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Economic assessment of water chestnut production: A case study of Gariyaband District

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Abstract

The present study analyses the cost and return structure of water chestnut (*Trapa bispinosa*) cultivation in Gariyaband district of Chhattisgarh using primary data collected from 50 sample farmers. The results revealed that the total cost of cultivation was ₹74,065.55 per hectare, comprising input material cost (41.66%), labour and power cost (56.49%) and fixed cost (1.85%). Among input materials, seed accounted for the highest share (42.13%) followed by plant protection chemicals (21.23%) and fertilizers (17.83%). The average yield was recorded at 38 quintals per hectare with a market price of ₹7,000 per quintal, generating a gross income of ₹2,66,000 per hectare. The net income was estimated at ₹1,91,934.45 per hectare, with a benefit–cost ratio of 2.59 and an input–output ratio of 3.59, indicating high economic viability. The cost of production was calculated at ₹1,949.09 per quintal. The findings highlight that water chestnut cultivation in Gariyaband district is a highly profitable enterprise and offers significant scope for income generation and livelihood improvement for farmers.

Keywords: Cost and return structure, economic viability, input material cost, fixed cost

Introduction

Water chestnut (*Trapa bispinosa* Roxb.), commonly known as Singhara, is an annual aquatic fruit crop of the family Trapaceae, cultivated mainly in wetlands, ponds, and slow-moving rivers of India, China, and Eurasia. In India it is grown during the kharif season in states like Madhya Pradesh, Uttar Pradesh, Bihar, Odisha, and West Bengal, with an average yield of about 15,000 kg/ha. The kernels are rich in carbohydrates ($\approx$70%), protein ($\approx$13%), minerals, vitamins, and bioactive compounds with antioxidant, anti-diabetic, and medicinal properties. Consumed fresh, boiled, or as Singhara flour, it serves as both food and traditional medicine. The crop is low-cost and resilient to fluctuating water levels, making it suitable for small farmers in regions like Gariyaband (Chhattisgarh). Despite high nutritional and economic potential, marketing remains largely unorganized, with farmers depending on local markets and intermediaries. Strengthening value-added processing, developing efficient supply chains, and promoting Farmer Producer Organizations (FPOs) can enhance income, create employment, and support sustainable agribusiness growth.To evaluate the economic viability of water chestnut production in Gariyaband district through cost–return analysis.

Materials and Methods

The study was carried out in Chhattisgarh's Gariaband district, where water chestnuts are primarily grown during the Kharif season. Due to its greater area dedicated to water chestnut cultivation, the Fingeshwar block was specifically chosen out of the district's five blocks: Gariaband, Fingeshwar, Mainpur, Chhura, and Deobhog. Secondary data from the Agriculture Department was used to identify farmers who were growing water chestnuts. Small or marginal landholders made up the majority of the chosen farmers. A structured interview schedule and questionnaire were used to gather the data, and basic averages and percentage methods were used for analysis.

1. Input-Output Ratio

$$\text{Input-Output Ratio} = \frac{\text{Gross Income}}{\text{Total Cost}}$$

2. Benefit-Cost Ratio (BCR)

$$\text{Benefit-Cost Ratio} = \frac{\text{Net Income}}{\text{Total Cost}}$$

3. Net Income (Profit)

$$\text{Net Income} = \text{Gross Income} - \text{Total Cost}$$

4. Cost per quintal

$$\text{Cost per Quintal} = \frac{\text{Total Cost}}{\text{Total Production (in quintals)}}$$

Results and Discussion
Input wise cost for cultivation of Water Chestnut
Table 4.5 displays the input-wise cost of growing water chestnuts, which was determined per hectare. Each hectare of input materials cost ₹30,852 in total. At ₹13,000 per hectare, or 42.13% of the total input cost, seed was the most expensive of the different inputs. Expenses for fertilizers (17.83%), interest on working capital (11.34%), plant protection chemicals (21.23%), and farmyard manure (7.45%) came next. 38 quintals of water chestnuts were produced on average per hectare.

Table 1: Input Wise Cost of Cultivation of Water Chestnut

S. No.	Particular	Input Material Cost Rs/hac.)	Percentage to total
A	**Input Material**		
1.	Seed	13000	42.13
2.	Manures	2300	7.45
B	**Fertilizer**		
1.	Urea	535	1.72
2.	SSP	3450	11.18
3	Potash	1520	4.92
	Total of Fertilizer cost	5502	17.83
C	Plant Protection Chemical	6550	21.23
D	Interest on Working Capital	3500	11.34
	Total	30852	100

Human labour and Power Cost for Cultivation of Water Chestnut
As indicated in Table 4.6, the cost of labor and power in water chestnut cultivation encompassed both manual and mechanical operations. The estimated cost of labor per hectare was ₹16,069.95 for family labor and ₹25,771.43 for hired labor. The cost of hired labor was ₹23,619.03 per hectare, and the cost of family labor was ₹15,003.70 per hectare. These two factors accounted for 61.59% and 38.41% of the total labor cost, respectively. Harvesting accounted for the largest portion of labor costs (36.48%), followed by transportation (29.91%), transplanting (11.51%), field preparation (5.47%), plant protection and intercultural operations (2.56%), the application of manure and fertilizer (2.10%), and irrigation (1.55%). While family labor contributed 38.78% of the cost of transplanting, family labor contributed 61.2h cost of harvesting. Hired labor made up 61.21% of the cost of harvesting, while family labor contributed 38.78%. In contrast, family labor made up a larger portion of the cost of transplanting, at 59.75%, than hired labor, which made up 40.24%. This suggests that, in comparison to family labor, hired labor was more important to the main operations of water chestnut farming. Furthermore, the cost of machinery power accounted for 7.69% of the total cultivation cost, or ₹3,218.65 per hectare.

Table 2: Human labour Cost for cultivation of water chestnut

S. No.	Particular	Human labour Cost (Rs/hac.)				Total	%
		Owned	%	Hired	%		
1.	Field Preparation	1550	9.64	742.44	2.88	2292.44	5.47
2.	Manure/Fertilizer Application	672.44	4.18	208.98	0.81	881.42	2.10
3.	Transplanting	1938.33	12.60	2877.89	11.16	4816.22	11.51
4.	Interculture Operation	722.44	4.49	350.64	1.36	1073.08	2.56
5.	Irrigation	650.2	4.04	0	0	650.2	1.55
6.	Plant Protection	905.48	5.63	220.3	0.85	1125.78	2.69
7.	Harvesting	5920.58	36.84	9344.78	36.26	15265.4	36.48
8.	Transporting	2644.23	16.45	9874	38.31	12518.2	29.91
9.	Sub Total	15003.7	93.36	23619.03	91.64	38622.7	92.30
10.	Machinery Power	1066.25	6.63	2152.4	8.35	3218.65	7.69
	Total	16069.95	100	25771.43	100	41841.4	100

Fixed cost of water chestnut
According to Table 4.7, land revenue and taxes, building and land depreciation, and interest on fixed capital were all included in the fixed cost of water chestnut cultivation. It was determined that the total fixed cost per hectare was ₹1,372.17. Of these, land and building depreciation accounted for the largest portion (83.08%) of the total fixed cost, followed by interest on fixed capital (15.75%) and land revenue and taxes (1.16%).

Table 3: Fixed cost of water chestnut

S. No.	Fixed Cost	From Taxes	(%)
1.	Land Revenue	16.00	1.16
2.	Depreciation on Land and Building	1140	83.08
3.	Intrest on Fixed Capital	216.17	15.75
	Total	1372.17	100

Costs and Returns in cultivation of water chestnut

According to Table 4.2.5, the estimated total cost of growing water chestnuts was ₹74,065.55 per hectare. Out of this, labor (power) costs made up 56.49%, input material costs made up 41.65%, and fixed costs made up 1.85%. The water chestnut crop yielded a net income of ₹1,91,934.55 per hectare, with a gross income of ₹2,66,000 per hectare. The return per rupee invested was calculated at 3.59, while the overall cost of production was ₹1,949.09 per quintal of water chestnut.

Table 4: Costs and Returns of Water Chestnut

S. No.	Particulars	Total Cost	Percentage (%)
A	**Total Cost**		
1.	Input Material Cost	30852	41.66
2.	Labour Cost	41841.38	56.49
3.	Fixed Cost	1372.17	1.85
	Total cost	74065.55	100
B	**Return**		
	Yield	38 qt/hac.	
	Price (Rs.)	7000/qt	
	Gross Income (Rs.)	266000	
	Net Income (Rs.)	191934.45	
	Input output Ratio	3.59	
	Benefit cost Ratio	2.59	
	Cost Per Quintal of Production	1949.09	

Conclusion

Table 4.8 shows the benefit-cost ratio, net income, and input-output ratio per hectare. Water chestnut cultivation generated ₹1,91,934.45 per hectare, according to the analysis. The calculated input-output ratio was 3.59, meaning that for every rupee invested in water chestnut farming, farmers made ₹2.59 in profit.

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