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Economics and profitability of freshwater fish production: A comparative analysis of Tilapia, Pangasius and mixed fish culture in Kanker district of Chhattisgarh

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Abstract

Freshwater aquaculture has emerged as one of the fastest growing agricultural enterprises in India, contributing significantly to employment generation, income enhancement, nutritional security and rural development. The present study was conducted in Kanker district of Chhattisgarh with the objective of analyzing the economics and profitability of Tilapia, Pangasius and Mixed Fish Culture systems. Primary data were collected from 200 fish farmers through a multistage sampling technique. The study estimated the cost of cultivation, gross returns, net returns and benefit-cost ratio for different fish production systems.

The results revealed that the average cost of production per hectare was ₹869,077.40 for Tilapia, ₹450,479.98 for Pangasius and ₹902,895.95 for Mixed Fish Culture. Feed cost constituted the major share of total production cost in all culture systems. The average yield obtained was 9.19 t/ha for Tilapia, 7.59 t/ha for Pangasius and 8.79 t/ha for Mixed Fish Culture. The highest net income was observed in Tilapia culture (₹509,422.60/ha) followed by Mixed Fish Culture (₹371,654.05/ha) and Pangasius culture (₹194,670.02/ha). The benefit-cost ratio was highest in Tilapia culture (1.58), indicating superior economic viability compared to Pangasius (1.43) and Mixed Fish Culture (1.41). The findings suggest that freshwater fish farming is a profitable enterprise in the study area and can significantly improve farmers' income through scientific management practices and efficient resource utilization.

Keywords: Freshwater aquaculture, Tilapia, Pangasius, production economics, profitability, benefit-cost ratio, Chhattisgarh

1. Introduction

Fisheries and aquaculture have become important components of the agricultural economy in India. The sector contributes significantly to food security, employment generation, export earnings and livelihood enhancement of rural households. India is one of the leading fish-producing countries in the world, and freshwater aquaculture contributes a major share to total fish production. In recent years, scientific fish farming has gained importance due to increasing demand for fish protein, changing consumption patterns and rising income levels. Chhattisgarh possesses abundant water resources suitable for freshwater aquaculture. Kanker district has witnessed rapid expansion of fish farming activities because of favorable climatic conditions, availability of water bodies and increasing awareness among farmers regarding commercial fish culture. Tilapia and Pangasius are among the most widely cultivated fish species due to their rapid growth, high survival rate and market demand.

Despite the growing importance of aquaculture, information on production economics and profitability of different fish culture systems remains limited. Therefore, an economic evaluation of fish farming systems is essential for identifying profitable production practices and improving farmers' income. The present study attempts to assess the comparative economics of Tilapia, Pangasius and Mixed Fish Culture in Kanker district of Chhattisgarh.

2. Materials and Methods

The study was conducted in Kanker district of Chhattisgarh. A multistage sampling technique was employed for the selection of respondents.

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A total of 200 fish farmers were selected and categorized into small, medium and large farm groups.

Primary data were collected through personal interviews using a pre-tested schedule. Cost concepts adopted in the study included variable costs, fixed costs and total costs. Profitability measures such as gross income, net income and benefit-cost ratio were calculated using standard farm management techniques.

Gross Income = Yield × Market Price

Net Income = Gross Income – Total Cost

Benefit-Cost Ratio = Gross Income/Total Cost

3. Results and Discussion

3.1 Cost of Production of Tilapia

Cost of production of Tilapia fish per hectare in different farm group, Number of respondents = 200 (Value in Rupees)

Sl. No.	Particulars	Small	Medium	Large	Average
1	Labour cost (hired + family labour)	37040.00	37723.00	38616.17	37793.05
	Seeds (Fingerlings)	71446.82	69546.2	69088.16	70027.06
	Feed	568765.80	583365.67	605596.64	585909.37
	Water cleaning cost (salt, lime and water exchange)	38444.36	39153.26	40080.29	39225.97
	Medicine cost	9391.66	9564.84	9791.30	9582.60
	Fertilizer cost (Urea and TSP)	2194.31	2324.17	2562.21	2360.23
	Fuel/Power cost	75484.35	38080.57	31661.60	22095.35
	Interest on working capital	36688.91	35935.18	35779.43	36134.51
	Sub-total (Cost A1)	839456.21 (95.66)	815692.89 (91.27)	833175.80 (91.07)	803128.14 (92.41)
2	Rental value of land	18607.77	56137.55	60669.47	45138.26
	(Cost A2)	858063.98	871830.44	893845.27	848266.40
	Interest on Fixed capital	10006.07	11442.05	11712.96	11053.69
	(Cost B)	868070.05	883272.49	905558.23	859320.36
	Equipment, boat and nets	9479.43	10458.75	9333.77	9757.31
	Sub-total Fixed cost	38093.27 (4.34)	78038.35 (8.73)	81716.20 (8.93)	65949.26 (7.59)
	Total (Cost C)	877549.48 (100.00)	893731.24 (100.00)	914892.00 (100.00)	869077.40 (100.00)

3.2 Measures of farm income across of Tilapia fish in different size farm groups in the study area.

Income measures	Small	Medium	Large	Sample average
Yield (t/ha)	7.05	9.18	11.35	9.19
Marketing surplus (t/ha)	7.05	9.18	11.35	9.19
Rate (Rs/t)	150000.00	150000.00	150000.00	150000.00
Gross income (Rs./ha)	1057500.00	1377000.00	1645750.00	1378500.00
Total cost (Rs/ha) (Cost of cultivation with cost of establishment)	877549.48	893731.24	914892.00	869077.40
Net income (Rs./ha)	179950.52	483268.76	730858.00	509422.60
B:C Ratio	1:1.20	1:1.54	1:1.79	1:1.58

The average total cost of Tilapia production was estimated at ₹869,077.40 per hectare. Variable costs accounted for 92.41 percent of total cost, while fixed costs contributed 7.59 percent. Feed cost constituted the largest component of total production cost (₹585,909.37), followed by seed cost and labour cost. The average net income from Tilapia

production was ₹509,422.60 per hectare with a benefit-cost ratio of 1.58.

3.3 Cost of Production of Pangasius

Cost of production of Pangasius fish per hectare in different farm group, Number of respondents = 200 (Value in Rupees)

Sl. No.	Particulars	Small	Medium	Large	Average
1	Labour cost (hired + family labour)	19558.52	19642.58	20006.85	19735.98
	Seeds (Fingerlings)	33555.37	33001.398	33234.13	33263.633
	Feed	300329.86	303761.81	313756.73	300329.86
	Water cleaning cost (salt, lime and water exchange)	20300.07	20387.32	20765.40	20484.27
	Medicine cost	4959.15	4980.46	5072.83	5004.15
	Fertilizer cost (Urea and TSP)	1158.68	1210.21	1327.47	1232.12
	Fuel/Power cost	39858.59	19828.77	16403.72	11574.22
	Interest on working capital	19373.13	18711.65	18537.15	18873.98
	Sub-total (Cost A1)	439093.37	421524.20	429104.28	416117.82
2	Rental value of land	9825.61	29231.14	31432.56	23496.44
	(Cost A2)	448918.98	450755.34	460536.84	439614.26
	Interest on Fixed capital	5283.58	5957.94	6068.43	5769.98
	(Cost B)	454202.56	456713.28	466605.27	445384.24
	Equipment, boat and nets	5005.50	5445.93	4835.78	5095.74
	Sub-total Fixed cost	20114.69	40635.01	42336.77	34362.16
	Total (Cost C)	459208.06	462159.21	471441.05	450479.98

3.4 Measures of farm income across of Pangasius fish in different size farm groups in the study area.

Income measures	Small	Medium	Large	Sample average
Yield (t/ha)	7.45	7.58	7.75	7.59
Marketing surplus (t/ha)	7.45	7.58	7.75	7.59
Rate (Rs/t)	85000.00	85000.00	85000.00	85000.00
Gross income (Rs./ha)	633250.00	644300.00	658750.00	645150.00
Total cost (Rs/ha) (Cost of cultivation with cost of establishment)	459208.06	462159.21	471441.05	450479.98
Net income (Rs./ha)	174041.94	182140.79	187308.95	194670.02
B:C Ratio	1:1.38	1:1.39	1:1.40	1:1.43

The average production cost of Pangasius was estimated at ₹450,479.98 per hectare. Feed expenditure represented the major share of total cost. The average yield was 7.59 t/ha and net income was ₹194,670.02 per hectare. The benefit-cost ratio was estimated at 1.43, indicating that Pangasius

culture is economically feasible.

3.5 Cost of Production of Mixed Fish Culture

Cost of production of Mixed Fish Culture per hectare in different farm group, Number of respondents = 200 (Value in Rupees)

Sl. No.	Particulars	Small	Medium	Large	Average
1	Labour cost (hired + family labour)	38038.24	38616.17	38983.94	38546.11
	Seeds (Fingerlings)	72831.5	73022.99	72240.38	72698.29
	Feed	584094.24	597177.95	611364.22	597545.47
	Water cleaning cost (salt, lime and water exchange)	39480.44	40080.29	40462.00	40007.58
	Medicine cost	9644.77	9791.30	9884.55	9773.54
	Fertilizer cost (Urea and TSP)	2406.42	2379.20	2586.61	2406.42
	Fuel/Power cost	77518.68	38982.20	31963.13	22584.24
	Interest on working capital	37677.68	36786.02	36120.19	36861.30
	Sub-total (Cost A1)	861539.00 (91.38)	836836.12 (90.91)	843605.02 (91.09)	820422.95 (90.87)
2	Rental value of land	61247.28	61247.28	61247.28	61247.28
	(Cost A2)	922786.28	898083.40	904852.30	881670.23
	Interest on Fixed capital	10275.73	11712.96	11824.51	11271.07
	(Cost B)	933062.01	909796.36	916676.81	892941.30
	Equipment, boat and nets	9734.90	10706.38	9422.66	9954.65
	Sub-total Fixed cost	81257.91 (8.62)	83666.62 (9.09)	82494.45 (8.91)	82473.00 (9.13)
	Total (Cost C)	942796.91 (100.00)	920502.74 (100.00)	926099.47 (100.00)	902895.95 (100.00)

3.6 Measures of farm income across of mix fish in different size farm groups in the study area.

Income measures	Small	Medium	Large	Sample average
Yield (t/ha)	8.50	8.83	9.05	8.79
Marketing surplus (t/ha)	8.50	8.83	9.05	8.79
Rate (Rs/t)	145000.00	145000.00	145000.00	145000.00
Gross income (Rs./ha)	1232500.00	1280350.00	1312250.00	1274550.00
Total cost (Rs./ha) (Cost of cultivation with cost of establishment)	942796.91	920502.74	926099.47	902895.95
Net income (Rs./ha)	289703.09	359847.26	386150.53	371654.05
B:C Ratio	1:1.31	1:1.39	1:1.42	1:1.41

The average production cost of Mixed Fish Culture was ₹902,895.95 per hectare. Feed expenditure accounted for the largest share of production cost. The average yield was 8.79 t/ha and net income was ₹371,654.05 per hectare. The benefit-cost ratio was estimated at 1.41.

Average production costs were ₹869,077.40/ha for Tilapia, ₹450,479.98/ha for Pangasius and ₹902,895.95/ha for Mixed Fish Culture. Tilapia recorded the highest profitability with a B:C ratio of 1.58.

3.7 Comparative Profitability Analysis

Comparative analysis indicated that Tilapia culture generated the highest net returns and benefit-cost ratio among the three production systems. Mixed Fish Culture ranked second in profitability, while Pangasius culture generated relatively lower returns. The higher profitability of Tilapia culture was mainly attributed to higher yield and favorable market prices.

4. Conclusion

The study concludes that freshwater fish farming is a profitable enterprise in Kanker district of Chhattisgarh. Among the culture systems evaluated, Tilapia culture emerged as the most profitable with the highest net income and benefit-cost ratio. Feed cost was identified as the major component of production cost, indicating the need for strategies aimed at reducing feed expenditure. Promotion of scientific fish farming practices, timely availability of quality fingerlings, access to institutional credit and strengthening of extension services can further enhance the profitability and sustainability of freshwater aquaculture in the region.

5. Policy Implications

The findings of the study indicate that freshwater fish farming is a profitable enterprise in Kanker district of Chhattisgarh. However, several interventions are required to

enhance productivity, profitability and sustainability of fish farming in the region.

5.1 Development of Low-Cost Feed Production Units

Feed constituted the largest share of total production cost in all fish culture systems. Therefore, establishing low-cost feed manufacturing units at the district and block levels can significantly reduce production costs and improve farmers' profitability. Government agencies, cooperatives and private entrepreneurs should be encouraged to produce nutritionally balanced fish feed using locally available ingredients. Financial assistance and technical support may be provided to promote feed enterprises and ensure timely availability of quality feed to fish farmers.

5.2 Strengthening Fish Seed Production and Distribution Systems

Availability of quality fingerlings is one of the most important factors affecting fish productivity. The government should strengthen hatchery infrastructure and fish seed production centres to ensure the timely supply of healthy and disease-free fingerlings. Establishment of additional hatcheries and seed rearing units in the study area would reduce farmers' dependence on distant markets and minimize transportation losses. Quality control mechanisms should also be implemented to maintain seed standards.

5.3 Improved Access to Institutional Credit

Many fish farmers face financial constraints and rely on informal credit sources that charge high interest rates. Easy access to institutional credit through commercial banks, regional rural banks and cooperative societies can help farmers adopt improved technologies and expand fish farming activities. Special credit schemes with subsidized interest rates may be introduced for aquaculture development. Simplification of loan procedures and timely disbursement of credit will further encourage investment in fish farming.

5.4 Capacity-Building Programmes for Fish Farmers

Regular training programmes should be organized to improve farmers' technical knowledge and managerial skills. Training should focus on scientific pond management, feed management, disease control, water quality management, harvesting techniques and post-harvest handling. Exposure visits to successful fish farms and demonstration programmes can help farmers adopt modern aquaculture technologies and improve farm performance.

5.5 Promotion of Scientific Aquaculture Practices through Extension Services

Extension services play a crucial role in transferring modern fish farming technologies to farmers. Strengthening fisheries extension networks can facilitate the dissemination of scientific information regarding stocking density, feeding practices, disease management and water quality monitoring. Regular interaction between fisheries experts and farmers can improve adoption rates of improved technologies and enhance production efficiency. Mobile-based advisory services and digital extension platforms may also be utilized to provide timely technical guidance.

5.6 Strengthening Fish Marketing Infrastructure

Development of fish markets, cold storage facilities, transportation networks and value-addition units can reduce

post-harvest losses and improve farmers' share in consumer expenditure. Better marketing infrastructure will enable farmers to obtain remunerative prices and increase profitability. Formation of fish farmer producer organizations (FPOs) can further strengthen collective marketing and bargaining power.

5.7 Sustainable Aquaculture Development

Sustainable management of water resources, efficient utilization of inputs and environmentally friendly production practices should be encouraged. Adoption of scientific waste management systems, water conservation measures and disease prevention strategies can ensure long-term sustainability of freshwater aquaculture in the region. Government policies should focus on balancing economic growth with environmental conservation.

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