Original Research Article

Economic analysis of production and primary processing of turmeric in Chamarajanagar district of Karnataka

Abstract

This study investigates the economic dynamics of turmeric production and primary processing in Chamarajanagar district, Karnataka, spotlighting the critical role of this region in bolstering India's reputation for producing high-curcumin-content turmeric. Despite the burgeoning domestic and international markets for turmeric, which have contributed to the crop's substantial growth in production and productivity over recent decades, a notable gap in organized processing units at the local level persists. Through a detailed analysis of the economic aspects encompassing both cultivation and primary processing phases among turmeric growers in the district, findings revealed that farmers accrue a net return of ₹ 18,134 per acre from cultivation after incurring costs of ₹ 86,424, and a higher net return of ₹ 24,775 per acre from primary processing with an incurred cost of ₹ 99,439 per acre. The cost-benefit analysis further underscores the economic viability of turmeric cultivation, with ratios of 1.21 without primary processing and 1.25 with it, thereby highlighting the substantial profitability of turmeric production for local growers. However, the study identifies significant challenges, such as labour shortages and elevated wage rates, attributed to the crop's labour-intensive nature. Moreover, while primary processing increases profitability, it also demands considerable labour and time, potentially compromising the quality of turmeric powder. The research suggests that the adoption of advanced technologies and machinery in curing and processing operations could mitigate these challenges, enhancing efficiency and product quality in turmeric cultivation and processing sectors.

Key words: Cost-Benefit analysis, Garret ranking, Primary processing, Cost of cultivation, Gross returns, Net returns

Introduction

India ispopularly known as the 'Spice Bowl of the World,' has a rich history of cultivating an expansive variety of premium quality spices since ancient times(Naik, V., 2022). With a leading position in the global spice production, India contributes to approximately 80 per cent of the worldwide output, producing 75 out of the 109 spice varieties recognized by the International Organisation for Standardisation(Mohan, *et al.,* 2013; Annamuthu, *et al.,* 2019).

This substantial contribution not only underscores India's pivotal role in global spice consumption and export but also highlights its dominance in the international spice market(Nagaraja., 2023). The superior quality and diversity of Indian spices have long captivated the global trade network, marking a significant footprint in the world's culinary landscape (Angles, *et al.*, 2011). In the year 2021-22, the total production of Indian spices was recorded at 10.88 million tonnes, with an export value of USD 330.46 million, witnessing a growth of 6.62 per cent over the previous year.

Among the spices, turmeric stands out not only for its culinary and medicinal value but also for its significant economic contribution. The state of Telangana leads in turmeric production, followed by Maharashtra, Karnataka, Tamil Nadu, and Andhra Pradesh. Specifically, Karnataka emerges as the third-largest producer, contributing 1,30,972 tonnes of turmeric over an area of 20,560 hectares, boasting a productivity rate of 6.38 tonnes per hectare(Anonymous, 2021a). Chamarajanagar district is the leading region in turmeric cultivation within Karnataka, accounting for 33.33 per cent of the total cultivated area with a production of 30,241 tonnes and a productivity of 4.00 tonnes per hectare (Anonymous, 2021b).

The turmeric growers in Chamarajanagar faces significant challenges, primarily due to the absence of sufficient secondary processing facilities within the state. This deficiency necessitates the transportation of produce to neighbouring states for further processing, inflating costs and complicating market access due to increased transportation expenses and the number of market intermediaries.These circumstances not only worsen the vulnerability of farmers to exploitation due to insufficient market price information but also emphasize the urgent requirement for improved production and processing strategies.In response to these challenges, both Central and State governments have initiated various schemes aimed at improving the production and processing systems within the Indian spice sector, recognizing turmeric's importance as a major commercial crop with vast domestic and international markets. This study endeavours to meticulously analyse the cost and returns associated with the production and farm-level processing of turmeric in the Chamarajanagar district of Karnataka. The insights derived from this analysis are intended to assist planners and policymakers in devising effective strategies and policies to bolster the turmeric production and processing landscape in the state, thereby enhancing the socio-economic status of the local farming community and reinforcing India's supremacy in the global spice market.

Methodology

Sampling procedure

The research focused on Chamarajanagar district, Karnataka, a region distinguished by its pre-eminence in turmeric cultivation within the state. The study employed a purposive selection method to choose this district due to its significant role in turmeric production. To ensure a comprehensive analysis, a stratified random sampling design was adopted for the farmer selection process. The stratification was based on four majors hoblis-Haradanahalli, Chandakavadi, Kasaba, and Terakanambialong with Gundlupete taluk, encapsulating a diverse cross-section of the district's turmeric farming community. A total of 60 turmeric-growing farmers, actively engaged in primary processing were selected. These participants were then interviewed using a well-structured and pre-tested schedule to gather relevant data for the study.

Analytical Tools and Techniques Employed

Cost and Returns Analysis

The study aimed to estimate the costs associated with turmeric cultivation and the subsequent primary processing activities conducted by the farmers. This estimation included both direct and imputed costs, representing inputs produced and owned by the farm but valued at their current market prices. The analysis utilized various cost concepts, including variable costs (direct costs that vary with production level), fixed costs (costs that do not change with the level of production) and total costs, to comprehensively understand the economic dynamics of turmeric farming. To delineate the financial outcomes of turmeric cultivation and processing, gross returns and net returns was calculated on a per-acre basisin the study.

- **Cost Structure in Turmeric Cultivation:** The study detailed the components of variable and fixed costs in turmeric cultivation, covering expenses from planting materials to managerial costs and risk premiums.
- **Cost Structure in Turmeric Primary Processing:** It similarly accounted for variable costs in primary processing, including raw material prices and marketing costs, among others.

Return Structure

The study delineated the return structure from both turmeric cultivation and primary processing:

a) Gross returns: Gross returns was worked out by multiplying total yield of turmeric with its unit price.

$$\text{Gross returns (GR)} = \text{Yield} * \text{Price}$$

b) Net returns over variable cost (TVC): Net returns over variable cost was obtained by deducting total explicit cost from gross return and denoted as:

$$\text{Net returns over variable cost} = \text{GR} - \text{TVC}$$

c) Net returns over total cost (TC): Net returns over total cost was worked out by deducting total cost (TC) of production from gross returns.

$$\text{Net returns over total cost} = \text{GR} - \text{TC}$$

d) Returns per rupee of investment: Returns per rupee spent was calculated by dividing gross returns from total costs.

$$\text{Returns per rupee of investment} = \text{GR} \div \text{TC}$$

Garrett Ranking Technique

To identify and rank the challenges faced by turmeric farmers in production and marketing, the Garrett ranking technique was applied. This method involves assigning a rank to each constraint based on its importance, as perceived by the farmers and then converting these ranks into percentage positions using Garrett's formula.

Garrett's formula for converting ranks into per cent was given by

$$\text{Per cent position} = \frac{R_{ij} - 0.5}{N_j} \text{ X } 100$$

Where, R_{ij} = rank given for ith factor by i^{th} individual

N_j = number of factors ranked by j^{th} individual

This approach allowed for the quantification and prioritization of the farmers' challenges, providing a clear indication of the most pressing issues that need to be addressed.By employing these methodologies, the study aimed to offer valuable insights into the economics of turmeric cultivation and primary processing in Chamarajanagar district, alongside identifying the key challenges faced by the local farming community. This comprehensive approach is intended to inform future policy-making and development strategies in the turmeric sector.

Results and Discussions

Stages in cultivation and processing of turmeric

The study presents a comprehensive overview of the traditional and improved methodologies involved in the cultivation and processing of turmeric, as depicted in Figure 1. The cultivation cycle begins with the planting of turmeric rhizomes in June, culminating in their harvest during February and March. Treated rhizomes are strategically dibbled into

ridges at a spacing of 45 cm X 15 cm and to a depth of 4 cm. Initially, farmyard manure is applied, followed by the use of inorganic fertilizers such as urea, DAP, MOP, and complex fertilizers as base doses, with top dressing also being utilized. Weeding can be done three times after planting at 60, 90, and 120 days to ensure optimal growth conditions. Plants usually start lodging around nine to ten months after planting, with crop maturity indicated by yellowing, drying, and lodging of leaves. Subsequent processing stages, which include polishing, grinding, sieving, powdering, and marketing, are executed at the processor level. This detailed cultivation and processing sequence underline the labour-intensive nature of turmeric farming, emphasizing the critical phases where efficiency gains can be made through technological advancements and improved agronomic practices. After digging deeply, the rhizomes are harvested. Post-harvest processing such as curing and drying is carried out at the farm level, while additional processes such as polishing, grinding, sieving, powdering, and marketing are executed at the processor level. Similar results were studied by Singh *et al.* (2020) and reported that the processed (powder) and semi-processed (slice/flakes) forms of turmeric earned good returns, although the powder form of turmeric was predominant. As such, there exists a significant opportunity for interventions aimed at streamlining these processes, reducing labour and cost, and ultimately improving the profitability and sustainability of turmeric farming for growers in the Chamarajanagar district and beyond.

Cost and returns in the production of turmeric

The study examined the economics of turmeric cultivation in Chamarajanagar district, using the costs and returns in turmeric cultivation per acre is presented in Tables 1 and 2. Material inputs, including planting materials, inorganic fertilizers, organic manure and plant protection chemicals accounted for 16.71, 12.83, 5.24 and 0.72 of the total cost, respectively,with corresponding values of ₹ 14,444, ₹ 11,090, ₹ 4,527and ₹ 621. The highest expense was attributed to human labour, amounted ₹ 10,500 and comprising 12.15 per cent of the total cost, followed by machine labour at 2.31 per cent and bullock labour at 0.93 per cent. Interest on working capital was 3.56 per cent of the total cost, accounted for ₹ 3,079.

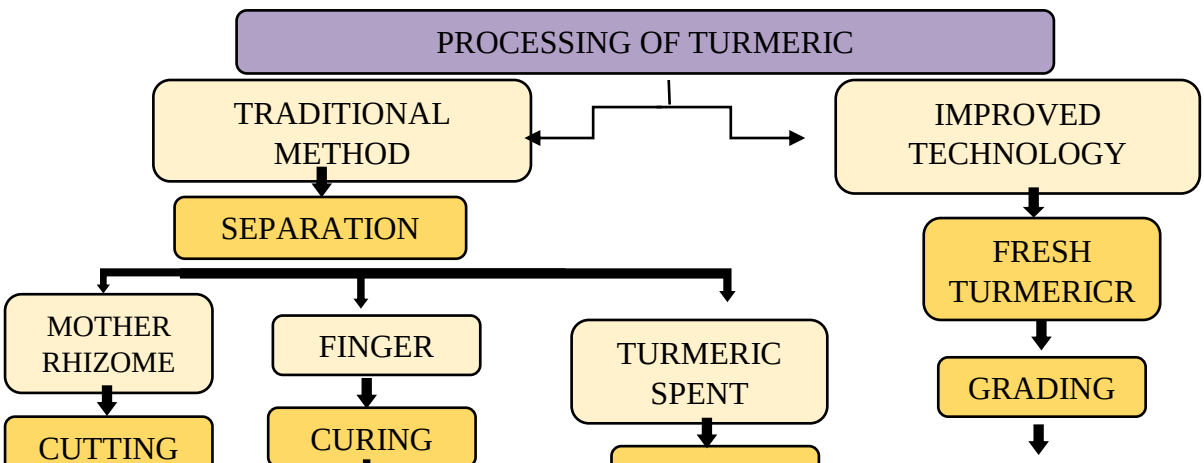

Fig. 1. Flow chart of turmeric processing at field and processor level in traditional andimproved

The expenditure incurred on fixed components such as land revenue, land rent, depreciation on equipment, amortized irrigation cost, managerial cost and interest on fixed capital accounted for 0.09, 24.20, 2.70, 5.54, 8.24 and 4.88 per cent of the total cost of cultivation, respectively (Table 1). Chinnadurai *et al.* (2018) found that large farmers incurred comparatively higher costs and recommended exploring value addition. These findings align with those of Viraja *et al.* (2018) estimated the average cultivation cost per hectare of turmeric to be ₹ 2,04,737 in Navsari district, South Gujarat.

The return from production of turmeric cultivation indicated that, with an average yield of 37.54 quintal per acre and a market price of ₹ 2,785.25 per quintal, farmers earned a gross return of ₹ 1,04,558 per acre. After deducting the total cultivation cost of ₹ 86,424, the net return amounted to ₹ 18,134 per acre (Fig. 2) underscoring the profitability of turmeric farming in the study area. Furthermore, the return on investment was calculated at ₹ 1.21 for every rupee invested, illustrating the efficacy of turmeric cultivation as a source of income for farmers (Table 2). These findings are in line with the results of Govindaswamy *et al.* (2021), reported that a Benefit-Cost ratio greater than one from turmeric cultivation in Coimbatore district, Tamil Nadu.

Table 1: Cost structure incurred in turmeric cultivation (Per acre, n=60)

Sl. No.	Particulars	Unit	Quantity	Total	% to total

				Amount (₹)	cost
I	**Variable cost**				
A	**Material cost**				
a	Planting material	Quintal	6.28	14444.00	16.71
b	Organic manure	Tonnes	3.05	4526.78	5.24
c	Inorganic Fertilizer				
	Urea	Bag	3.67	1101.00	1.27
	DAP	Bag	3.23	5814.00	6.73
	MOP	Bag	2.56	3840.00	4.44
	Complex	Bag	0.67	335.00	0.39
d	Plant protection chemicals	Litre		620.50	0.72
	Subtotal (A)			**30681.28**	**35.50**
B	**Labour cost**				
a	Human labour				
	Men	Man days	6.00	2100.00	2.43
	Women	Man days	42.00	8400.00	9.72
b	Machine labour	Hours	2.00	2000.00	2.31
c	Bullock labour	Hours	1.00	800.00	0.93
	Subtotal (B)			**13300.00**	**15.39**
C	Interest on working capital @ 12%			3078.69	3.56
	Total variable cost			**47059.97**	**54.45**
II	**Fixed cost**				

a	Land revenue			75.00	0.09
b	Land rent			20911.66	24.20
c	Depreciation on equipment			2332.22	2.70
d	Managerial cost			4706.00	5.45
e	Amortized irrigation cost			7122.00	8.24
f	Interest on fixed cost @ 12%			4217.62	4.88
	Total fixed cost			**39364.50**	**45.55**
III	**Total cost of cultivation**			**86424.47**	**100.00**

Table 2: Return from production of turmeric cultivation (Per acre, n=60)

Sl. No.	Particulars	Unit	Quantity	Total Amount (₹)
I	Average Yield	Quintal	37.54	-
II	Average Price			2785.25
III	Gross income			104558.29
IV	Net returns over variable cost			57498.32
V	Net returns over total cost			18133.82
VI	Returns per rupee of investment			1.21

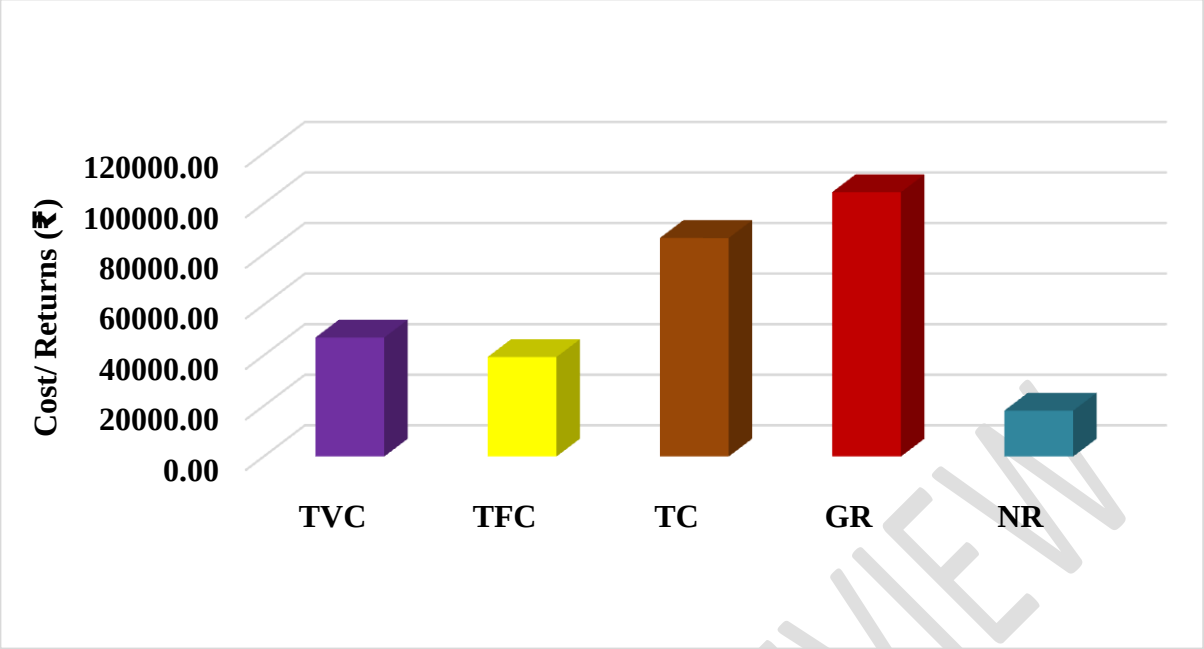

Fig. 2. Cost and returns of turmeric cultivation

Note: TVC: Total Variable Cost, **TFC:** Total Fixed Cost, **TC:** Total Cost, **GR:** Gross Returns, **NR:** Net Returns

Economics of primary processing of turmeric

The cost and returns analysis of primary processing was estimated on per acre basis and presented in the Table 3. After harvesting the turmeric rhizomes undergo picking, cleaning, boiling and drying at the farm level before being sold. Among the material inputs, the expenditure incurred on raw turmeric production, fuel wood, gunny bag and cow dung accounted for 86.91, 5.30, 0.20 and 0.06 per cent of the total cost of primary processing with the corresponding values of inputs were ₹ 86,425, ₹ 5,268, ₹ 200 and ₹ 57.02, respectively. Human labour cost was amounted to ₹ 3,400, which constituted about 3.42 per cent of total cost of primary processing. The expenditure on fixed components includes depreciation on containers (baani), which accounted for 0.88 per cent of the total cost of primary processing. With an average yield of turmeric at 16.83 quintals per acre, the sale price of turmeric after primary processing was ₹ 7,380.52 per quintal in the study area. Similar results are in line with the study conducted by Lokesh and Chandrakanth (2003) in the production and marketing of turmeric cultivation.

Table 3: Economics of primary processing of turmeric (Per acre, n=60)

Sl. No.	Particulars	Unit	Quantity	Total Amount (₹)	% to total
I	**Variable cost**				
A	**Material cost**				
a.	Total cost of production of 37.54 q of raw turmeric			86424.47	86.91
b.	Fuel wood	Truck load	2.84	5268.20	5.30
c.	Gunny bag	No.	8	200.00	0.20
d.	Cow dung	Kg.	47.52	57.02	0.06
	Subtotal(A)			91949.69	92.47
B	Human labour				0.00
a.	Men	Man days	8	2800.00	2.82
b.	Women	Man days	3	600.00	0.60
	Subtotal(B)			3400.00	3.42
C	Interest on variable cost at 7%			624.77	0.63
	Total variable cost			**95974.46**	**96.52**
II	**Fixed cost**				
A	Depreciation on container			880.00	0.88
	Total fixed cost			**880.00**	**0.88**
III	**Marketing cost**			**2584.28**	**2.60**
IV	**Total cost of primary processing**			**99438.74**	**100.00**

V	**Average Yield**	Quintal	16.83		
VI	**Average Price**	₹ per quintal		**7380.52**	
VII	**Gross income**			**124214.15**	
VIII	**Net returns over variable cost**			**28239.69**	
IX	**Net returns over total cost**			**24775.41**	
XI	**Returns per rupee of investment**			**1.25**	

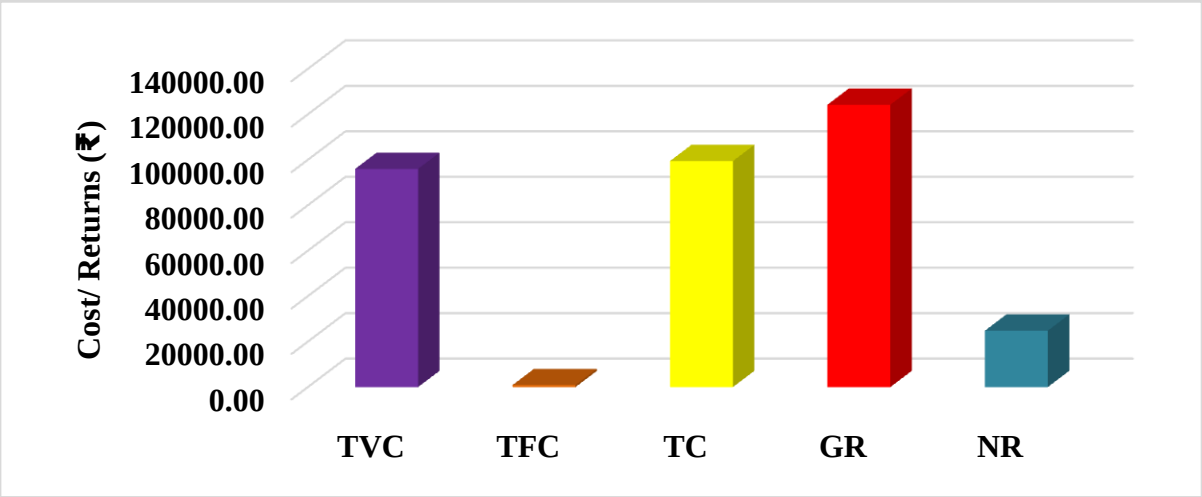

Fig. 3. Cost and returns from primary processing of turmeric

Note: TVC: Total Variable Cost, **TFC:** Total Fixed Cost, **TC:** Total Cost, **GR:** Gross Returns, **NR:** Net Returns

After primary processing, the gross return for farmers amounted to ₹ 1,24,214. Deducting the total cost of turmeric primary processing, which stood at ₹ 99,439, farmers realized net returns over total costs of ₹ 24,775 (Fig. 3). The returns realized by the farmers per rupee of investment was ₹ 1.25. Similar findings were observed in the study conducted by Devi and Bhoi (2022), indicating that farmers who processed turmeric incurred higher total costs compared to those who chose not to process the rhizome. However, a significant difference was observed in price per unit, gross return, net return and the benefit-cost ratio

realized by the farmers who were selling the produce in powder form as compared to fresh, thus made a significantly higher profit in processed than non-processed produce. Girma and Mohammedsani (2021) also reported that post-harvest practices such as washing, boiling, drying and polishing rhizomes were responsible for quality improvement in turmeric.

Constraints faced among the turmeric cultivators

Table 4 presents the production and marketing constraints encountered by turmeric cultivators. It highlights the non-availability of labor, high wage rates, insufficient storage facilities, market price fluctuations, and lack of technical guidance as the primary constraints faced by turmeric cultivators.

Table 4: Constraints faced among sample farmers

Sl. No.	Factors	Garrett score	Rank
1.	Non-availability of labour	93.33	1
2.	High wage rate	91.67	2
3.	Lack of storage facilities	83.33	3
4.	High fluctuation in the market price	66.67	4
5.	Lack of technical guidance	41.67	5

Conclusion

In conclusion, the results of the study indicated that Cost-Benefit analysis of turmeric production without and with primary processing was found to be 1.21 and 1.25, respectively, indicating that the production of turmeric was highly remunerative for growers in the study area. To further enhance profitability, it is imperative to ensure the availability of high-quality turmeric rhizomes at affordable rates, thereby incentivizing farmers to utilize them and bolster their profitability.While primary processing offers increased profitability, it is hindered by labour-intensive and time-consuming procedures that can compromise turmeric powder quality. Therefore, the adoption of advanced technologies and machinery in curing activities is crucial. Addressing the major constraint of labour scarcity and high wage ratesnecessitates the introduction of machinery such as turmeric harvesters, boilersand weeders. Establishing these resources in custom hiring centres would alleviate labour burdens and cultivation costs for farmers ultimately improves their productivity and profitability.

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