Estimation of Tomato Resource Use Efficiency and Cost and Returns per Ha in Raipur District, Chhattisgarh, India

Abstract

"Economic analysis of production and marketing of tomatoes in Raipur, Chhattisgarh" is the topic of the current study. The sample was chosen using a multistage random sampling technique. The Raipur district's 1 Block, 5 Villages, and 60 Tomato Growers were all included in the research. By using the personal interview approach, the main statistics for the season of 2023 were gathered. Different secondary sources were used to gather information on the region, production, and productivity. Tabular analysis was heavily employed to achieve the study's numerous goals. The main conclusions of the study showed that the cost of production per quintal of tomatoes and the cost of cultivation per hectare were both Rs. 67892.643. A total of Rs. 101700.00 was the net profit per acre. The return on investment was 2.50 rupees.

Key words: Benefit-cost ratio, net profit, gross returns, cost of production, and cost of cultivation.

Introduction

Tomato (Solanum lycopersicum), a member of the Solanaceae family, is originally from tropical America. The horticulture sector encompasses various types of crops, including fruits, vegetables, potatoes, tubers, ornamental plants, medicinal and aromatic plants, spices, and plantation crops. India, with its diverse climate and soil conditions, is highly suitable for cultivating a wide range of horticulture crops. This sector is experiencing rapid growth within the agricultural industry, contributing to poverty alleviation, ensuring nutritional security, and offering ample opportunities for farmers to increase their income. Moreover, it plays a vital role in sustaining numerous agro-based industries, which in turn generate substantial employment opportunities. Population growth, economic growth, and urbanization might be among the factors that drive increased demand for tomatoes, which then lead to a rise in the cultivated area and production. However, such an increase has also been driven by the status of tomato as a profitable crop as revealed in many studies [9-11]. Tomatoes are cultivated in over 150 countries, and approximately 80 percent of the global tomato production is consumed. The leading tomato-producing countries include China, India, the USA, Italy, Turkey, and Egypt. Worldwide, the total cultivated area dedicated to tomatoes is 45,82,438 thousand hectares, with a production of 182,5,08,395 metric tons and a productivity rate of 32.8 tonnes per hectare (as of 2017-18).In India, the total cultivated area for tomatoes is around 767.32 thousand hectares, with a production of 20,7,08,000 metric tons (according to the NHB DATABASE; 2017-18). The major tomato-producing states in the country are Andhra Pradesh, Madhya Pradesh, Karnataka, Gujarat, Orissa, West Bengal, Chhattisgarh, Maharashtra, Bihar, Haryana, Uttar Pradesh, Telangana, and Tamil Nadu. These states collectively account for nearly 90 percent of the country's total tomato production. In Chhattisgarh, the total tomato production is 11,33,435 metric tons from an area of approximately 64,681 hectares (2017-18). The major tomato-producing districts in Chhattisgarh include Raipur, Durg, Bastar, Balod, and Jashpur. Among them, Raipur district alone produces 82,096 metric tons of tomatoes in an area of 4,508 hectares dedicated to vegetable crops.

Objectives

1. The objective of this study is to analyze the socio-economic characteristics of farmers in the study area.
2. This study aims to determine the cost and returns per hectare, as well as the input-output ratio or benefit-cost (B:C) ratio of tomato cultivation across various size groups.

Methodology

Sampling Design:

A multi-stage sampling design was implemented to ensure a representative selection process. The selection of districts served as the first stage unit, followed by blocks as the second stage unit, villages as the third stage units, and finally, individual farm holdings as the ultimate stage units.

Selection of Districts:

The study area consisted of 33 districts, and for the purpose of this study, Raipur district was purposively selected as the focus area for investigating tomato cultivation.

Selection of Blocks:

Raipur district comprises four blocks, and out of these, Abhanpur block was purposively chosen as the target block for this study.

Selection of Villages:

A comprehensive list of all villages in the study area was obtained from the respective Gram Panchayats. From this list, 5% of the villages were randomly selected to participate in the study. For the selection of these villages, Raipur district was chosen randomly, ensuring that it had a significant presence of tomato cultivation. The Block Development Officer was consulted to compile a list of tomato-growing villages. Based on this information, the villages of Julum, Tekari, Raweli, Mundra, and Kanhera were selected for the study.

Selection of Respondents/Farmers:

A separate list of farmers engaged in tomato cultivation from the selected villages was obtained from the Gram Pradhan (village head). These farmers were then categorized into different farm size groups. From each group, 10% of the respondents were randomly selected to participate in the study, taking into account their involvement in tomato cultivation. The farmers were classified into three groups based on the size of their holdings.

List 1 : Classification of farmers based on size of holding.

SR. NO.	CATEGORY	SIZE - CLASS
1	Marginal	Below 1.00 hectare
2	Small	1.00-2.00 hectare
3	Semi medium	2.00-4.00 hectare
4	Small Medium	4.00-10.00 hectare
5	Large	10.00 hectare & above

(https://www.pib.gov.in)

Sample Selection:

From the compiled list, a total of 60 respondents were randomly selected using proportionate allocation based on the population size.

Data Analysis and Analytical Tools:

The analysis of data involved both secondary and primary data. Secondary data from the selected district were analyzed to obtain estimates of growth rates in tomato area, production, and productivity. Primary data, on the other hand, were collected and analyzed to determine the cost of production and marketing of tomatoes.

Analytical Techniques Employed:

To achieve the stated objectives, the following analytical procedures were adopted:

Cost of Cultivation:

The cost of cultivation for tomato crops was analyzed using standard farm management studies. Various cost concepts were utilized during the data analysis, including Cost-A1, Cost-A2, Cost-B1, Cost-B2, Cost-C1, and Cost-C2. These concepts encompass factors such as hired labor, machinery, inputs, irrigation charges, taxes, depreciation, interest, and miscellaneous expenses. Additionally, marketing costs and rent on land were considered in the analysis.

Cost Concept:

Wages for hired human labor were calculated based on the prevailing wage rates for both male and female labor in the area. Charges for bullock labor, whether owned or hired, were determined according to the prevailing rates in the respective villages. The value of fertilizers, plant protection chemicals, and other inputs were considered based on the actual prices paid by the farmers. The cost concepts were formulated as Cost-A, Cost-B, and Cost-C, incorporating various factors as described.

Income Measures:

The following income measures were utilized in the analysis:

1. **Gross Income:** This represents the total value of the main product and any by-products.

   GI = (Qm x Pm) + (Qb x Pb)

   Where GI = Gross Income, Qm = Quantity of main product, Pm = Price of main product,

   Qb = Quantity of by-product, Pb = Price of by-product.

2**. Return over Variable Cost (RVC):** This measure calculates the income after deducting the cost of production (Cost-A1) from the gross income.

3. **Farm Business Income (FBI):** It represents the income after deducting the total costs of production (Cost-A2) from the gross income.

4. **Family Labor Income (FLI):** This measure accounts for the income after deducting the total costs (Cost-B2), including the rental value of owned land, from the gross income.

5. **Net Income:** Defined as the difference between gross income and the total cost incurred by the farmers (NI = Gross income - Cost-C2).

Results and Discussion:

Cost of Production and Profitability of Tomato

The decision to grow specific crops and allocate the farm area to each crop is influenced by factors such as output prices, productivity levels, available technology, and input prices. Understanding the input use, cost structure, and profitability of crop cultivation is crucial for formulating policies at both macro and micro levels, particularly for market-oriented crops like cash crops, oilseeds, spices, fruits, vegetables, and high-value crops. In this section, the input use, cost structure, and profitability of tomato cultivation are discussed

Economics of Tomato Crop:

In farm management studies, costs are examined from various perspectives for different purposes. The costs of cultivation are used by agricultural cost and price commissions to determine the support price for agricultural commodities. Additionally, they play a significant role in farm planning and policy-making. Therefore, the operational costs of tomato cultivation were analyzed to understand the economics of agriculture in the study area. The farmers in the sample farm allocated 14.55% of the gross cropped area to tomato cultivation. As shown in Table 1, the total cost incurred in tomato cultivation on the overall farm was Rs. 67,892.64 per hectare. The cost was highest in large farms (Rs. 76,359.03/ha) and lowest in small farms (Rs. 60,493.88/ha), indicating an inverse relationship with farm size due to economies of scale. Operational costs accounted for 65.50% (Rs. 44,467.98) of the total cost, while fixed costs accounted for approximately 34.50% (Rs. 23,424.66) of the total cost. Labor costs accounted for an average of 35.76% of the total cost, ranging from 35.10% in large farms to 36.02% in medium farms. The variation in labor requirements among different farm sizes can be attributed to differences in operational practices. Similar findings have been reported in earlier studies conducted by Bagari, Beck, Banafar, and others. Among the material costs, the cost of seeds alone contributed about 3.58% of the total cost at the overall level, with the lowest cost observed in medium farms (Rs. 2,423.07/ha) and the highest in large farms (Rs. 2,603.44/ha). The combined expenditure on manure and fertilizer accounted for 7.93% of the total cost on the sample farm, with variations ranging from 7.48% to 7.85% among different farm sizes. The cost of irrigation represented an average of 3.71% of the total cost. Plant protection chemical costs accounted for approximately 11.08% of the total cost, while interest on working capital constituted 3.27% of the total cost across various farm sizes. Rental value of land and fixed items accounted for 24.97% of the total cost, showing an inverse relationship with farm size. The yield of the main product per hectare was found to be 127.15 quintals (q/ha) on the overall level, with the lowest yield in small farms (130.46 q/ha) and the highest in large farms (145.82 q/ha). This indicates intensive tomato cultivation by the farmers in the study area. Overall, analyzing the cost structure and profitability of tomato cultivation provides valuable insights for decision-making, policy formulation, and farm planning in the agricultural sector.

Table 1: Cost of Tomato Cultivation on Sample Farm (in Rs/ha)

Particulars		Size group			
		Small	**Medium**	**Large**	**Overall**
1. Operational cost					
A. Labour cost					
i.Human labour	Family	5585 (9.23)	6441.71 (9.06)	4372 (5.73)	**5466.23 (8.05)**
	Hired	12540.3 (20.73)	16673.22 (23.44)	18887.17 (24.73)	**16033.56 (23.62)**
ii. Machine	Owned +	2300	2500	3545	**2781.66**
labour	Hired	(3.80)	(3.52)	(4.64)	**(4.10)**
Sub Total		20425.3	25614.93	26804.17	**24281.46**
		(33.76)	(36.02)	(35.10)	**(35.76)**
B. Material cost					
i. Seed		2423.07 (4.01)	2500 (3.52)	2603.44 (3.41)	**2429.7 (3.58)**
ii. Fertilizer & manure		5248.84 (8.68)	5320.69 (7.48)	5993.47 (7.85)	**5383.63 (7.93)**
iii. Plant protection		5536 (9.15)	7794 (10.96)	9240.1 (12.10)	**7523.36 (11.08)**
iv. Irrigation charge		2662 (4.40)	2349.09 (3.30)	2536.31 (3.32)	**2515.8 (3.71)**
Total material cost		15869.91 (26.23)	17963.78 (25.41)	20373.32 (25.46)	**18069 (26.61)**
Interest on working capital@10%		1905.49 (3.15)	2287.88 (3.22)	2476.81 (3.24)	**2223.39 (3.27)**
Total operational cost (A+B)		38109.97 (63.00)	45757.64 (64.34)	49536.36 (64.87)	**44467.98 (65.50)**
A. Rental value of land		17394.67 (28.75)	18074.67 (25.41)	19442.67 (25.46)	**16953.33 (24.97)**
B. Depreciation		1960.78 (3.24)	3089.73 (4.34)	3094.72 (4.05)	**2715.07 (4.00)**
C. Revenue/tax		12 (0.02)	12 (0.02)	12 (0.02)	**12 (0.02)**
D. Interest on fixed capital@12%		3016.46 (4.99)	4186.21 (5.89)	4273.28 (5.60)	**3744.26 (5.51)**
Total fixed cost		22383.91 (37.00)	25362.61 (35.66)	26822.67 (35.13)	**23424.66 (34.50)**
Total cost (Operational cost + Fixed cost)		**60493.88 (100.00)**	**71120.256 (100.00)**	**76359.035 (100.00)**	**67892.643 (100.00)**

Cost Structure: Estimates of Different Costs

Table 2: Cost of Tomato Cultivation on Sample Farms (According to Cost Concepts)

S. No.	Cost	Size group			
		small	**Medium**	**Large**	**Overall**
1	Cost A_1/A_2	34497.75	42417.67	48271.08	**41728.82**
2	Cost B_1	37514.21	46603.88	52544.36	**45473.08**
3	Cost B_2	54908.88	64678.55	71987.03	**62426.41**
4	Cost C_1	43099.21	53045.59	56916.36	**50939.31**

5	Cost C_2	60493.88	71120.26	76359.03	**67892.64**
6	**Cost C_3**	**66543.27**	**78232.28**	**83994.94**	**74681.91**

Farm Organization and Operation Costs: Analysis of Cost Concepts Cost consideration plays a crucial role in farm organization and operational decision-making on a daily basis. It serves as an important tool for measuring farm business activities. In the field of farm management, specialists have categorized the cost of cultivation into various concepts, namely cost A_1, A_2, B_1, B_2, C_1, C_2, and C_3. These cost concepts have been discussed in the methodology chapter. In this section, we will delve into the cost of cultivation based on these different cost concepts. Table 2 presents a clear overview of the cost of cultivation according to various cost concepts. On average, the total cost per hectare (cost C_3) required to produce the crop amounted to Rs. 74,681.90. This cost comprised 61.46% of the variable cost, commonly known as cost A_1 and A_2. When the interest on fixed capital was added to cost A_1, it increased to 66.97% as cost B_1. Furthermore, upon including the imputed value of land, the cost rose to 91.94%. Finally, when 10% of the cost C_2 was added as managerial cost, it constituted the total cost or cost C_3. The table also indicates that the cost from A_1 to C_3 increases with the size of the farm holding. Similar findings have been observed in earlier studies conducted by Ali, Sahu, Tambe, Patel, Hajong, and others. (Note: The actual cost values are not provided in the given information)

Profitability Concepts: Estimation of Tomato Production on a Sample Farm

Profitability is a key factor in any business activity, including farming. The amount of profit a farmer earns as net income and family labor income, as well as the satisfaction derived by the farmer and their family as consumers, play a crucial role in the organization and operation of a farm. Therefore, in this section, we have made efforts to estimate the gross income, total operational cost, total cost, net income, benefit-cost ratio, and cost of production for tomato cultivation on a sample farm.

Table 3: The Profitability of Tomato Production on a Sample Farm

S. No.	Economic parameter	Size group			
		Small	**Medium**	**Large**	**Overall**
1	Total operational cost	38109.97	45757.65	49536.36	**44467.98**
2	Total cost	60493.88	71120.26	76359.03	**67892.64**
3	Yield (q/ha)	130.46	135.56	145.82	**127.15**
4	Gross income (Rs/ha)	164861.88	179568.26	193015.03	**169612.64**
5	Net income	104368.00	108448.00	116656.00	**101720.00**
6	Return to management	98318.61	101335.97	109020.10	**94930.74**
7	Cost of production	463.70	524.64	523.65	**533.96**
8	Return over variable cost	130364.13	137150.59	144743.95	**127883.82**
9	Farm business income	130364.13	137150.59	144743.95	**127883.82**
10	Family labour income	109953.00	114889.71	121028.00	**107186.23**

11	**Return per rupee (RPR)**	**2.73**	**2.52**	**2.53**	**2.50**

Based on the data presented in Table 3, it is evident that the total cost of tomato production varies across different farm sizes. For small, medium, and large farms, the total costs are Rs. 60,493.88, Rs. 71,120.26, and Rs. 76,359.03, respectively, with an average of Rs. 67,892.64 on the sample farm. Thus, the total cost of tomato production increases as the farm size increases. When the physical output of tomato production is converted into monetary terms, the benefit-cost ratio measures the return per rupee of investment. The return per rupee (RPR) is more favorable for small farms (2.73), followed by medium farms (2.52), and large farms (2.53). This indicates that the benefit-cost ratio tends to increase with the size of the landholding. At the overall level, the net income per hectare is Rs. 101,720.00/ha, with the lowest being in small farms (Rs. 104,368.00/ha) and the highest in large farms (Rs. 116,656.00/ha) and medium farms (Rs. 108,448.00/ha). The overall benefit-cost ratio (B:C ratio) is found to be 2.50, with the lowest being in medium farms (2.52) and the highest in small farms (2.73). The cost of production per quintal is found to be Rs. 463.70, Rs. 524.64, and Rs. 523.65 in small, medium, and large farms, respectively, with an overall level of Rs. 533.96 per quintal. These findings indicate the profitability and cost dynamics of tomato production across different farm sizes, emphasizing the financial aspects of the farming operation.

Conclusion:

In conclusion, the analysis of tomato production on the sample farm reveals several key findings. The total cost per hectare incurred in tomato production was Rs. 67,892.64, with operational costs accounting for 65.50% and fixed costs comprising 34.50% of the total cost. As the farm size increases, the cost of cultivation according to various cost concepts (Cost A_1 to Cost C_3) also increases. The net income per hectare was highest in large farms (Rs. 116,656.00/ha), followed by medium farms (Rs. 108,448.00/ha), and lowest in small farms (Rs. 104,368.00/ha). The overall return per rupee investment (B:C ratio) was 2.50 at the overall level, with the highest ratio observed in small farms (2.73) and the lowest in medium farms (2.52). Furthermore, the cost of production per quintal was found to be Rs. 463.70, Rs. 524.64, and Rs. 523.65 in small, medium, and large farms, respectively, with an overall average of Rs. 533.94 per quintal. These findings provide insights into the cost dynamics and profitability of tomato production, highlighting the financial aspects associated with different farm sizes. Farmers can use this information to make informed decisions regarding their production strategies and maximize their profitability.

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