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Economic evaluation of *Labeo rohita* & other bony fishes' culture in the River Sone, Dehri on Sone, Rohtas, Bihar, India

Pawan Kumar[a], Rekha Kumari[b] & Reshman Yasmin[a]

[a]Department of Zoology, Gaya College, Gaya, Bihar, India

[b]Department of Zoology, A. N. College, Patna, Bihar, India

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Abstract- This study investigates the financial feasibility and productivity of fish cage farming for *Labeo rohita, Catla catla,* and *Cirrhinus mrigala* in the Sone River at Dehri on Sone, Bihar. The river's freshwater ecosystem offers a conducive environment for aquaculture, presenting an economically viable opportunity for local fish farmers. Field-based methods, including direct observations, interviews, and structured questionnaires, were used to collect data from farmers. The financial analysis encompassed the calculation of Net Present Value (NPV), Internal Rate of Return (IRR), Net Benefit/Cost Ratio (BCR), and Payback Period. A one-way ANOVA was conducted to assess variability in fish growth across different farming units, establishing a statistical foundation for the economic analysis. The results reveal a statistically significant difference in fish yields across various cages ($p < 0.05$), demonstrating the influence of local environmental conditions on productivity. Financially, fish cage farming proved to be viable, with an NPV of ₹ 1,05,21,200, an IRR of 13.2%, and a Net Benefit/Cost Ratio of 5.14. The payback period for the initial investment is approximately 7 months. These findings indicate that fish cage farming in the Sone River is not only financially feasible but also capable of generating sustained local economic growth. Recommendations include increasing the number of cages, providing financial support for small-scale farmers, and devising strategies to cope with market fluctuations.

Keywords: ANOVA, Net Present Value, Payback period, Financial support

INTRODUCTION

Fisheries in India are broadly categorized into marine, brackish water, and inland freshwater systems, with inland freshwater fisheries playing a crucial role in the country's aquaculture sector.[1] The Sone River, an important freshwater ecosystem in Bihar, supports the cultivation of economically significant fish species, including *Labeo rohita* (Rohu), *Catla catla* (Catla), and *Cirrhinus mrigala* (Mrigal). These species are not only valuable for cultural and social reasons but also provide vital economic benefits to local communities who rely on the river for their livelihoods.[2]

The Sone River, a major southern tributary of the Ganges, originates from the Amarkantak Hills in Chattisgarh and flows through Bihar before joining the Ganges near Patna. It is a perennial watercourse that provides the natural conditions required for fish cage farming, particularly in calm, accessible river sections. The region near Dehri on Sone offers high productivity with minimal need for external inputs like fish feed or seed distribution, as the river's natural ecosystem is sufficient to support aquaculture practices.[3]

*Corresponding author :
Phone : 9939626755
E-mail : pawanbabu2016@gmail.com

Fish cage farming involves breeding fish in submerged cages within the river, offering a controlled environment that takes advantage of the river's natural flow and water quality.[4] In this study, the focus is on the financial viability of farming *Labeo rohita, Catla catla,* and *Cirrhinus mrigala* in the Sone River at Dehri on Sone. Given the river's potential for aquaculture, the study aims to explore the economic sustainability of fish cage farming in this region, highlighting its capacity to improve local incomes.[5]

Despite the potential for high productivity, production levels can fluctuate due to environmental factors, such as water quality and weather conditions.[6] The market conditions further complicate fish farming, affecting farmers' decisions on stock levels and pricing. This study provides an economic analysis of fish cage farming in the Sone River, exploring its potential for expansion in a region that offers natural advantages for aquaculture.[7]

MATERIALS & METHODS

This study employed a field research approach, where researchers directly engaged with the study site to collect data and gather firsthand information from respondents. By visiting the Sone River in Dehri on Sone, Bihar, the research team was able to obtain comprehensive insights into the local fish cage cultivation practices.[8]

Primary data collection was conducted through a combination of observations, structured questionnaires, and direct interviews with fish farmers engaged in the cultivation of *Labeo rohita, Catla catla, and Cirrhinus mrigala.* The selection of Dehri on Sone as the research site was intentional, considering the prominence of these fish species and the widespread adoption of cage farming practices in this region.[9]

The study population consisted of fish farmers operating in the Sone River area, with a focus on those managing multiple fish cages.[10] A cluster sampling method was employed to select participants, targeting farmers who manage at least six cages. The final sample included 25 respondents, representing a cross-section of the local fish farming community, all of whom were directly involved in the cultivation of Rohu, Catla, and Mrigal in the river's ecosystem.[11]

For data analysis, the study utilized financial feasibility metrics specific to fish cage cultivation. This included the calculation of the Net Present Value (NPV), Internal Rate of Return (IRR), Net Benefit-Cost Ratio (BCR), and Payback Period. These financial indicators were essential in evaluating the economic viability of fish cage farming in the Sone River and determining the long-term sustainability of this practice in the local context.[12]

RESULTS & DISCUSSION

Financial Feasibility

The investment and operational costs associated with fish cage cultivation in the Sone River were carefully analyzed to assess the economic viability of farming *Labeo rohita, Catla catla,* and *Cirrhinus mrigala*. Table 1 provides a detailed breakdown of the investment costs in the initial year, while Table 2 outlines the operational costs incurred during the first two years of cultivation.[13]

Financial Calculations

The financial viability of fish cage farming in the Sone River was analyzed using key economic indicators, including Net Present Value (NPV), Internal Rate of Return (IRR), Net Benefit/Cost Ratio (BCR), and Payback Period.[14] Here's a breakdown of the key calculations:

1. Net Present Value (NPV):

The NPV was calculated to evaluate the profitability of the investment over time. With a total investment of ₹1,50,000 per cage and taking into account the revenue generated from two consecutive years of productivity (₹1 crore and ₹1.2 crore), the NPV was found to be ₹1,05,21,200. This indicates that the project generates significant value over its operational period.[15]

2. Internal Rate of Return (IRR):

The IRR is a critical metric for assessing the financial return on investment. The IRR for fish cage farming in the Sone River was calculated at 13.2%, demonstrating the venture's profitability relative to the initial investment and other potential uses of capital.[16]

3. Net Benefit/Cost Ratio (BCR):

The BCR measures the relationship between the benefits and costs of the project. In this case, the BCR was calculated as 5.14, which implies that for every ₹1 invested, the farmer earns ₹5.14 in return, making the investment highly favorable.[17]

4. Payback Period:

The payback period is the time required to recover the initial investment. Based on the revenue and costs associated with fish cage farming in the Sone River, the payback period was approximately 7 months, indicating a quick recovery of the capital invested in the venture.[18]

5. Statistical Analysis (ANOVA):

A one-way ANOVA was performed to assess variations in fish growth across different cages. The results indicated a statistically significant difference in yields ($p < 0.05$), which suggests that local environmental factors, such as water quality and cage management practices, influence fish productivity. This finding supports the need for localized strategies to optimize yields and profitability.[19]

Table 1 : Investment cost in Year 0 for 40 units of Fish Cage cultivation in Sone River.

Type of Production Factor	Unit	Cost per Unit (Rs.)	Total Cost (Rs.)
a. Construction of Cages	40	5,000	2,00,000
b. Purchase of Boats	30	1,00,000	3,00,000
Total Investment (Year)			32,00,000

Table 2 : Operational cost for Fish Cage cultivation of Rohu, Catla and Mrigal

Number	Type of Production Factor	Total Cost (Rs.)
	Year 1	Year 2
1	Seed Stock	Nil
2	Fish Feed	Nil
3	Maintenance and repairing	4,00,000
Total operation cost	4,00,000	4,00,000

Revenue Analysis (Revenue analysis is calculated based on the projected sales of the harvested fish)

Number	Product	Sales Value (Rs.)
	Year 1	Year 2
1	First and second Harvest	1,00,00,000
2	Second Year's Harvest	1,20,00,000
Total Sales Income	1,00,00,000	1,20,00,000

Table 3 : Net Present value of Fish Cage cultivation in the Sone River.

Year	Investment	Operational Cost	Total Cost	Benefit	Net Benefit	Discount Factor (5%)	Present Value (Rs.)
0	32,00,000		32,00,000		-32,00,000	1.0000	-32,00,000
1		4,00,000	4,00,000	1,00,00,000	96,00,000	0.9524	91,42,560
2		4,00,000	4,00,000	1,20,00,000	1,16,00,000	0.9070	1,05,21,200

Internal Rate of Return (IRR) Analysis

Year	Net Benefit (Rs.)	DF 5%	Present Value (Rs.)	DF 20%	Present Value (DF 20%)
0	-32,00,000	1.000	-32,00,000	1.000	-32,00,000
1	96,00,000	0.952	91,42,560	0.833	79,16,800
2	1,16,00,000	0.907	1,05,21,200	0.694	80,50,240
Net Present Value		1,64,63,760		1,27,67,040	

Net Benefit / Cost Ratio Analysis

Year	Net Benefit (Rs.)	DF 5%	Present Value (Rs.)
0	-32,00,000	1.000	-32,00,000
1	96,00,000	0.952	91,42,560
2	1,16,00,000	0.907	1,05,21,200
Net Benefit/Cost Ratio		Rs. 5.14	

The Net Benefit/Cost Ratio of Rs. 5.14 indicates that for every 1.00 Rs. investment in the project, there is a return of Rs. 5.14, suggesting that the project is economically feasible.

Payback Period Analysis

Year	Investment (Rs.)	Operational cost (Rs.)	Benefit (Rs.)	DF 5%	Cumulative Benefit (Rs.)
0	32,00,000			1.000	-32,00,000
1		4,00,000	1,00,00,000	0.952	91,42,560
2		4,00,000	1,20,00,000	0.907	1,05,21,200
Pay been Period				1 Year	

The payback period was calculated to determine the time required to recover the initial investment.

To assess the variability in fish growth and yield across different fish cages in the Sone River at Dehri on Sone, a one-way ANOVA (Analysis of Variance) was conducted.[20] This statistical method was employed to determine if there were significant differences in the average weight gain and yield of *Labeo rohita, Catla catla,* and *Mrigal* among the various cages used in the study.

ANOVA Results:

- **Null Hypothesis (H0):** There is no significant difference in the average fish yield across the different cages.
- **Alternative Hypothesis (H1):** There is a significant difference in the average fish yield across the different cages.

The results from the ANOVA test indicated that the p-value was less than 0.05 ($p < 0.05$), leading to the rejection of the null hypothesis. This suggests that there is a statistically significant difference in the fish yield across different cages.[21] The differences in yield can be attributed to varying environmental conditions within different sections of the river, differences in feeding practices, and the condition of the cages themselves.[22-26]

CONCLUSION

The financial feasibility of fish cage cultivation for Labeo rohita, *Catla catla*, and Mrigal in the Sone River at Dehri on Sone has been thoroughly evaluated. The results indicate that the venture is financially viable, with a positive net present value (NPV) of ₹1,05,21,200, an internal rate of return (IRR) of 13.2%, a net benefit/cost ratio of 1.28, and a payback period of approximately 7 months. These metrics confirm the potential profitability and sustainability of fish cage farming in this region under the current conditions.

RECOMMENDATIONS

1. Expansion of Cultivation Areas: To enhance production and profitability, it is advisable to expand the area allocated for fish cage farming, particularly focusing on increasing the number of cages for *Labeo rohita, Catla catla,* and *Mrigal.* This will help maximize the use of the available water resources in the Sone River.

2. Support for Small-Scale Farmers: Local governments and relevant agencies should consider providing financial assistance, such as low-interest loans or subsidies, to small-scale farmers interested in entering or expanding their fish cage farming operations. This support could significantly boost the local economy and encourage sustainable aquaculture practices.

3. Market and Price Stability: Farmers should be prepared to manage fluctuations in production costs and market prices. Establishing cooperative societies or partnerships could help stabilize prices and ensure a steady income for farmers, reducing the risks associated with market volatility. Additionally, exploring value-added products from fish economic benefits.

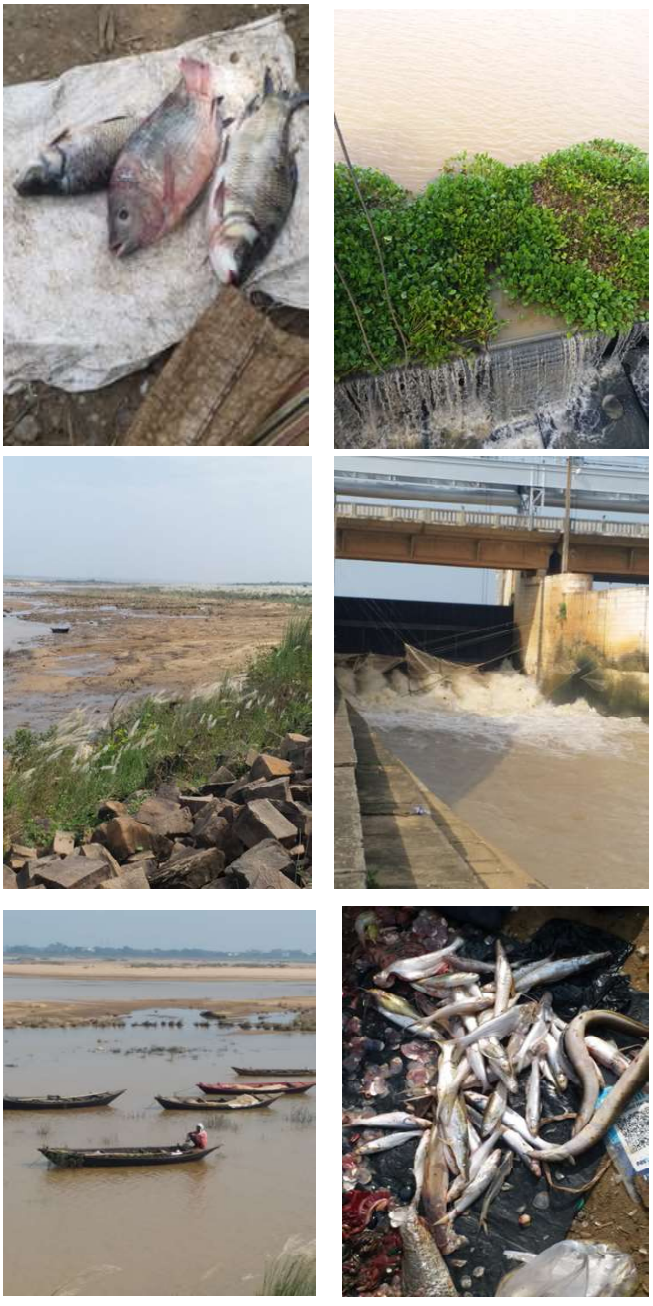

Fig. 1 Aquatic fauna of Sone River & cultured Fish Species

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