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Economic evaluation of rice cultivation among three categories of farmers in Bilaspur district, Chhattisgarh

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Abstract
This research was conducted in the Bilha Block of Bilaspur District in Chhattisgarh, India with the objective of evaluating the gross cost, net returns, profit structure, and benefit-cost ratio (BCR) among three categories of rice farmers: small, medium, and large. A purposive, stratified random sampling technique and random sampling technique were employed, selecting 90 rice growers, 30 from each category. The economic data was gathered from the selected rice growers through a pre-testing interview schedule. The research findings revealed that the average cost per hectare at Cost at C1, C2 and C3 levels for small, medium, and large farmers was 48,636 Rs., 95,394 Rs., and 104,934 Rs., respectively. The average net returns per hectare at Cost C2 and Cost C3 were 107,386 Rs. and 97,846 Rs., respectively. The BCR for three categories of rice growers on average was 1:2.13 at Cost 2 and 1:1.93 at Cost 3. The research study concluded that large and medium farmers achieved higher profit comparison to small farmers. It also highlighted that labour costs were significantly high, suggesting the need for better planning and adoption of scientific farming technologies to reduce production cost for rice growers.

Keywords: Rice crop, cost concepts method, gross cost, net returns, and BCR

Introduction
Scientific agriculture technology plays a pivotal role in the economy of India. Agriculture sector provides employment to approximately 52 percent of the country's total workforce and contributes around 14 percent to the National Gross Domestic product (GDP). Rice has been recognized most important cereal crop of the world. Rice comes under genus *Oryza* and *family* Gramineae. Rice crop is one of the few crop species characterized by exceptionally rich genetic diversity, making it a key focus in agricultural research and food security strategies. India ranks second in the world as the largest producer of rice after China. The nation has vast area covered to rice farming, making it one of the most important staple crops in terms of both nutrition and agricultural production (Agarwal, 2018) [1]. Nutrient composition of rice crop notably rich, with carbohydrates constituting about 65-70% of its content. It also contains 2-3% fat, 7-8% protein and a rich source of vitamins and minerals including manganese, iron, folic acid, phosphorous, thiamine, and niacin (Chaithanya & Maurya, 2020) [2]. Rice (*Oryza sativa*) is one of the primary cereal crops of the world. In India, rice is cultivated over an area of 43.57 million hectares, yielding a total production of 104.32 million tons (GOI, 2017) [4]. The growing demand for rice, coupled with the need for food security in the developing countries, necessitates a 50 percent increase in rice production by 2025 (Saravanakumar and Kiruthika, 2015) [7]. The population of India continues to increase; it can be concluded that the demand for rice will also rise. It has been predicted that approximately 260 million tons of food grains will need to be produced yearly by the years 2029 to 2030 to meet the country's requirements (Pathak *et al*., 2021) [6]. The rice crop in Chhattisgarh state was recorded at 9,810 tons in 2023, an increase from the previous year's 8,020,000 tons in 2022. (GOI, 2023) [3]. In Chhattisgarh, rice is the primary cereal crop of the state, covering 78% of the cultivable land. The cultivation of rice crops is practiced during two seasons, i.e., the Aman season and summer. Chhattisgarh is recognized as the "Rice Bowl of India" due to its significant contribution to rice production. Chhattisgarh has a vast area dedicated to the cultivation of various rice varieties, including Mahamaya, Rajeswari, HMT, Sawrna, Kalimooch, IR-36, MTU-1010, and IR-64, among others.

These rice varieties are cultivated by the different categories of farmers across various different agro-climatic zones of Chhattisgarh state (Sharma *et al*., 2018) [8]. Rice cultivation provides livelihood security to millions of farmers in India. The rice farming directly provides employment opportunities to rural workers who engage in farming activities for their livelihood. In most parts of South Asia, rice growers pay agricultural laborers in kind after the rice harvest, which helps reduce poverty among households that are working in the fields of rice (Hazari *et al*., 2015) [5].

The goal of research was achieved through the following objectives:

1. To measure the cost and net returns of rice cultivation across different categories of landholders.
2. To analyze the profitability of rice cultivation among three categories of landholders.

Material and Methods

The research was conducted in the Bilha block of Bilaspur district in Chhattisgarh state. The primary objective of the study was to estimate the cost and net returns of rice cultivation, helping farmers understand their actual cost and return. This insight would enable farmers to identify areas where costs can be reduced in their farming operations. The Bilha block and district Bilaspur were selected using purposive sampling techniques. Six villages within the selected block were selected and then chosen using a random sampling technique. The respondents were categorized according to their land size holdings into small rice growers (up to 2.0 hectares), medium rice growers (> 2 to 4.0 hectares), and large rice growers (More than 4 hectares) using stratified random sampling techniques. In each village, 15 respondents were selected, resulting in 90 respondents for the research study. The economic data were collected using a pre-testing interview schedule. The gross cost and net returns of rice cultivation were calculated using the cost concept method. This study is expected to provide valuable insight for policymakers, economists, agricultural scientists, and agriculture extension officers in aiding in the formulation of policies that support the growth of rice farmers.

Cost concepts tool

- **Cost A1:** All actual cost incurred in the rice production/hectare
- **Cost A2:** Cost A1 + rent paid for the leased land
- **Cost B1:** Cost A2 + the interest on the value of owned fixed capital, excluding land.
- **Cost B2:** Cost B1 + rental value of owned land.
- **Cost C1:** Cost B1 + imputed value of family labor.
- **Cost C2:** Cost B2 + imputed value of family labor.
- **Cost C3:** Cost C2 + 10% of cost C2 to account for the managerial cost of inputs of farmers.

Production cost (Rs./quintal) = Gross cost - value of by product (Rs./hectare) / yields (quintal/hectare)

Profitability concepts tool

Gross production: Main product with its by-product.
Gross income = Sum of the value of main product + by-product
Farm business income = Gross income – Cost A1
Family labor income = Gross income – Cost B2
Net income = Total income – Cost C3

Benefit-cost ratio (BCR): Gross income/gross cost

Results and Discussion

Table 1: Estimate the gross cost of rice cultivation for different categories of rice growers (per hectare)

S. No.	Particulars	Cost incurred of Small Farmers/ hectare (Rs.)	Cost incurred of Medium Farmers/ hectare (Rs.)	Cost incurred of Large Farmers/ hectare (Rs.)	Overall (Rs / hectare)
	Operations wise cultivation	A. Labour and equipment Cost			
a)	Bullock and Machine labour (Bund preparation, ploughing, levelling, paddling, and trimming)	3267 (3.86)	3280 (3.50)	3303 (3.05)	3283 (3.44)
b)	Family labour	6343 (7.49)	2600 (2.78)	1400 (1.29)	3448 (3.61)
c)	Application cost of manure and fertilizers	322 (0.38)	2451 (2.62)	3733 (3.45)	2169 (2.27)
d)	Application cost of pesticides and herbicides	250 (0.29)	583 (0.62)	930 (0.86)	588 (0.61)
e)	Harvesting and transport (Machine, Manual harvesting cost, Bagging, other labor costs)	2842 (3.35)	3582 (3.83)	3642 (3.36)	3355 (3.51)
	Total -Cost	13024 (15.39)	12496 (13.36)	13008 (12.03)	12843 (13.46)
B.	Seeds and sowing	B. Material cost			
a)	Cost of seed (Treatment, sowing, gap-filling charges)	4895 (5.78)	5442 (5.81)	5863 (5.42)	5400 (5.67)
C.	Manures and Fertilizers				
a)	Organic manures cost	1102 (1.30)	3928 (4.20)	9170 (8.48)	4733 (4.97)
b)	Fertilizer cost (Urea, DAP, SSP, MOP)	7011 (8.28)	7778 (8.31)	8932 (8.26)	7907 (8.29)
D.	**Weed management**				
a)	Cost of hand weeding	1467 (1.73)	3283 (3.51)	6342 (5.86)	3697 (3.88)
b)	Cost of herbicide	2860 (3.38)	2805 (2.99)	2768 (2.56)	2811 (2.95)
E.	**Plant Protection**				
a)	Cost of chemicals	3120 (3.68)	3060 (3.27)	3020 (2.79)	3067 (3.21)
F.	Irrigation cost	20(0.02)	10 (0.01)	10 (0.01)	13 (0.01)
G.	Interest on working capital	777 (0.91)	781 (0.83)	605 (0.55)	721 (0.75)
	Sub-Total	21252 (25.11)	27087 (28.96)	36710 (33.96)	28349 (29.72)
	Operational cost	34276 (40.51)	39583 (42.33)	49718 (46.00)	41192 (43.18)
	Fixed cost				
H.	Land revenue and taxes	10 (0.01)	10 (0.01)	10 (0.01)	10 (0.01)
I.	Rental Value of owned land	43400 (51.29)	46500 (49.72)	50375 (46.61)	46759 (49.01)
J	Depreciation cost	2344 (2.77)	2511 (2.68)	2664 (2.46)	2506 (2.62)
K.	Interest on Fixed Capital (10%)	4575 (5.40)	4902 (5.24)	5305 (4.90)	4927 (5.16)
	Total fixed cost	50329 (59.48)	53923 (57.66)	58354 (53.99)	54202 (56.82)
	Total cost of cultivation (Rs.)	84605 (100)	93506 (100)	108072 (100)	95394 (100)

Farm management plays a crucial role in the planning and implementation, and control of farming operation with the aim of enhancing productivity and profitability of in the crop farming. It involves the efficient utilization of input such as labor and capital and other resources to optimize agricultural outcomes. Farm management helps in determining the actual production level, resources use, net cost and net profits, decision-making process, time management, and marketing process. It also offers various methods and techniques to promote economic efficiency, profitability, and sustainability in agriculture. The study of farm management enables a comprehensive evaluation of farming operation from multiple perspectives. In the context of policy formulation, bodies such as the Commission on Agriculture utilize cost and profits estimation framework to determine the Minimum Support Price for various crop production. This process involves the consideration of both farming operational and fixed costs in evaluating the total cost of crop production. According to operationally categorized farming practices, the total cost of rice farming per hectare was recorded as Rs. 84605 for small rice growers, Rs. 93506 for medium rice growers, and Rs. 108072 for large rice growers. The overall average total cost across all categories of rice growers was estimated to be 95394 Rs per hectare. On average, operational costs constituted 43.18% and fixed costs accounted for 56.82% of the total cost of rice farming. Furthermore, the gross labour cost, including harvesting, recorded 13.46% of the total cultivation cost per hectare. This portion varied by farm size, ranging from 15.39% for small-scale farmers to 12.03% for large-scale farmers, indicating economies of scale in labour utilization.

Table 2: Calculate of rice production cost per hectare on cost concepts method

Different costs	Small farmers	Medium farmers	Large farmers	Average (Rs/hectare)
Cost A1 (A2)	30287	39504	50992	40261
Cost B1	34862	44406	56297	45188
Cost B2	78262	90906	106672	91947
Cost C1	41205	47006	57697	48636
Cost C2	84605	93506	108072	95394
Cost C3	93066	102857	118879	104934

The scientific cost of rice cultivation in per hectare land was calculated using cost concept components as presented in table 2.

Cost A_1: It includes all actual expenses incurred in rice cultivation, such as interest on working capital and land revenue, and taxes incurred calculated on a per-hectare basis. The analysis revealed that Cost A1 accounted for Rs. 30287 per hectare for small farmers, Rs. 39504 per hectare, and Rs. 50992 per hectare for large farmers. The overall average across three categories of farmers was Rs. 40261 per hectare. Cost A1 was highest among large farmers, followed by medium farmers and small farmers, respectively.

Cost A_2: Accounts for the expenses, including those in Cost A1, along with the rent paid for leased land. In this study, farmers cultivated on their land and did not incur any rental expenses for farmland.

Cost B_1: Cost B1 of rice cultivation was calculated as Rs. 34862 per hectare for small-category farmers, Rs. 44406 per hectare for medium-category farmers, and Rs. 56297 per hectare for large-category farmers. The overall average of all three categories of farmers was Rs. 16,495.39 per hectare. The result indicates that Cost B1 increases with the size of farmland, showing a significant relationship between farm size and investment in fixed capital.

Cost B_2: It included all components of Cost B1 along with the imputed rental value of their owned land, allowing for a more accurate estimation of the real cost of rice cultivation. The Cost B2 for rice cultivation was recorded as Rs. 78,262 per hectare for small-category farmers, Rs. 90,906 per hectare for medium-category farmers, and Rs. 106,672 per hectare for large-category farmers. The overall average of all three categories of farmers was Rs. 91,947 per hectare.

Cost C_1: It included both the Cost B1 and the imputed value of family labour in rice cultivation, which was recorded as Rs. 41,205 per hectare for small-category farmers, Rs. 47,006 per hectare for medium-category farmers, and Rs. 57,697 per hectare for large-category farmers. Overall, an average Cost C1 was recorded at Rs. 48,636 per hectare.

Cost C_2: It included both Cost B2 and the imputed value of family labour in rice farming and was found to be Rs. 84,605 per hectare for small-category farmers, Rs. 93,506 per hectare for medium-category farmers, and Rs. 108,072 per hectare for large-category farmers. Accordingly, the overall average cost was recorded as Rs. 95,394 per hectare.

Cost C_3: It included 10% of Cost C2 as management cost. Accordingly, the cost was recorded as Rs. 93,066 per hectare for small-category farmers, Rs. 102,857 per hectare for medium-category farmers, and Rs. 118,879 per hectare for large-category farmers. The overall average cost of all three categories of farmers was Rs. 104,934 per hectare.

Table 3: Cost and returns of rice cultivation across three farm size categories

Particulars	Size of farmers Rs/hectare			
	Small	Medium	Large	Average (Rs/hectare)
Grain yield (quintal /hectare)	56	62.75	67.25	62
Price per quintal (Rs.)	3100/-	3100/	3100/-	3100/-
Value of main product (Rs./hectare)	173600	194525	208475	192200
Quantity of by product (quintal/hectare)	98.55	107.59	111.27	105.80
Price per quintal (Rs.)	100	100	100	100
Value of by product (Rs./hectare)	9855	10759	11127	10580.33
Gross income (Rs/hectare)	183455/-	205284/-	219602/-	202780.33
Production cost (Rs./quintal) at Cost C2	1510.80	1490.13	1607.07	1536
Production cost (Rs./quintal) at Cost C3	1661.89	1639.15	1767.71	1689.58

The analysis of economic data of rice cultivation, as presented in table 3, highlighted total income per hectare, the total cultivation cost per hectare, and cost of production per quintal across different cost concepts. The highest total income from rice cultivation per hectare was recorded among large farmers at Rs. 219,602 per hectare, followed by medium-category farmers at Rs. 205,284 per hectare and small-category farmers at Rs. 219,602 per hectare. At the cost C3 level, the total cost of cultivation was Rs. 118,879 per hectare for large farmers, Rs. 102,857 per hectare for medium farmers, and Rs. 93,066 per hectare for small farmers. Similarly, the per quintal cost of cultivation (Rs/q.) at the cost C3 level was Rs. 1661.89 per quintal for small farmers, Rs. 1639.15 per quintal for medium-category farmers, and Rs. 1767.71 per quintal for large-category farmers. On overall average, production cost at the C3 level was recorded as Rs. 1767.71 per quintal. It was recorded that the production cost of rice cultivation was moderate among the large-category farmers group compared to the other farmer groups.

Table 4: Profitability framework of rice cultivation across three farm size categories

	Size of farmers Rs/hectare			
Particulars	**Small**	**Medium**	**Large**	**Average (Rs/hectare)**
Gross income of rice	183455/-	205284/-	219602/-	202780.33
Gross expenses in rice farming	93066	102857	118879	104934
Net profit at Cost C2	98850	111778	111530	107386
Net profit at Cost C3	90389	102427	100723	97846
Farm business income	153168	165780	168610	162519
Family labour income	105193	114378	112930	110834
BCR at Cost C2	1:2.16	1:2.19	1:2.03	1:2.13
BCR at Cost C3	1:1.97	1:1.99	1:1.84	1:1.93

Farmers should conduct an economic analysis of rice cultivation on owned land to better understand their expenditure patterns. The effective techniques for economic analysis of farm enterprises can be clearly defined and diversified to accurately determine the actual cost and profit in a scientific and systematic manner. The economic analysis of operational rice cultivation helps identify the key factors, such as net income, total income, family labor income, farm business income, and the benefit-cost ratio across all three categories of rice growers. The profitability framework for the selected three categories of rice farmers was estimated and shown in Table 4. It is found that both harvested economic yield and biological yield were converted into monetary terms, referred to as the total return from rice cultivation. The gross return was recorded as Rs. 183,455 for small farmers, Rs. 205,284 for medium farmers, and Rs. 219,602 for large farmers. The overall average gross returns across three categories of farmers were Rs. 202,780.33 per hectare. The total returns were highest among large farm holders, followed by the medium and small farm holders. Additionally, net returns at Cost C2 were found to be Rs. 111,778 per hectare for medium farmers, Rs. 111,530 per hectare for large farmers, and Rs. 98,850 per hectare for small farmers.

Similarly, the net returns at Cost C3 were recorded as Rs. 102,427 per hectare for the medium landholding group. Rs. 100,723 per hectare for the large landholding group and Rs. 90,389 per hectare for the small landholding group. The recorded highest net return at both cost C3 and C2 levels for medium and large farmers, with small farmers showing relatively lower profitability. The family labour income, the highest, was recorded in large farms at Rs. 114,378 per hectare, followed by medium farms at Rs. 112,930 per hectare, followed by large and small farms at Rs. 105,193 per hectare.

Thus, BCR indicates the return earned from every rupee spent. At the Cost C2 level, the BCR was found highest for the medium landholding group at 1:2.19, followed by small farmers at 1:2.16 and large farmers at 1:2.03. Medium and large farmers achieved higher net income, largely due to their effective use of available resources, which resulted in higher profitability compared to small land farmers. In contrast, small farmers were found to use available agricultural resources in an unscientific and inconsistent manner, applying them heavily without maximizing returns. On average, the overall BCR was recorded at 1:2.13 at Cost C2 level and 1:1.93 at Cost C3 level.

Conclusion

The net returns were found to be higher at both cost C3 and C2 for medium and large landholding farmers, followed by the small landholding group. The Benefit-Cost Ratio (BCR) at Cost C2 was highest in the medium landholding group at 1:2.19, followed by the small landholding group at 1:2.16 and the large landholding group at 1:2.03. The cost of rice cultivation for small landholding farmers can be reduced by adopting operation-based scientific rice production techniques such as water management technology, integrated nutrient management technology, integrated weed management technology, and integrated pest management techniques. Agricultural scientists and extension personnel can play an important role in disseminating these various improved rice farming technologies to farmers in the study areas through various extension methods such as training, demonstration, and field visits. The agricultural extension program should focus on building the capacity of both farmers and extension workers in planning and implementing diverse agricultural and extension activities. This approach will support the adoption of improved farming practices. It is also important to note that although improved varieties of rice crops may have a higher cost, their productivity per unit area is significantly higher. Additionally, it is recommended that farmers conduct soil testing prior to growing crops, which can help reduce cultivation costs.

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