Economic Analysis of Papaya Farming in Chitradurga: Production and Marketing Perspectives

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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

In India, papaya cultivation thrives as a vibrant testament to the nation's rich agricultural diversity, offering both economic promise and nutritional benefits. With its lush, tropical appeal and versatile uses, papaya stands out as a key player in the country's fruit sector, captivating farmers and consumers alike with its sweet, succulent offerings. This study presents an economic analysis of papaya farming in Chitradurga, focusing on production costs, returns, and marketing perspectives.

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The research aimed to identify the key economic factors influencing papaya cultivation and marketing efficiency. The methodology involves calculating cost of cultivation with detailed assessments of marketing channels and constraints. The findings revealed that the total cost of papaya cultivation was Rs. 3,58,998.19 per hectare, with labour-intensive practices contributing significantly to the overall expenses. The study found a gross return of Rs. 8,90,784.69 per hectare and a net profit of Rs. 5,31,786.50 per hectare, indicating profitable cultivation. Among the marketing channels, Channel-I (Producer → Pre-harvest contractor → Wholesaler → Retailer → Consumer) was the most prevalent, though it involved higher marketing costs. The primary production constraints identified were fruit dropping, inadequate quality seedlings, and pest damage, while marketing constraints included price fluctuations and lack of demand during peak seasons. These results underscore the need for improved management practices and marketing strategies to enhance profitability and address key challenges in papaya farming.

1. INTRODUCTION

Papaya (Carica papaya L.), native to Mexico and northern South America, is widely cultivated across tropical and subtropical regions due to its adaptability to varied soil and climatic conditions. Its year-round fruiting, rapid returns, and significant nutritional and medicinal value have elevated papaya from a home garden staple to a profitable orchard crop in many countries. The fruit is rich in vitamins C and A, fibre, and other nutrients. It contains the enzyme papain, used for meat tenderizing and various industrial applications, including pharmaceuticals and cosmetics. Papaya also boasts powerful antioxidants, which may reduce the risk of several diseases, including cancer and heart disease, and improve skin health and digestion [1]. India is the leading producer of papaya, contributing approximately 45% of the global production, with an annual yield of about 5.9 million tonnes [2]. The total area under papaya cultivation in India increased significantly from 98,000 hectares in 2008-09 to 138,400 hectares in 2021-22, with production rising from 3.6 million tonnes to nearly 6 million tonnes during the same period [3]. Major papaya-growing states in India include Andhra Pradesh, Gujarat, and Karnataka, with Karnataka ranking third in papaya production in 2021-22, producing 593,690 tonnes on 8,750 hectares. Chitradurga, a district in Karnataka, is one of the significant contributors to the state's papaya production. Despite the importance of papaya cultivation in the region, farmers face several challenges related to production costs, market accessibility, and value chain efficiency. The perishable nature of papaya necessitates careful handling and efficient marketing to minimize losses and ensure fair returns for farmers. However, the presence of multiple intermediaries in the marketing channels often reduces the income of farmers, emphasizing the need for improved market facilities and direct marketing opportunities.

This study aims to provide a comprehensive economic analysis of papaya farming in Chitradurga, focusing on both production and marketing perspectives. It seeks to identify the various marketing channels, estimate the price spread and marketing efficiency, and identify the constraints faced by producers and intermediaries. By examining the costs, returns, and resource use efficiency of papaya cultivation, this research intends to offer valuable insights and practical recommendations for enhancing the profitability and sustainability of papaya farming in Chitradurga. In doing so, this study will contribute to a better understanding of the economic dynamics of papaya cultivation and provide actionable strategies for improving market access and income for papaya farmers in the region.

2. METHODOLOGY

The present study is mainly based on the primary data collected from Chitradurga District of Karnataka. Chitradurga ranks top in the production of papaya in Karnataka with 0.77 thousand hectares area and with a production of 60.06 thousand MT [3]. Hence the district was chosen for the study. Papaya cultivation is practiced throughout Chitradurga district. However, the large, medium and small-scale production of papaya was concentrated in Challakere, Hollalkere and Hosadurga taluks contributing 47.34 per cent, 8.13 per cent and 3.38 per cent respectively. From each taluk 15 farmers were randomly selected. Totally 45 farmers were selected from three taluks. Further, 5 each of pre-harvest contractors, wholesalers

and retailers were randomly selected for the study.

The cost of cultivation of papaya was calculated by using various cost concepts. Garrett's ranking technique was used to identify the most important constraint which influences the respondents [4]. As per this, respondents have been asked to allocate the rank for all factors and the outcome of such ranking has been converted into score value with the help of the following formula:

$$Percent\ position = 100((R_{ij} - 0.5)/N_j$$

Where,
R_{ij} = Rank given for i^{th} item by j^{th} individual
N_j = Number of items ranked by j^{th} individual

The per cent position of each rank was converted into scores by referring to Garrett's table. Then for each factor, the scores of individual respondents were summed up and divided by the total number of respondents for whom scores were gathered. The mean scores for all the factors were ranked; following the decision criteria that higher the value, more important is the constraint or most important reason for the beneficiaries.

3. RESULTS AND DISCUSSION

3.1 Costs and Returns of Papaya Cultivation

The cost of cultivation of papaya was computed based on the prevailing production practices of farmers. The costs were classified into Cost-A1, Cost-A2, Cost-B1, Cost-B2, Cost-C1, Cost-C2 and Cost-C3. As shown in Table 1, cost-A1 accounted for 36.85 per cent (Rs. 1,32,301.99/ha). Among all the individual items of cost-A1, hired human labour was the highest (8.40 %), followed by farmyard manure (7.68 %) and cost of seedlings (5.46 %). Interest on working capital and cost of chemical fertilizers contribute about 5.21 per cent and 4.37 per cent of cost-A1 respectively. It can be concluded that production of papaya is labour intensive. Cost-B1 accounted for 40.16 per cent which included cost-A1 and interest on fixed capital (3.31 %). In cost-B2 (81.52 %), cost-B1 and rental value of owned land was included (41.36 %). Cost-C1 accounted for 49.55 per cent in which cost B1 and imputed value of family labour (9.39 %) were

included and cost-C2 (90.91 %) included cost-B2 and imputed value of family labour. In cost-C3, i.e., the total cost of cultivation amounted to Rs. 3,58,998.19/ha, which included cost-C2 and managerial cost of 9.09 per cent. As cultivation of papaya was labour intensive on both hired and family human labour was 17.79 per cent (8.40+9.39) of the total cost of papaya cultivation. Shennewad [5], Patel [6] and Kumbhar et al. [7] reported that cultivation of papaya needs higher employment of human labour and results were similar with this study. These results are also comparable with those of [8,9].

3.2 Profitability of Papaya Production

The gross return, family labour income, farm business income, net profit per hectare, returns per rupee of investment and B:C ratio are presented in Table 2. The results indicated that the productivity was 750.86 quintals per hectare which resulted in Rs. 890784.69 gross return per hectare. The Farm business income and family labour income were Rs. 7,58,482.71 and Rs. 5,98,130.79 per hectare, respectively. The per hectare net profit realized by papaya farmer was Rs. 5,31,786.50 per hectare. The ratio of benefit over Cost-C3 amounted to 1.48. The net income in this study was higher when compared with [10] report. The net returns per rupee of investment in this study was higher than those reported by [11,12], i.e., 1.32 and 1.86 respectively. Hence this study proves the stated hypothesis that papaya cultivation is profitable. The findings are in line with the results of [7,13,14].

3.3 Marketing Channels and Price Spread in Marketing of Papaya Fruit

The papaya growers in the study area sold their produce to pre-harvest contractors, wholesalers and retailers. The Pre-harvest contractors are predominant in the marketing of papaya fruit. Three major marketing channels identified in papaya marketing in the study area are mentioned below:

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

Channel – II: Producer → Wholesaler → Retailer→ Consumer

Channel – III: Producer → Retailer → Consumer

Table 1. Cost of papaya cultivation in Chitradurga district (in Rs/ha)

Sl. No.	Particulars	Cost	Percentage
1	Hired labour charges	30173.52	8.40
2	Bullock labour charges	0.00	0.00
3	Machinery labour charges	2637.96	0.73
4	Cost of seedlings	19584.63	5.46
5	FYM cost	27570.14	7.68
6	Cost of chemical fertilizers	15677.09	4.37
7	Cost of plant protection charges	5385.84	1.50
8	Irrigation charges	8552.25	2.38
9	Land revenue	133.38	0.04
10	Interest on working capital @ 12%	18703.36	5.21
11	Depreciation and repairs	766.60	0.21
12	Miscellaneous charges	3117.23	0.87
13	**Cost A1** ($\sum$ item 1 to 12)	132301.99	36.85
14	Rent paid for leased in land	0.00	0.00
15	**Cost A2** ($\sum$ item 13 and 14)	132301.99	36.85
16	Interest on fixed capital @ 8%	11887.80	3.31
17	**Cost B1** ($\sum$ item 13 and 16)	144189.79	40.16
18	Rental value of owned land	148464.12	41.36
19	**Cost B2** ($\sum$ item 14, 18 and 17)	292653.90	81.52
20	Imputed value of family labour	33708.09	9.39
21	**Cost C1** ($\sum$ item 17 and 20)	177897.88	49.55
22	**Cost C2** ($\sum$ item 19 and 20)	326361.99	90.91
23	Managerial cost (10% of all cost)	32636.20	9.09
24	**Cost C3** ($\sum$ item 22 to 23)	358998.19	100.00

Source: Author's calculations based on primary data

Table 2. Profitability of papaya production in Chitradurga district

Sl. No.	Particulars	Cost/returns (Rs/ha)
1	Yield (qtl)	750.86
2	Price (Rs. / qtl)	1186.36
3	Gross return (Rs.)	890784.69
4	Cost A1	132301.99
5	Cost B2	292653.90
6	Cost C3	358998.19
7	Farm business income (gross return minus cost A1)	758482.71
8	Family labour income (gross return minus cost B2)	598130.79
9	Net profit (gross return minus cost C3)	531786.50
10	Returns per rupee of investment (gross return / cost C3)	2.48
11	B:C Ratio (net profit / cost C3)	1.48

Source: Author's calculations based on primary data

Table 3. Disposable pattern of papaya through different marketing channels

Sl. No.	Marketing channel	No. of farmers	Per cent to the total	Quantity sold (in qtl)
1	Channel-I	35	77.77	24545
2	Channel-II	2	4.44	1200
3	Channel-III	2	4.44	750
4	Channel-I and Channel-II	5	11.11	6320
5	Channel-I and Channel-III	1	2.22	700
Total		**45**	**100**	**33515**

Source: Author's calculations based on primary data

3.4 Mode of Marketing of Papaya

It can be observed from Table 3 that 77.77 per cent of the farmers sold their produce only through channel-I, 4.44 per cent of farmers used only channel-II and 4.44 per cent of them used channel-III. About 11 per cent of farmers followed both channel-I and channel-II while 2.22 per cent of farmers sold their produce through both channel-I and channel-II.

In case of channel-I, pre-harvest contractors visit to the farm and fix the price and then later take the produce to the market. Majority of the farmers preferred this channel as the marketing cost incurred was minimum in this channel and there was no risk of price fluctuation. In channel-II and channel-III farmer himself took the produce to the distant market where he incurred all the marketing cost but no doubt the farmer realised the better prices for produce in the market than at farm level. Similar findings were reported by [15,16,17], in market system of papaya that few market intermediaries dominated the market and the producer-seller had very less control in fixing the price for their produce.

3.5 Marketing Cost of Papaya in Different Channels

The marketing cost per quintal of papaya in different channels of marketing was studied and results are presented in Table 4. It could be seen from the table that highest marketing cost was incurred in channel – I i.e., Rs. 796.20 followed by Rs. 693.22 and Rs. 462.36 in channel – II and channel – III respectively. Farmers didn't incur any marketing cost. Among the intermediaries, pre-harvest contractors incurred 35.28 per cent on transportation, 34.71 per cent on labour charges, 15.93 per cent on wastage losses and 13.09 per cent on packaging. Wholesaler incurred 50.26 per cent on labour charges, 29.01 per cent on wastage losses and 19.74 per cent on transportation. Whereas retailer incurred 40.62 per cent on labour charges, 34.60 per cent on transportation charges and 23.78 per cent on wastage losses in channel – I. In channel – II, producer incurred a large proportion of marketing cost on labour charges (53.66 %), wastage losses (23.24 %) and packaging (22.11 %), whereas wholesaler incurred 56.12 per cent on labour charges, 22.77 per cent on transportation and 20.12 per cent on wastage losses. Retailer incurred 42.08 per cent and 35.84 per cent on labour charges and transportation respectively.

In channel – III, producer incurred large amount on, labour charges (45.76 %) followed by wastage losses (19.84 %), packaging (18.38 %) and transportation (15.03 %). Whereas retailer incurred 49.94 per cent on labour charges, 27.55 per cent and 21.52 per cent on wastage losses and transportation losses respectively. These results are comparable with the [18] in which the authors studied the economics of marketing of papaya in middle Gujarat Region.

From Table 4, it is prominently observed that the labour charges (loading and unloading), wastage losses and transportation are the major item of marketing cost. Better packing always helped in reducing the losses during the transport on account of spoilage and in maintaining the better quality. Packing of papaya is generally done by using newspapers and transported by trucks where the bottom of was filled with straw to prevent physical damage to fruit. Holani [19] and Shekhaliya and Mishra [16] reported that in marketing of papaya main items of expenditure includes transportation charges, transportation losses and loading and unloading charges and is confirmed through the findings from this study.

3.6 Channel-wise Marketing Margin and Price Spread

The channel-wise marketing margin and price spread in study area was analysed and the same is inferred in Table 4. The marketing cost was higher in channel – 1 (Rs. 796.20) followed by channel – II (Rs. 693.22) and channel – III (Rs. 462.36). The producer share in consumer rupee was maximum in channel – III (74.76%) and minimum in channel – I (44.62%), while gross marketing margin was higher in channel – I (23.66%) and lowest in channel – III (14.39%). This showed that when there are fewer intermediaries, producer received higher share in consumer rupee and vice-versa. Further, it was shown that the consumer was most benefited in purchase of papaya fruit through channel – III as the retail price in this channel is lower as compared to channel – I and channel – II.

3.7 Production Constraints Faced by Papaya Farmers

The production constraints in papaya cultivation were analysed and presented in Table 5. The constraints were ranked based on their severity,

as perceived by the sample farmers, using Garrett's ranking method. The most significant constraint identified was fruit dropping, which had the highest mean Garrett's score of 76.64. This indicates that fruit dropping is a critical issue affecting papaya production. The second most significant constraint was the inadequate availability of quality seedlings, with a mean Garrett's score of 70.84. Farmers reported difficulties in obtaining seedlings that are resistant to viral diseases, which are particularly detrimental to papaya crops. Damage due to pests and diseases ranked as the third major constraint, with a mean Garrett's score of 63.16. Farmers highlighted the impact of mealy bugs and leaf curl virus as major pest-related issues. The non-availability of labour during peak periods was identified as a critical input constraint, ranking fourth with a mean score of 59.02. This underscores the importance of labour availability in the production cycle of papaya. The fifth and sixth significant constraints were uneven bearing and damage due to untimely and heavy rainfall, with mean scores of 56.98 and 54.60,

respectively. These environmental factors significantly impact the yield and quality of the papaya crop. Other constraints identified included scarcity of irrigation water, lack of technical know-how, high initial orchard investment, lack of training for farmers, and high cost of production, which ranked seventh to eleventh, with mean scores of 49.51, 47.33, 46.93, 39.33, and 33.91, respectively. These factors highlight the multifaceted challenges faced by papaya farmers in managing their orchards efficiently. The least severe production constraints, as perceived by the farmers, were inadequate finance and other unspecified issues, which ranked twelfth and thirteenth, with mean scores of 32.11 and 15.00, respectively.

These results align with findings [20,21,22]. These findings provide a clear indication of the primary challenges in papaya production and emphasize the need for targeted interventions to address these constraints to enhance the productivity and profitability of papaya cultivation.

Table 4. Marketing cost of papaya in different channels

Sl. No.	Particular	Channels		
		Channel I	Channel II	Channel III
1	**Cost incurred by producer**			
a.	Packaging charges	0.00	48.20	49.40
b.	Transportation	0.00	0.00	40.40
c.	Wastage/losses	0.00	50.67	53.33
d.	Labour charges	0.00	117.00	123.00
e.	Miscellaneous expenditure	0.00	2.16	2.66
	Total		**218.03**	**268.79**
2	**Cost incurred by pre-harvest contractor**			
a.	Packaging charges	46.00	-	-
b.	Transportation	124.00	-	-
c.	Wastage/losses	56.00	-	-
d.	Labour charges	122.00	-	-
e.	Miscellaneous expenditure	3.48	-	-
	Total	**351.48**	**-**	**-**
3	**Cost incurred by wholesaler**			
a.	Transportation	55.00	71.66	-
b.	Wastage/losses	80.80	63.33	-
c.	Labour charges	140.00	176.66	-
d.	Miscellaneous expenditure	2.76	3.12	-
	Total	**278.56**	**314.77**	**-**
4	**Cost incurred by retailer**			
a.	Transportation	57.50	57.50	41.66
b.	Wastage/losses	39.52	33.83	53.33
c.	Labour charges	67.50	67.50	96.66
d.	Miscellaneous expenditure	1.65	1.59	1.92
	Total	**166.17**	**160.42**	**193.57**

Source: Author's calculations based on primary data

Table 5. Production constraints faced by papaya farmers

Sl. No.	Constraints	Garrett's values	
		Mean score	Rank
1	Fruit dropping	76.64	I
2	Inadequate availability of quality seedlings	70.84	II
3	Damage due to pests and diseases	63.16	III
4	Shortage of labour	59.02	IV
5	Damage due to untimely and heavy rain	56.98	V
6	Uneven bearing/low bearing	54.60	VI
7	Scarcity of irrigation water	49.51	VII
8	Lack of technical know-how	47.33	VIII
9	High initial orchard investment	46.93	IX
10	Lack of training facility to farmers on crop management	39.33	X
11	Higher cost of production	33.91	XI
12	Inadequate finance	32.11	XII
13	Others	15.00	XIII

Source: Author's calculations based on primary data

Table 6. Marketing constraints faced by papaya farmers

Sl. No.	Constraints	Garrett's values	
		Mean score	Rank
1	Too much variation in prices/price fluctuations	73.84	I
2	No market demand during peak arrivals	72.51	II
3	Quick deterioration in quality	68.09	III
4	High rejection rate of the produce	65.78	IV
5	Long distance to market	58.11	V
6	High marketing costs	49.22	VI
7	Lack of storage facilities	47.84	VII
8	Lack of knowledge about processing	46.40	VIII
9	Lack of awareness about market information	44.58	IX
10	Delay in payment	36.87	X
11	Inadequate transportation facilities	31.47	XI
12	Lack of organized marketing system	25.13	XII
13	Inadequate/poor harvesting practices	23.42	XIII

Source: Author's calculations based on primary data

3.8 Marketing Constraints Faced by Papaya Farmers

Marketing constraints faced by farmers are presented in Table 6. The primary marketing challenge identified was the excessive fluctuation in prices, which received the highest mean score of 73.84. Farmers expressed frustration with the frequent and significant price variations, which resulted in lower-than-expected prices for their produce. The second major marketing constraint was the lack of demand for papaya fruits during peak arrivals in the market. This issue, with a mean score of 71.27, led to reduced demand and farmers being compelled to sell high-quality produce at prevailing market prices, often lower than anticipated. The third and fourth constraints were the quick deterioration of quality and a high rejection rate of produce, with mean scores of 68.09 and 65.78, respectively. These factors significantly impacted the marketability of papaya. The long-distance to markets was identified as the fifth constraint, with a mean score of 58.11, further complicating the marketing process. High marketing costs, lack of storage facilities, lack of knowledge about processing, lack of market information, and delays in payment were ranked sixth to tenth, with mean scores of 53.66, 51.21, 49.89, 47.34, and 45.77, respectively. These constraints highlight the diverse challenges faced by farmers in effectively marketing their produce. The least severe constraints were inadequate transportation facilities, lack of an organized marketing system, and poor harvesting practices, which were ranked eleventh to thirteenth, with mean scores of 31.47, 25.13, and 23.42, respectively. These results align with findings

from [5], who reported similar marketing constraints among papaya farmers. These results also align with findings from [20,23]. The constraints outlined emphasize the need for targeted interventions to improve marketing efficiency and profitability in papaya farming.

4. CONCLUSIONS

The economic analysis of papaya farming in Chitradurga reveals significant insights into both the production costs and marketing dynamics associated with this crop. The cost of cultivating papaya was meticulously categorized into several components, with Cost-A1 accounting for 36.85% of the total cost. Notably, hired human labour emerged as the largest expense within Cost-A1, highlighting the labour-intensive nature of papaya production. Other significant costs included farmyard manure, seedlings, interest on working capital, and chemical fertilizers. The total cost of cultivation, classified under Cost-C3, amounted to Rs. 3,58,998.19 per hectare, incorporating managerial costs. The high proportion of labour costs, amounting to 17.79% of the total, underscores the critical role of human resources in papaya farming, which emphasize the substantial labour requirements in papaya cultivation. In terms of returns, the study demonstrated that papaya farming yields substantial economic benefits. The gross return per hectare was Rs. 8,90,784.69, with farm business income and family labour income recorded at Rs. 7,58,482.71 and Rs. 5,98,130.79, respectively. The net profit per hectare was Rs. 5,31,786.50, and the benefit-cost ratio stood at 1.48. which highlights the profitability of papaya farming in the region. This affirms the hypothesis that papaya cultivation is economically advantageous.

Regarding marketing, the study identified three primary channels. Channel I was the most commonly used and favoured for its lower marketing costs and reduced price fluctuation risks. However, marketing costs were highest in this channel, with significant expenses incurred by pre-harvest contractors. Channels II and III, while involving higher marketing costs for farmers, offered better pricing for their produce. The analysis of marketing margins revealed that the producer's share in the consumer rupee was highest in Channel III, where fewer intermediaries were involved. This channel also offered the lowest retail prices for consumers, highlighting the benefits of direct marketing for both producers and buyers. Overall, the study provides a comprehensive view of the economic viability of papaya farming in Chitradurga, emphasizing its profitability and the impact of marketing channels on economic returns.

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.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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