultural marketing system act as a link between the farm and the non-farm sectors (Dastagiri et al. 2013). It also reduces costs of production, the producers get its due share and removes unfair Consumer’s price. Effective marketing strategies for selling produce are key to overall success. In recent years, market data for economically viable crops has garnered increasing attention. In this context, the present study, titled "An Economic Analysis of Papaya Marketing in North-Eastern Karnataka," was conducted with the following specific objectives:

i. To identify the existing marketing system for papaya
ii. To compute price spread and marketing efficiency in papaya marketing channels

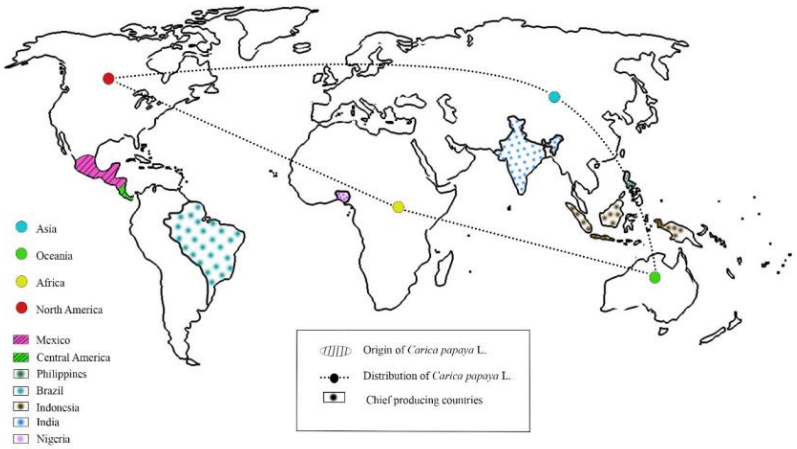

Fig. 1. Carica papaya: World map showing the origin, distribution and the chief production countries.

2. METHODOLOGY

2.1 Sampling Design

The study employed multistage random sampling technique. In the first stage, four districts Ballari, Koppal, Raichur, and Kalaburagi were selected based on the largest area under papaya cultivation within the North Eastern Karnataka (NEK) region. In the second stage, two taluks from each district were selected based on their area under papaya cultivation and production potential, in consultation with officials from the Raitha Samparka Kendra and the Taluk Horticulture Department of the respective taluks. In the third stage, ten farmers were randomly selected from each of these taluks to ensure representation across different villages. Thus total of 80 papaya cultivators were included in the sample with 20 farmer respondents from each district. Additionally, 20 market intermediaries 5 respondents from each district were selected to gather the required marketing information. In total the study's sample size consisted of 100 respondents, comprising 80 papaya cultivators and 20 market intermediaries.

2.2 Analytical Tools Used

2.2.1 Marketing costs

The movement of the products from the producers to the ultimate consumers involves costs, taxes and cess, which are called marketing costs. These costs vary with the channels through which a particular commodity passes through. Marketing cost (MC) is the total cost incurred on marketing by various intermediaries involved in the sale and purchase of the commodity till it reaches the ultimate consumer (Laishram et al. 2022) was calculated by using the formula.

$$MC = C_F + C_D$$

Where,

MC = Total marketing cost
C_F = Marketing cost incurred by farmers
C_D= Marketing cost incurred by market intermediaries

2.2.2 Marketing margins

Marketing margin represents the difference between the price paid and received by a given intermediary in the marketing of a commodity such as a pre-harvest contractor, wholesaler, retailer, etc. The variation among the rupee spent by the end user and the portion of that rupee gained by the grower is also referred as the marketing margins (Kohls et al. 1985).

$$MM_D = P_C - (P_F + C_D)$$

Where,

MM_D = Net marketing margin of the dealer
P_c = Purchase price of the consumer
C_D = Marketing cost of the intermediaries
P_F = Price received by farmers

Total marketing margin = Consumer price – (Net price received by farmer + Marketing costs of intermediaries).

2.2.3 Price spread

The price spread is the difference between the price paid by the consumer and the net price received by the farmer for an equivalent quantity of farm product. A higher producer shares in consumer rupee and a narrow price spread results in the preferable attention of both i.e. producer and consumer (Kumar et al. 1993). The economic efficiency of a market is generally measured in terms of the net price spread of an agricultural commodity.

$$P_S = P_C - P_f$$

Where,

P_S = Price Spread
P_C = Price paid by the consumer
P_f = Net price received by the farmer

2.2.4 Producer's share in consumer's rupee

The share of producer in consumer's rupee in papaya marketing, were worked out using the formulas (Acharya et al. 2003).

$$PS = \frac{PF}{PC} \times 100$$

Where,

PS = Producer's Share in Consumer's Rupee
PF = Price of the producer received by the farmer
PC = Price of the produce paid by the consumer

2.2.5 Shepherd's method

Shepherd has suggested that the ratio of the total value of goods marketed to the marketing cost may be used as a measure of marketing efficiency. The higher the ratio, higher the marketing efficiency and vice versa (Shepherd 1965).

$$ME = \frac{PC}{MC} - 1$$

Where,

ME = Marketing efficiency
PC = Consumer price/ Total marketing output
MC = Total marketing cost

2.2.6 Acharya and Agarwal method

An efficient marketing channel ensures fair prices for all its members and helps maintain price balance throughout the entire channel (Acharya 2019). Acharya's formula (Acharya 2014) was used for calculating the marketing efficiency of different channels of the papaya crop. It is expressed as:

$$ME = \frac{NP_F}{(MM + MC)} - 1$$

Where:

ME = Marketing efficiency
NP_F = Net price received by the farmers
MM = Total Marketing margin
MC = Total marketing cost

3. RESULTS AND DISCUSSION

The choice of marketing channels is crucial for papaya farmers, as their actual profit largely hinges on the selection of the right agency and channel for selling their produce. The channels chosen should minimize marketing expenses and guarantee a greater portion of the consumer's rupee. The decision on which marketing channel to use depends on factors such as the volume of marketable surplus available, farmer's ability to store and hold the produce, prevailing price trends, availability of necessary infrastructure, etc.

Marketing channels identified in the study area are:

Channel – I: Producer →Pre-harvest contractor →Wholesaler →Retailer → Consumer
Channel – II: Producer → Wholesaler → Retailer→ Consumer
Channel – III: Producer → Retailer→ Consumer

3.1 Mode of Papaya Marketing

It can be observed from the Table 1, that lion's share (94.10%) of the total quantity of papaya, about 58,500 quintals was marketed through Channel-I, exhibited the most preferred option among the farmers. Channel-II accounts for 4.70 per cent of the produce (2,925qtl), while Channel-III handled only 1.20 per cent (736 qtl).

In channel I, the pre-harvest contractors (PHC's) visit the papaya fields to assess the quality of produce, agree on a price with the farmer and transport produce to the market. Most of the farmers preferred this channel due to minimum cost incurred. Whereas in case of channel II and channel III farmers themselves transport their

produce to distant markets, bearing all marketing expenses. Similar results were observed by Shivannavar 2005 in their study conducted in Bidar and Kalaburgi districts of north Karnataka, where in small number of market intermediaries controlled the larger market share of papaya, limiting producer-sellers influence over the pricing (Khalon 1985).

3.2 Marketing Cost Incurred in Different Channels

The whole marketing process of papaya in the study area involved packing, transportation and selling functions. Better packing always helped in maintaining the quality and reducing the loss during the transit on account of spoilage. Packing of papaya is generally done in papers. They are generally transported by trucks where the bottom is filled with fodder to prevent spoilage (Shivalingamma 2022). The detailed breakdown of the costs incurred by various intermediaries in the marketing of papaya across three different marketing channels in the study area is presented in Table 2 and intermediaries involved includes the producer, pre-harvest contractor, wholesaler and retailer.

In Channel I, majority of the marketing costs are borne by the pre-harvest contractor, who incurred the highest cost of Rs. 355.91 per quintal which constitutes transportation (Rs. 125.73) cost, labour charges (Rs. 120.81) and packaging (Rs. 48.36) cost. The producer incurred a relatively lesser cost of Rs. 45.12 per quintal for loading and unloading, with no other expenses. The wholesaler and retailer were also incurred notable costs, particularly in labour and transportation, accounting Rs. 291.71 and Rs. 183.86 per quintal, respectively.

In Channel II, the burden of marketing expenses shifts primarily to the producer and the wholesaler. The producer incurs the cost of Rs. 278.23 per quintal on labour charges (Rs. 145.24) and wastage/losses (Rs. 51.45) being major. The wholesaler's total costs amount to Rs. 323.99 per quintal with the higher expenses on labour charges (Rs. 183.77), while retailer incurred least cost (Rs. 173.78) on transportation, wastage/losses and labour charges.

In case of channel III, the producer incurred a higher cost of Rs. 303.66 per quintal, on labour charges (Rs. 151.65) and wastage/losses (Rs. 55.90) being the most significant components. The retailer in Channel III incurred marketing cost of Rs. 195.47 per quintal, on labour (Rs. 92.11), wastage/losses (Rs. 54.58) and transportation (Rs. 46.74).

The analysis of the cost structure across different marketing channels revealed a trade-off between cost efficiency and potential profitability for papaya farmers. Channel I allow for minimal cost exposure to producers but limit potential returns, while Channels II and channel III offered opportunities for higher profits at the expense of increased financial risk and operational responsibility. This information will help farmers take informed decisions about which marketing channel to use, depending on their risk tolerance, financial capacity and market access.

3.3 Marketing Margin & Price Spread across Different Channels

The analysis of the channel-wise marketing cost, margin and price spread for papaya revealed key insights into the distribution of profits and costs among various stakeholders in the supply chain, as presented in Table 3. In case of channel I, farmers received a price of Rs. 1250.68 per quintal but incurred minimal marketing costs of Rs. 45.12 resulting farm gate price of Rs. 1205.56. The marketing margins were Rs.202.36, Rs. 150.45 and Rs. 250.31 for pre-harvest contractor, wholesalers and retailers respectively. The producer's share in the consumer's rupee was also least at 45.17 per cent.

Table 1. Disposal pattern of papaya farmers through different marketing channels

Sl. No.	Marketing channel	No. of farmers	Quantity (qtl)	%
1	Channel-I	72	58500	94.10
2	Channel-II	5	2926	4.70
3	Channel-III	3	736	1.20
Total		**80**	**62162**	**100.00**

Table 2. Cost incurred by farmers and intermediaries in marketing of papaya (Rs./qtl)

Sl. No.	Particular	Channels		
		Channel I	**Channel II**	**Channel III**
1	**Producer**			
a.	Packaging charges	-	49.60	50.55
b.	Transportation	-	29.71	42.70
c.	Wastage/losses	-	51.45	55.90
d.	Labour charges	45.12	145.24	151.65
e.	Miscellaneous expenditure	-	2.23	2.86
	Total	**45.12**	**278.23**	**303.66**
2	**Pre-harvest contractor**			
a.	Packaging charges	48.36	-	-
b.	Transportation	125.73	-	-
c.	Wastage/losses	57.41	-	-
d.	Labour charges	120.81	-	-
e.	Miscellaneous expenditure	3.60	-	-
	Total	**355.91**	-	-
3	**Wholesaler**			
a.	Transportation	56.21	74.34	-
b.	Wastage/losses	87.90	62.79	-
c.	Labour charges	145.45	183.77	-
d.	Miscellaneous expenditure	2.15	3.09	-
	Total	**291.71**	**323.99**	-
4	**Retailer**			
a.	Transportation	62.66	61.22	46.74
b.	Wastage/losses	42.76	36.90	54.58
c.	Labour charges	75.90	72.49	92.11
d.	Miscellaneous expenditure	2.54	3.17	2.04
	Total	**183.86**	**173.78**	**195.47**

Table 3. Channel-wise marketing cost, margin and price spread of papaya (Rs. /qtl)

Sl. No	Particulars	Channel I	Channel II	Channel III
1	**Farmer**			
a.	Selling price	1250.68	1450.27	1467.89
b.	Marketing cost	45.12	268.23	303.66
c.	Net price received	1205.56	1182.04	1164.23
2	**Pre-harvest contractor**			
a.	Purchasing price	1250.68	-	-
b.	Marketing cost	353.60	-	-
c.	Marketing margin	202.36	-	-
d.	Sale price	1806.64	-	-
3	**Wholesaler**			
a.	Purchasing price	1806.64	1450.27	-
b.	Marketing cost	291.05	323.99	-
c.	Marketing margin	150.45	197.98	-
d.	Sale price	2248.14	1972.24	-
4	**Retailer**			
a.	Purchasing price	2248.14	1972.24	1467.89
b.	Marketing cost	170.50	173.78	195.45
c.	Marketing margin	250.31	253.33	257.78
d.	Sale price	2668.95	2399.35	1921.12
Total marketing cost		860.27	766.00	499.11
Total marketing margin		603.12	451.31	257.78
Price spread		1463.39	1217.31	756.89
Producer's share in consumer's rupee(%)		**45.17**	**48.63**	**60.60**

In Channel II, although farmers received higher selling price of Rs. 1450.27, their marketing costs were also higher at Rs. 268.23, resulted a net price realisation to Rs. 1182.04. The price spread in this channel was lower compared to Channel I, amounting to Rs. 1217.31. The

producer's share in consumer's rupee was 48.63 per cent, indicated relatively better returns for farmers despite the higher marketing costs.

Channel III showed the highest producer's share in the consumer's rupee with 60.60 per cent, as the total price spread was the least in this channel at Rs. 756.89. This channel have fewer intermediaries, resulted in a narrower price spread and higher returns received by the farmers.

Similar findings were reported by Thejashwini 2020, in her analysis of marketing channels of papaya in Chitradurga district. The findings of her study revealed that more the number of intermediaries involved, the broader the price spread, leading to lower returns for the farmer producers. The choice of marketing channel significantly affects the profitability and risk distribution among the different players in the supply chain.

3.4 Efficiency of Papaya Markets

Marketing efficiency is closely linked to the costs associated with transporting goods from farm to fork and the level of services provided. An efficient marketing system is one where the costs incurred by intermediaries are lower relative to the services delivered. Enhancing marketing efficiency implies reducing marketing costs without compromising the quality or quantity of services offered to consumers. Table 4, provided insights into the comparative performance of different marketing channels using three methods: The Shepherd method, and the Acharya approach.

Using the Shepherd method, Channel III exhibited the highest marketing efficiency ratio of 3.84, inferred that this channel was the most efficient in converting marketing costs into consumer prices. Despite having the lowest consumer price at Rs. 1921.12, the lower marketing costs of Rs. 499.11 in Channel III resulted in a more efficient marketing process. Channel I and channel II had lower marketing efficiency ratios of 3.10 and 3.13, respectively due to higher marketing costs.

The Acharya approach, which compares the farmer's price (FP) to the combined marketing cost and margin also revealed that Channel III demonstrated higher efficiency with a ratio of 1.54. This suggests that farmers in Channel III retained a larger portion of the consumer's price compared to channel I and channel II. Channel II had a ratio of 0.97 and Channel I had the lowest ratio of 0.82 evidenced that farmers in Channel I received the smallest share of the final consumer price after deducting marketing costs and margins.

Channel III demonstrated the highest marketing efficiency under both Shepherd approach and Acharya approach. It is clear from aforesaid discussion that channel – III was the most cost-effective in converting marketing expenses into consumer prices and allowed farmers to retain a larger portion of the final price. Channels I and channel II had lower efficiency due to higher marketing costs incurred by market intermediaries.

These findings suggested that optimising marketing channels, particularly by reducing intermediary costs, can significantly enhance the overall efficiency and profitability of the marketing system for papaya.

Table 4. Efficiency of papaya markets in the study area

Sl.No	Methods	Particulars	Channel-I		Channel-II		Channel-III	
			Price (Rs.)	**Marketing efficiency ratio**	**Price (Rs.)**	**Marketing efficiency ratio**	**Price (Rs.)**	**Marketing efficiency ratio**
1	**Shepherd method**	Consumer Price	2668.95	**3.10**	2399.35	**3.13**	1921.12	**3.84**
		Marketing cost	860.27		766.00		499.11	
2	**Acharya approach**	Farmer price (FP)	1205.56	**0.82**	1182.04	**0.97**	1164.23	**1.54**
		(MC+MM)-1	1462.39		1216.36		755.89	

4. CONCLUSION

The analysis of papaya marketing through different channels reveals distinct cost structures and preferences. Channel-I, which handled major (94.10%) of the total papaya, is favoured by farmers as the cost incurred by farmers in Channel-I is relatively minimal compared to Channels II and III. In Channel-II, marketing costs are more evenly distributed between producers and wholesalers, with the producer bearing significant costs. Although this channel results in higher selling prices for farmers, it also involves higher expenses, which impact net returns. Channel-III shows the highest costs for producers, particularly in labor and wastage, yet offers greater price efficiency with the highest producer's share in consumer's rupee (60.60%). Based on both the Shepherd and Acharya approaches channel III proves to be the most efficient with fewer intermediaries and a narrower price spread, While Channel II and Channel I, both are less efficient due to marketing costs and marketing margins of intermediaries. The suggests, as the farmers incurred higher cost on marketing they preferred selling through pre-harvest contractor (PHC) hence these intermediaries should be regulated through APMC to streamline the supply chain and provide better market access for papaya growers.

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 this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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