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VALUE CHAIN ANALYSIS OF TRADITIONAL RICE (ORYZA SATIVA L.) VARIETIES IN THANJAVUR DISTRICT: IMPLICATIONS FOR CONSUMER AWARENESS, CONSUMPTION PATTERNS AND SUSTAINABLE AGRICULTURE

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ABSTRACT

Traditional rice (Oryza sativa L.) varieties are gaining importance because of their nutritional value, medicinal properties and role in sustainable agriculture. Among them, Karuppu Kavuni, a traditional black rice variety of Tamil Nadu, is well known for its rich antioxidant and bioactive compound content. The present study analyzed the value chain, economic viability, consumer awareness and marketing efficiency of traditional rice varieties in Thanjavur district, Tamil Nadu, with special focus on Karuppu Kavuni rice. Primary data were collected from farmers, rice millers, wholesalers, retailers and 150 consumers through a structured questionnaire, while secondary information was obtained from journals, reports and related publications. Economic tools such as cost and returns analysis, benefit-cost ratio, price spread analysis and value chain analysis were employed. The total cultivation cost of Karuppu Kavuni rice was Rs. 41,460.15 per acre, with a gross return of Rs. 58,800 and a benefit-cost ratio of 1.42, indicating profitability despite high production costs. Direct marketing channels provided the highest farmer's share in the consumer rupee (89.81%) and reduced price spread compared to channels involving intermediaries. Consumers preferred traditional rice mainly because of its nutritional and health benefits. Karuppu Kavuni rice contains important bioactive compounds such as anthocyanins, phenolics, flavonoids, γ-oryzanol, carotenoids and tocopherols, which possess strong antioxidant, antidiabetic, anti-inflammatory and cardioprotective properties. However, constraints such as high labour costs, poor market access, limited consumer awareness, inadequate processing facilities and dependence on intermediaries continue to hinder the wider cultivation and commercialization of traditional rice varieties.

KEYWORDS: Traditional rice (Oryza sativa L.), Karuppu Kavuni, Cost of cultivation, Value chain analysis, Sustainable agriculture.

INTRODUCTION

Rice (O. sativa L.) is one of the most widely cultivated and consumed cereal crops in the world and serves as the staple food for nearly half of the global population. It contributes approximately 21% of the total dietary energy requirement worldwide and accounts for nearly 76% of caloric intake in Southeast Asian countries (Mohidem et al., 2022). Besides being a major energy source, rice contains essential nutrients such as carbohydrates, proteins, dietary fiber, vitamins and minerals. Owing to its low fat and gluten-free nature, rice is considered a healthy dietary component that may reduce the risk of chronic diseases (Sobhana et al., 2023). Furthermore, rice plays a crucial role in food security, rural employment and economic development, especially in developing countries (Bin Rahman and Zhang, 2023).

Rice grains are nutritionally rich and contain several bioactive compounds including phenolics, flavonoids, anthocyanins, tocopherols, tocotrienols, sterols, terpenoids and γ-oryzanol, which exhibit strong antioxidant properties and contribute to the prevention of cardiovascular diseases and diabetes (Mohidem et al., 2022). Rice is also a good source of thiamine, folic acid, calcium, iron, and vitamin E. However, polishing significantly reduces its nutritional quality, causing substantial losses of vitamins and minerals such as vitamin B1, B3, B6, manganese and phosphorus (Kowsalya et al., 2022).

Globally, rice production has increased more than threefold since 1961, reaching approximately 755 million tonnes, with Asia contributing the majority of production. Countries such as China, India, Indonesia, Bangladesh, Vietnam, Myanmar and Thailand together account for over 80% of global rice production (Bin Rahman and Zhang, 2023). According to the United States Department of Agriculture (USDA), China and India are the leading rice producers globally, producing 148.30 and 120.00 million tonnes, respectively, during 2020-2021 (Mohidem et al., 2022). Despite the dominance of modern high yielding varieties (HYVs) introduced during the Green Revolution, increasing attention is now being directed

toward traditional rice varieties because of their superior nutritional quality, medicinal value and adaptability to adverse environmental conditions (Udhaya Nandhini et al., 2023).

Traditional rice varieties, also referred to as indigenous or landrace varieties, have evolved over centuries under specific agro climatic conditions and possess immense genetic diversity. These varieties are rich in nutrients, phytochemicals and medicinal properties, making them valuable resources for sustainable agriculture and human health. However, the Green Revolution of the 1960s and 1970s led to the widespread adoption of HYVs, resulting in the gradual disappearance of numerous indigenous rice varieties. India alone is reported to have lost more than one lakh native rice varieties after the 1970s due to the increasing preference for HYVs (Eliazer Nelson et al., 2019). This genetic erosion has increased vulnerability to climate stress, pests, and nutritional deficiencies.

India is recognized as one of the world's richest centers of rice biodiversity. Before the Green Revolution, the country possessed thousands of indigenous rice varieties differing in grain quality, medicinal properties, culinary applications and ecological adaptability (Umadevi et al., 2012). Traditional rice varieties are known to contain higher levels of vitamins, minerals, dietary fiber and antioxidants and are reported to provide protection against diabetes, obesity, and cardiovascular diseases (Eliazer Nelson et al., 2019). Several Indian traditional rice varieties such as Kattuyanam, Kavuni, Mappillai Samba, Poongar and Navara possess important phytochemicals with antioxidant, hepatoprotective, anticancer and antidiabetic properties (Kowsalya et al., 2022).

Tamil Nadu possesses a rich heritage of traditional rice cultivation and is home to numerous indigenous rice varieties including Mappillai Samba, Karuppu Kavuni, Karunguruvai, Seeraga Samba, Thooyamalli, Kichili Samba and Poongar (Balasubramanian et al., 2019). The Cauvery delta region, particularly Thanjavur district, is historically referred to as the "Rice Bowl of South India" due to its extensive rice cultivation practices. Traditional rice varieties cultivated in this region are known for their superior nutritional quality, resilience to climatic stress, and medicinal importance (Manikandan et al., 2025). Metabolomic studies on traditional rice varieties from the Cauvery delta region, including Chinnar, Chithiraikar, Karunguruvai, Kichili Samba and Thooyamalli, have confirmed the presence of valuable bioactive compounds and enhanced nutritional properties (Udhaya Nandhini et al., 2023).

Among the traditional rice varieties of Tamil Nadu, Karuppu Kavuni, a black pigmented rice has gained considerable scientific attention because of its exceptional nutritional and therapeutic properties. Karuppu Kavuni is particularly rich in phenolic compounds, flavonoids, anthocyanins, tannins, proanthocyanidins, carotenoids, dietary fiber, resistant starch and essential minerals such as iron, zinc, calcium, magnesium and potassium (Valarmathi et al., 2015; Kowsalya et al., 2022; Rasaily et al., 2024). The major anthocyanins present in Karuppu Kavuni include cyanidin-3-glucoside and peonidin-3-glucoside, which contribute to its intense pigmentation and potent antioxidant activity (Sassikumar et al., 2025). GC-MS studies have also identified several bioactive metabolites such as linoleic acid, oleic acid, tocopherols, γ-sitosterol, alkaloids, terpenoids, and saponins in this rice variety (Ashokkumar et al., 2020; Palaniswamy et al., 2024). These compounds are associated with antidiabetic, anti-inflammatory, anticancer, antimicrobial, antiarthritic, and cardioprotective activities (Das et al., 2023; Javed et al., 2025). Moreover, the high anthocyanin content of Karuppu Kavuni has been reported to inhibit α-amylase and α-glucosidase enzymes, thereby supporting glycemic control and diabetes management (Ramanathan et al., 2022).

Despite the nutritional, medicinal and economic importance of traditional rice varieties, their cultivation area is steadily declining due to factors such as high cultivation costs, inadequate government support, poor seed availability, limited market awareness and dependence on middlemen (Vijayakrishna et al., 2019). Additionally, conventional rice processing technologies are often unsuitable for traditional varieties, resulting in grain breakage and quality deterioration (Venkatesan et al., 2023). Therefore, there is an urgent need to conserve and promote indigenous rice varieties through scientific evaluation, value addition and effective value chain development.

In this context, assessing the nutritional significance, bioactive potential, cultivation practices, processing challenges, and market opportunities of traditional rice varieties, particularly Karuppu Kavuni from the Thanjavur region, is essential for ensuring sustainable agriculture, improving farmer livelihoods and enhancing consumer awareness regarding functional foods.

2.MATERIALS AND METHODS

2.1 Study area and sampling design

The present study was conducted in Thanjavur, one of the major rice-producing districts of Tamil Nadu. The district is located in the Cauvery delta region and is well known for its favorable agro-climatic conditions, fertile alluvial soils and adequate irrigation facilities, which support both conventional and traditional rice cultivation. Thanjavur district was purposively selected for the study due to its importance in rice production and the increasing cultivation and consumption of traditional rice varieties such as Karuppu Kavuni rice. Both primary and secondary data were used for the study. A multi-stage sampling technique was adopted, in which the district and major paddy growing areas were selected purposively, while respondents from each category were selected randomly. A total of 150 consumers were surveyed to assess their awareness, availability and consumption of traditional rice and related products. Secondary data were collected from research articles, government reports and other relevant databases to support and validate the study findings

2.2 Descriptive analysis

The socio-economic background of the respondents, as well as their consumption habits when it comes to traditional varieties of rice, was evaluated through descriptive statistical measures. Simple percentages and arithmetic means were used to analyze the gathered data. Percentage analysis, which is very useful in comparing different sub-groups within a

sample population on categorical bases like age, sex, educational attainment, occupation, income and family size (Kothari et al., 2004) was formulated as follows:

$$\text{Percentage analysis} = \frac{\text{No of samples taken}}{\text{Total no of samples}} \times 100$$

2.3 Production analysis

2.3.1 Cost of cultivation

The cost of cultivation and its economic benefits through conventional paddy cultivation was determined on the basis of cost principles defined by the Commission on Agricultural Costs and Prices (CACP), Government of India. The concepts of cost mentioned above are quite popular among researchers in agricultural economics in India (Venkateswarlu et al., 2021, Birthal et al., 2013). The cost components considered were Cost A1, A2, B1, B2, C1, C2 and C3. Among these, Cost C3, encompassing all actual and imputed costs along with a managerial allowance was treated as the total cost of cultivation, following the methodology recommended by Sharma (Majumdar et al., 2020). The per-unit cost of production was estimated as:

$$\text{Cost of production} = \frac{\text{(Cost C1 – Value of by-product)}}{\text{Quantity of main product produced}}$$

2.3.2 Measurement of variables

Costs of input, which include seeds, labor, fertilizer, irrigation and machinery were measured according to their actual consumption and market prices as indicated in the stated procedure (Kumar et al., 2023). Labor was converted to man days with proper coefficients for women and children's labor as suggested by CACP standards. Interest rates for working and fixed capital were determined using institutional interest rates, while depreciation was calculated using the straight line method (Barkley et al., 2016).

2.3.3 Returns

2.3.3.1 Gross returns

Gross returns were estimated by multiplying the quantity of the main product and by-product with their respective market prices.

Gross return = Quantity of main product (in kg/acre) × Price (Rs/kg) + Quantity of by-product (in quintals/acre) × Price (Rs/quintal)

2.3.3.2 Net returns

Net returns were derived by deducting the total cost of cultivation from the gross returns.

Net return = Gross return – Total cost of cultivation.

2.3.3.3 Benefit-cost ratio

The Benefit-Cost (B:C) ratio was computed to assess the economic viability of traditional rice cultivation, following the methodology described by Reddy (Ben Hassen et al., 2017):

$$\text{B: C ratio} = \frac{\text{GR}}{\text{TC}}$$

A B: C ratio greater than one indicates that the enterprise is economically viable, while a ratio less than one signifies unprofitability.

2.3 Marketing analysis

2.3.1 Marketing cost

Marketing cost encompasses all expenditures incurred in the movement of produce from the farm gate to the final consumer, including processing, packaging, transportation, storage and intermediary services (Acharya et al., 2004). Total marketing cost was estimated as:

TMC = CF + MC1 + MC2 + MC3 + … + MCn

Where, TMC = Total marketing cost; CF = Cost received by producers and MCn= Cost incurred by the nth intermediary involved in the buying and selling process.

2.3.2. Marketing margin

Marketing margin represents the share of the final consumer price retained by intermediaries after accounting for marketing costs (Kohls et al., 2002). Both absolute and percentage margins were computed to evaluate value distribution along the marketing chain.

1.Absolute margin of the ithmiddleman (Ami)

$A_{mi} = P_{Ri} - (P_{Pi} + C_{mi})$

$$Pmi = \frac{PRi - (PPi + Cmi)\ Pni}{PRi} \times 100$$

Percentage margin of the ithmiddleman (Pmi)

Where, PRi = Total value of receipts per unit (sale price); Ppi = Purchase value of goods per unit (purchase price) and Cmi = Cost incurred on marketing per unit

2.3.3 Price spread

Price spread, defined as the difference between the consumer price and the farm gate price, was analysed to evaluate the efficiency of the marketing system and the extent of value appropriation by intermediaries (Lusk et al., 2021).

2.4 Producer's share in consumer's rupee

The producer's share in the consumer's rupee was calculated to determine what proportion of the retail price ultimately accrues to the farmer (Barman et al., 2025).

$$PS = \frac{Pf}{Pr} \times 100$$

Where, PS = producer's share in consumer's rupee (per cent); Pf = producer's price (Rs/Kg) and Pr = price paid by the consumers (Rs/Kg).

2.5 Value chain analysis

The Value chain analysis (VCA) exercise was performed to document the value chain of traditional rice from its production all the way to consumer use. The theoretical model employed herein takes into consideration the value chain analysis model presented by Kaplinsky & Morris (Kaplinsky et al., 2000). This involves examining value creation, costs incurred, and margins along the chain. Stakeholders in the traditional rice value chain that were involved in this study include farmers, millers, merchants, wholesalers, retailers, and consumers.

3.RESULTS

3.1 Cost and returns from traditional rice varieties

Table 1: Cost and returns for traditional rice varieties (Rs/Acre)

S. No	Particulars	Karuppukavuni	Percentage
	Labour charges	7200	17.85
	Land preparation (Twice plough)	7700	19.1
	Seed cost (10 kg/ acre)	1300	3.23
	Manures	3600	8.92
	Machine labour	3500	8.67
	Irrigation	1700	4.22
	Fertilizers	750	1.86
	Plant Protection Chemicals	900	2.23
	Depreciation on farm implements and farm buildings	850	2.11
	Land tax	15	0.04
	Sub total	27515	68.23
	Interest on working capital @ 7 %	1926.05	4.78
	Cost A1	29441.05	73.01
	Rent paid for leased land	–	0
	Cost A2	29441.05	73.01
	Interest value of own fixed capital @12%	1450	3.6
	Cost B1	30891.05	76.61
	Rental value of own land	6800	16.86
	Cost B2	37691.05	93.47
	Imputed value of family labour	–	0
	Cost C1	30891.05	76.61
	Imputed value of family labour taxes and interest on working capital	–	0
	Cost C2	37691.05	93.47
	10 per cent of cost C2	3769.1	6.53
	Cost C3(total cost of cultivation)	41460.15	100

The cost of cultivation (C3) of Karuppu Kavuni rice is shown in Table 1 to be Rs. 41,460.15 per acre, which is an indication of the relatively high amount of investment needed for cultivation. The cost of land preparation and labour constituted the largest portion of the total cost of cultivation, accounting for 19.10% and 17.85%, respectively. This shows that the cultivation of traditional rice is labour intensive. From the cost structure, there is evidence that shows variable costs form a high proportion of the overall cost of production, which reflects the heavy dependence on labor and use of inputs. Moreover, the value of rented land formed 16.86 percent of the total cost of production, highlighting the significance of land as an economic consideration in rice production. According to the results in Table 2 below, the yield of the rice type is 980kg per acre, with an average price of Rs. 60 per kg, thus giving a gross income of Rs. 58,800 per acre. The net income from the rice was Rs. 17,339.85, showing that the cost of production is high but farmers still make profits According to Table 2, the BCR of 1.42 proves that farming of Karuppu Kavuni rice is economically feasible because its earnings are higher than its total cost. But there seems to be some risk in terms of profitability, as its margin of profit is not too high. Additionally, the cost of production has been found to be fairly high at Rs. 41.50 per kg; however, it has also been proved to be quite reasonable due to its high selling price in the market.

Table 2: Cost of production of paddy (Rs/Acre)

S. No	Particulars	Karuppukavuni
	Yield (kg/acre)	980.00
	Price (kg)	60.00
	Gross Return	58800.00
	Net Return	17339.85
	Benefit cost ratio (BCR)	1.42
	Value of by product (straw value)	800.00
	Cost of Production (Rs/kg)	41.50

3.2 Price spread analysis and marketing efficiency of Karuppu Kavuni rice

Karuppu Kavuni rice price range analysis based on various marketing methods, illustrated in Table 3, shows considerable disparities in marketing efficiency and farmer rupees in the consumer's rupee. In Channel I (Producer → Consumer), The farmer obtained a gross price of Rs. 16,500 and net price of Rs. 14,819, having incurred a marketing cost of Rs. 1,681, thus yielding the highest percentage of farmer's share i.e., 89.81%, along with the least price spread of Rs. 1,681. This clearly shows that direct marketing is the most effective mode, as it avoids intermediaries. In contrast, Channel II (Producer → Rice Miller → Retailer → Consumer) shows a reduction in the farmer's share to 48.69%, with a net price of Rs. 6,015 and a higher price spread of Rs. 6,357, due to additional costs and margins incurred by rice millers and retailers. Similarly, in Channel III (Producer → Rice Miller → Wholesaler → Retailer → Consumer), the farmer's share further declines to 43.83%, while the price spread increases to Rs. 7,729, which is the highest among all channels, reflecting the impact of multiple intermediaries on increasing marketing costs and reducing producer returns.

Table 3: Price spread analysis of Karuppu Kavuni

S. No	Particulars	Karuppu Kavuni					
	Marketing channel	I	%	II	%	III	%
A. Producers							
1	Gross price received	16500	100	6300	50.98	6300	45.9
	Marketing cost						
	Gunny bags cost	146	0.89	146	1.18	146	1.07
	Loading and unloading charges	31	0.19	18.5	0.15	18.5	0.13
	Transportation cost	66	0.4	27.5	0.22	27.5	0.2
	Weighing charges	30.5	0.18	19	0.16	19	0.14
	Waste charges (Harvesting losses, winnowing losses, drying losses)	11	0.07	0	0	0	0
	Drying cost	147	0.89	73.5	0.59	73.5	0.53
	Parboiling cost	660	4	0	0	0	0
	Milling cost	551	3.34	0	0	0	0
	Packing cost	27.5	0.17	0	0	0	0
	Sales tax	11	0.07	0	0	0	0
2	Total marketing cost	1681	10.19	1396	1396	1396	1396
3	Net price received	14819	89.81	6015	48.68	6015	43.83
B. Rice millers							
1	Purchase price	0.00	0.00	6300	50.98	6300	45.9

S. No	Particulars	Karuppu Kavuni					
	Marketing channel	I	%	II	%	III	%
2	Processing cost	0.00	0.00	1295	1295	1295	1295
3	Marketing cost	0.00	0.00	101	101	101	101
4	Total marketing cost	0.00	0.00	1396	11.28	1369	10.16
5	Marketing margin	0.00	0.00	3000	26.66	3000	24
6	Sales price	0.00	0.00	11000	88.92	11000	80.05
C. Wholesalers							
1	Purchase price	0.00	0.00	0.00	0.00	11000	80.05
1	Marketing cost	0.00	0.00	0.00	0.00	52.00	0.37
2	Marketing margin	0.00	0.00	0.00	0.00	1320	9.60
3	Sales price	0.00	0.00	0.00	0.00	12372	90.03
D. Retailers							
1	Purchase price	0.00	0.00	11000	88.92	12372	90.03
2	Marketing cost	0.00	0.00	52	0.42	52	0.37
3	Marketing margin	0.00	0.00	1320	10.66	1320	9.60
4	Sales price	0.00	0.00	12372	100	13744	100
E. Consumers							
1	Purchase price	16500	100	12372	100	13744	100
	Price spread	1681	10.19	6357	51.32	7729	56.17
	Farmers share in consumer rupee	89.81	-	48.69	-	43.83	-

3.3 Value chain of Karuppu Kavuni variety in the rice production

Table 4: Value chain of Karuppu Kavuni variety in the rice production

Stakeholder	Source	Purchasing price	Processing/ marketing charges	Processed output	Processed output Kg/Qtl	Price/ Kg	Value	Gross return	Total cost	Value added (Rs. /Qtl)	per cent
Value chain of Karuppu Kavuni variety in the rice production (Rs/Qtl)											
Farmer	-									6300	52
Rice miller	Farmer	6300	1300	Rice	70.0	140	9800	10450	7600	2850	24.1
				Broken rice	2.0	90	180				
				Husk	27.0	20	540				
				Waste	1.0	0.0	0.0				
Wholesaler	Rice miller	10450	60	Rice	70	170	11900	11900	10510	1390	11.75
Retailer	Wholesaler	11900	60	Rice	70	190	13300	13300	11960	1340	11.33
Consumer	Retailer	13300									
Total value addition (Rs/Qtl)										13,300	100
Net value addition (Rs/Qtl)										5,580	

Table 4 explains the value chain of Karuppu Kavuni rice by showing the costs, returns, and value addition at different stages from farmers to consumers. Farmers sell paddy at Rs. 6,300 per quintal, contributing about 52 % of the final consumer price, which shows that production forms the major share of the value chain. The rice miller plays a major role in value addition by processing paddy into edible rice and by-products such as husk and broken rice, with a processing cost of Rs. 1,300 This stage contributes the highest increase in value because processing improves the quality and market price of the rice. The wholesaler purchases rice for Rs. 10,450 spends Rs. 60 on marketing and sells it for Rs. 11,900 adding Rs. 1,390 (11.75%) through storage, transport and distribution activities. Similarly, the retailer buys rice for Rs. 11,900 spends Rs. 60 on marketing, and sells it to consumers for Rs. 13,300 adding Rs. 1,340 (11.33%) in value. The total value addition in the chain is Rs. 5,580 and the final consumer price is Rs. 13,300 per quintal. The analysis shows that although farmers contribute most to the base value, the processing stage adds the highest additional value, while the presence of several intermediaries reduces the share received by farmers in the final consumer price.

3.4 Reason for consumption of traditional rice and its value-added products

Table 5: Reason for consumption of traditional rice and its value-added products

S. No	Reason for consumption	No. of respondents	Percentage
	High nutritional value and health benefits	72	48.00

	Preference for chemical free and organically grown food	41	27.33
	Medicinal properties and suitability for specific health conditions	31	20.67
	Better taste and traditional food habits	4	2.67
	Growing awareness about healthy lifestyles and indigenous food systems	2	1.33
Total		150	100.00

Distribution of respondents according to reasons for consumption of traditional rice and its processed products. In Table 5 above, the distribution of respondents according to the reasons for consumption of traditional rice and its processed products has been provided. It can be seen that from the total number of 150 respondents, 48.00% believed that high nutrition was the main reason for consumption, which shows that consumers have opted for healthy food options. In second place, 27.33% responded that chemical free, organically grown rice was their choice.Moreover, 20.67% of the interviewees ate rice traditionally due to its healing qualities and compatibility with certain health problems. The taste factor was cited by 2.67% of the interviewees. This suggests that cultural considerations are less influential than health considerations. Lastly, an insignificant percentage of 1.33% claimed that increased knowledge of healthy living and traditional foods motivated them to eat rice traditionally. In conclusion, it is quite clear from the results that health and nutrition considerations dominate the consumption pattern, whereas the factors of taste and awareness play only a secondary role. This implies that highlighting the nutritional and therapeutic values of rice can boost its sales to a considerable degree.

3.5 Consumer awareness of traditional rice and its value-added products

Table 6: Consumer awareness of traditional rice and its value-added products

S. No	Level of Awareness	No. of Respondents	Percentage
1.	Slightly aware	33	22.00
2.	Partially aware	43	28.67
3.	Highly aware	74	49.33
Total		150	100.00

The degree of consumer awareness with respect to the traditional rice and their value-added products is provided in Table 6 above. It was observed that nearly half (49.33%) of the total respondents of 150 individuals had high awareness levels, thereby pointing out towards a high degree of awareness on traditional rice. This implies that awareness and health consciousness activities have played an influential role in shaping consumer attitudes. On the other hand, around one-fourth (28.67%) of the total respondents were partially aware. This means that they are aware of traditional rice but not fully about its value-added products. The findings reveal that despite the considerable level of awareness, more effort is needed to increase the awareness levels among partly and barely aware individuals via proper promotions and marketing in order to increase the consumption of traditional rice and its value-added products.

3.6 Availability of traditional rice and value-added products

Table 7: Availability of traditional rice and value-added products

S. No	Availability in local market	No. of respondents	Percentage
	Not available	11	7.33
	Rarely available	23	15.33
	Sometimes available	21	14.00
	Mostly available	42	28.00
	Always available	53	35.33
Total		150	100.00

Availability of traditional rice as well as the availability of value-added products from traditional rice is shown in Table 7 above. Out of the total respondents of 150, 35.33% reported that they are always available, and another 28.00% said that these products were mostly available. This indicates that the traditional rice products have a reasonably high level of availability in the market. On the other hand, 14.00% of respondents stated that traditional rice products were sometimes available, while 15.33% reported it to be rarely available. Additionally, 7.33% of respondents mentioned that traditional rice was unavailable at local markets, showing the need for better distribution channels. In summary, results show that while traditional rice and its value addition products are easily available, further steps should be taken to ensure availability and better distribution systems.

4.discussion

The present investigation revealed that the cultivation and value chain of traditional rice varieties, particularly karuppu kavuni rice, possess considerable economic, nutritional, and therapeutic significance despite the relatively high cost of

cultivation. The cost of cultivation of karuppu kavuni rice was estimated at rs. 41,460.15 per acre, mainly due to higher labour requirements, land preparation costs, and input utilization. Nevertheless, the crop generated a gross return of rs. 58,800 per acre with a benefit-cost ratio of 1.42, indicating that traditional rice cultivation remains economically feasible and profitable under favorable market conditions. Similar observations were reported by ben hassen et al. (2017), who stated that traditional rice varieties often obtain premium market prices due to their superior nutritional quality and increasing consumer preference for healthy foods. The study further demonstrated that direct marketing channels significantly improved the farmer's share in the consumer rupee (89.81%) and reduced price spread, whereas the involvement of intermediaries substantially reduced producer profits. These findings are in accordance with the observations of vijayakrishna et al. (2019), who reported that direct farmer-to-consumer marketing systems increase profitability and market efficiency for traditional rice growers. The value chain analysis also indicated that rice millers contributed the highest value addition through processing activities, which improved the quality, shelf life, and market value of the rice. However, the presence of multiple intermediaries increased marketing costs and reduced the share received by farmers, highlighting the need for efficient and farmer-centered marketing strategies.

The increasing consumer preference for karuppu kavuni rice observed in the present study is primarily associated with its exceptional nutritional and bioactive composition. Traditional pigmented rice varieties are widely recognized as functional foods because of their rich content of health-promoting phytochemicals and nutraceutical compounds. Karuppu kavuni rice contains high levels of dietary fiber, resistant starch, proteins, essential amino acids, vitamins, and minerals such as iron, zinc, calcium, magnesium, phosphorus, and potassium, which contribute significantly to nutritional security and metabolic health. In addition to these nutrients, the rice possesses several biologically active compounds including phenolics, flavonoids, anthocyanins, tannins, proanthocyanidins, tocopherols, tocotrienols, γ-oryzanol, carotenoids, terpenoids, alkaloids, saponins, and phytosterols such as γ-sitosterol. These compounds are known for their strong antioxidant potential and therapeutic properties. Studies conducted by kowsalya et al. (2022) and valarmathi et al. (2015) reported that traditional pigmented rice varieties possess significantly higher antioxidant activity compared to modern polished rice due to the abundance of anthocyanins and phenolic compounds. The major anthocyanins identified in karuppu kavuni rice, namely cyanidin-3-glucoside and peonidin-3-glucoside, are responsible for its characteristic black pigmentation and strong free radical scavenging activity. These compounds help in reducing oxidative stress, delaying cellular aging, and preventing chronic degenerative diseases.

Several supporting studies have highlighted the medicinal importance of black rice varieties such as karuppu kavuni. Das et al. (2023) reported that black rice exhibits potent anti-inflammatory, antidiabetic, anticancer, antimicrobial, antiobesity, hepatoprotective, and cardioprotective properties because of its rich phytochemical profile. Likewise, javed et al. (2025) emphasized that black rice is emerging as an important functional food owing to its therapeutic and nutraceutical benefits. The high anthocyanin content of karuppu kavuni rice has been shown to inhibit α-amylase and α-glucosidase enzyme activities, thereby slowing carbohydrate digestion and helping to regulate postprandial blood glucose levels. This property makes the rice particularly beneficial for diabetic patients and individuals with metabolic disorders. Ramanathan et al. (2022) also confirmed the molecular mechanisms associated with the therapeutic potential of kavuni rice and reported its effectiveness in glycemic regulation. In addition, the resistant starch and dietary fiber present in traditional rice improve digestive health, enhance gut microbiota, reduce cholesterol absorption, and lower the risk of cardiovascular diseases. The iron-rich nature of karuppu kavuni rice also helps in preventing anemia and improving hemoglobin levels, especially among women and children.

Metabolomic studies by udhaya nandhini et al. (2023) confirmed the abundance of nutraceutical metabolites and therapeutic compounds in traditional rice cultivars from the cauvery delta region of tamil nadu. Similarly, ashokkumar et al., 2020 and vellaiyan et al. (2024) identified several bioactive metabolites such as linoleic acid, oleic acid, tocopherols, and terpenoids in indigenous rice varieties through gc-ms profiling. These compounds possess strong antioxidant, anti-inflammatory, and immune-enhancing activities that support human health and disease prevention. Furthermore, chimmili et al. (2021) highlighted the presence of lutein and carotenoid compounds in kavuni rice, which are beneficial for eye health and may reduce the risk of age-related macular degeneration. The increasing demand for chemical-free and organically cultivated traditional rice observed among consumers in the present study further supports the findings of dewan et al. (2023), who reported a growing global interest in pigmented rice varieties because of their nutritional superiority and health-promoting effects.

Despite these advantages, the study identified several constraints affecting the production and commercialization of traditional rice varieties. Climate variability, inadequate irrigation facilities, high labour costs, poor processing technologies, limited market access, lack of quality seed availability, and dependence on intermediaries continue to hinder large-scale cultivation and marketing. Inadequate consumer awareness regarding the nutritional and medicinal benefits of traditional rice also limits wider adoption. Similar constraints were documented by eliazer nelson et al. (2019), who reported that the green revolution led to the decline of indigenous rice varieties due to the dominance of high-yielding varieties and changing agricultural practices. Therefore, effective policy interventions are necessary to conserve traditional rice biodiversity and improve farmer livelihoods. Strengthening direct marketing systems, establishing farmer producer organizations, improving processing infrastructure, promoting value-added products, and conducting awareness campaigns regarding the health benefits of karuppu kavuni rice can significantly enhance consumer demand and market opportunities. Overall, the present study emphasizes that karuppu kavuni rice is not only economically viable but also nutritionally and therapeutically valuable, making it an important traditional functional food capable of contributing to sustainable agriculture, food security, and public health improvement.

5.CONCLUSION

The present study clearly demonstrated that the cultivation and value chain of traditional rice varieties, particularly Karuppu Kavuni rice, possess substantial economic, nutritional, and therapeutic importance despite relatively higher production costs. The total cost of cultivation (Cost C3) was estimated at Rs. 41,460.15 per acre, of which land preparation (19.10%) and labour charges (17.85%) constituted the major share, indicating the labour-intensive nature of traditional rice cultivation. However, the crop yielded 980 kg per acre with a gross return of Rs. 58,800 and a net return of Rs. 17,339.85, resulting in a favorable benefit-cost ratio of 1.42, confirming the economic viability of Karuppu Kavuni cultivation under suitable market conditions. The marketing analysis revealed considerable differences among marketing channels, where direct marketing (Producer → Consumer) provided the highest farmer's share in the consumer rupee (89.81%) with the lowest price spread (Rs. 1,681), whereas the involvement of intermediaries in Channel III reduced the farmer's share to 43.83% and increased the price spread to Rs. 7,729. This indicates that direct marketing systems improve producer profitability and marketing efficiency. The value chain analysis further showed that farmers contributed nearly 52% of the total consumer value, while rice millers added the highest additional value (24.1%) through processing activities such as milling, grading, and packaging, thereby increasing market quality and consumer acceptability. Consumer survey results indicated that 48% of respondents consumed traditional rice mainly because of its high nutritional value and health benefits, while 27.33% preferred it due to its chemical-free and organically grown nature, demonstrating increasing health consciousness among consumers. Nearly 49.33% of consumers were highly aware of traditional rice and its value-added products, and 35.33% reported that these products were always available in local markets, suggesting growing market demand. The increasing preference for Karuppu Kavuni rice is mainly attributed to its exceptional nutritional profile and abundance of bioactive compounds. Karuppu Kavuni rice is rich in dietary fiber, resistant starch, proteins, iron, zinc, calcium, magnesium, potassium, vitamins, phenolics, flavonoids, anthocyanins, tannins, tocopherols, tocotrienols, γ-oryzanol, carotenoids, alkaloids, saponins, and phytosterols. The major anthocyanins, cyanidin-3-glucoside and peonidin-3-glucoside, possess strong antioxidant activity that helps reduce oxidative stress and lower the risk of chronic diseases. The rice also exhibits antidiabetic, anti-inflammatory, anticancer, antiobesity, antimicrobial, hepatoprotective, and cardioprotective properties due to its rich phytochemical composition. Furthermore, the resistant starch and dietary fiber present in the rice improve digestive health, enhance gut microbiota, reduce cholesterol absorption, and support glycemic control, while its iron-rich nature helps prevent anemia. Despite these advantages, constraints such as climate variability, inadequate irrigation facilities, high labour costs, poor processing technologies, limited market access, lack of quality seed availability, and dependence on intermediaries continue to hinder wider cultivation and commercialization of traditional rice varieties. Therefore, strengthening direct marketing channels, improving processing infrastructure, promoting value-added products, and creating greater consumer awareness regarding the nutritional and medicinal benefits of Karuppu Kavuni rice are essential for improving farmer income, conserving indigenous rice biodiversity and supporting sustainable and health-oriented food systems.

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Conflict of interest

We do not have any conflict of interest to declare.

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