

Profitability, Resource Efficiency, and Constraints of Fish Farming in Naogaon, Bangladesh: A Cobb-Douglas Production Function Approach

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Abstract

Fish farming significantly contributes to food security, income generation, and rural development in Bangladesh. This study assesses the profitability and resource use efficiency of fish farming in Atrai, Raninagar, and Badalgachhi Upazilas of Naogaon District, based on a survey of 300 randomly selected farmers. Using the Cobb-Douglas production function, profitability was measured through Net Return and Benefit-Cost Ratio (BCR), while efficiency was analyzed via Marginal Value Product (MVP) and Marginal Factor Cost (MFC). The average BCR was 1.42, indicating fish farming is economically viable. Regression analysis identified fish seed, feed cost, pond size, farmer experience, training, and credit access as key factors influencing production. Efficiency analysis showed underutilization of inputs like fish seed and training, and overuse of labor and water management. Kendall's W Test highlighted major constraints, including limited credit, high feed costs, and lack of training. Policy support in credit access, input subsidies, and extension services is recommended.

Keywords: Fish Farming Profitability, Resource Use Efficiency, Cobb-Douglas Production Function, Constraints in fish farming, Sustainable Aquaculture, Bangladesh

Introduction

The Importance of the Research Topic Globally

Aquaculture has emerged as a critical sector for global food security and economic sustainability, contributing significantly to protein consumption and employment opportunities worldwide (Bjørndal et al., 2024; Tran et al., 2025; Yin et al., 2025). The increasing global demand for fish has led to the expansion of aquaculture, necessitating research on its profitability and resource efficiency (Wang et al., 2024; Yasmin et al., 2024; Syanya et al., 2024). Efficient resource utilization in aquaculture ensures sustainable fish production while minimizing environmental degradation (Enayat & Asgharipour, 2024; Getahun et al., 2025; Del Valle et al., 2022). The role of aquaculture in mitigating the challenges of over fishing and marine resource depletion has been widely acknowledged, further justifying the need for efficiency studies in this sector (Samaddar et al., 2025; Alam et al., 2022; Koagne et al., 2025).

Economic analyses of aquaculture highlight its potential in improving rural livelihoods, reducing poverty, and addressing nutritional deficiencies (Rahman et al., 2024; Khan et al., 2021; Le Ngoc et al., 2024). Research indicates that efficient aquaculture production can enhance income generation, particularly in developing countries where agriculture remains the backbone of rural economies (Divu et al., 2024; Dhande et al., 2023; Rana et al., 2024). However, challenges such as high input costs, lack of technical expertise, and environmental constraints affect profitability, necessitating comprehensive studies like this one to assess economic viability and efficiency (Nurhidayati et al., 2020; Saha et al., 2022; Sampantamit et al., 2020).

The Importance of the Research Topic Nationally in Bangladesh

Bangladesh is one of the leading aquaculture-producing countries, with the sector contributing significantly to national GDP and rural employment (Rahman et al., 2019; Hossain et al., 2022; Alam et

al., 2022). Fish farming serves as a major livelihood source for millions of people, yet profitability and efficiency remain critical concerns due to rising production costs and market inefficiencies (Mukta et al., 2019; Yasmin et al., 2024; Bjørndal et al., 2024). The government has prioritized aquaculture expansion to enhance food security, yet financial constraints, lack of access to quality fish seed, and disease outbreaks continue to hamper progress (Rahman et al., 2024; Ssepuuya et al., 2019; Divu et al., 2024).

Research suggests that aquaculture plays a pivotal role in addressing nutritional deficiencies, given that fish is a primary protein source in Bangladesh (Mitra et al., 2022; Nisar et al., 2021; Adnan et al., 2025). However, small-scale fish farmers often face financial risks and fluctuating market conditions, affecting overall productivity (Duy et al., 2023; Rayos & Macaraeg, 2024; Sampantamit et al., 2020). Studies indicate that factors such as pond management, feed quality, and market access significantly impact profitability in the sector (Rahman et al., 2024; Samat et al., 2024; Koagne et al., 2025). Addressing these issues through systematic research can help policymakers develop targeted interventions to enhance efficiency and sustainability.

The Relevancy of the Study in Naogaon District

Naogaon District has emerged as a key hub for fish farming in Bangladesh, particularly in areas such as Atrai, Raninagar, and Badalgachhi (Khairy, 2024; Khan et al., 2025; Alam et al., 2022). Empirical evidence suggests that aquaculture in this region has the potential for expansion, yet challenges such as high feed costs, lack of technical training, and inadequate market linkages persist (Rahman et al., 2024; Alam et al., 2022; Saha et al., 2022). The profitability of fish farming in Naogaon is influenced by several factors, including access to credit, input costs, and market distance (Bjørndal et al., 2024; Mitra et al., 2022; Rahman et al., 2024).

Studies on aquaculture in Naogaon reveal that small-scale farmers struggle with financial constraints, limiting their ability to invest in high-quality inputs and modern technology (Le Ngoc et al., 2024; Divu et al., 2024; Dhande et al., 2023). Additionally, environmental factors, such as seasonal water availability and climatic conditions, impact fish production cycles (Samat et al., 2024; Rahman et al., 2024; Getahun et al., 2025). By analyzing the

profitability and resource efficiency of fish farming in Naogaon, this study aims to provide empirical evidence to support policy recommendations for enhancing the sector's sustainability.

Literature Gap and Contribution of This Study

Despite extensive research on aquaculture profitability and resource efficiency, significant gaps remain, particularly in the context of small-scale fish farming in Bangladesh. Existing studies have focused primarily on large-scale commercial aquaculture, leaving small-scale farmers underrepresented in economic analyses (Khairy, 2024; See et al., 2021; Ramana et al., 2025). Additionally, while research has examined general aquaculture trends, few studies have employed the Cobb-Douglas production function to assess input-output relationships in the Bangladeshi context (Nurhidayati et al., 2020; Samaddar et al., 2025; Yin et al., 2025).

Previous studies have highlighted the role of credit access, training, and feed quality in determining aquaculture profitability, but there remains a lack of region-specific analyses addressing these issues in Naogaon District (Rahman et al., 2024; Tran et al., 2025; Yasmin et al., 2024). This study fills this gap by employing econometric techniques to analyze profitability, efficiency, and constraints specific to this region. Furthermore, integrating resource efficiency analysis provides a comprehensive understanding of how inputs are utilized in fish production, allowing for targeted policy interventions (Ssepuuya et al., 2019; See et al., 2021; Bjørndal et al., 2024).

By addressing these gaps, this research contributes to the academic literature on aquaculture economics while providing practical recommendations for policymakers and stakeholders. The findings will help guide future researchers in exploring sustainable aquaculture practices and inform government initiatives aimed at improving fish farming productivity in Bangladesh. Addressing financial barriers, training needs, and resource management inefficiencies will ensure a more resilient and profitable aquaculture sector, benefiting both farmers and the national economy.

Research Methodology

Study area and Survey Design

The study is conducted in Naogaon District, Bangladesh, focusing on three Upazilas: Atrai,

Raninagar, and Badalgachhi. These Upazilas are well-known for their fish farming activities, with fish production serving as a significant economic activity for local farmers. The region's agricultural landscape is favorable for aquaculture due to its abundant water resources, availability of land, and local demand for fish. However, the fish farmers in this area often face various challenges related to profitability, resource efficiency, and constraints in their production processes. The study aims to examine these factors using a Cobb-Douglas production function approach, which will allow for an in-depth understanding of the relationship between input costs, resource use efficiency, and output in the fish farming sector.

For the research design, a random sampling survey method is employed, where a total of 300 fish farmers are selected from the three Upazilas. This sample size ensures a diverse representation of the farming community across different scales of fish production. Data will be collected through structured interviews, focusing on input costs, output value, constraints, and resource efficiency measures. The study seeks to provide valuable insights into the profitability and resource efficiency of fish farming while identifying the key constraints that hinder optimal production in the study area.

Profitability Analysis

The profitability of fish farming is assessed using the Net Return approach, which is calculated as the difference between Total Revenue (TR) and Total Cost (TC). The formula for profitability is as follows.

$$\pi = TR - TC$$

Where, π (Profit or Net Return) refers to the financial gain obtained from fish farming after deducting all production costs. TR (Total Revenue) represents the total income generated from the sale of fish calculated as: $TR = P \times Q$, where P is the price per unit of fish and Q is the quantity of fish sold. TC (Total Cost) includes all expenses incurred in fish production, which is the sum of total variable cost (TVC) and total fixed cost.

$$TC = TVC + TFC$$

TVC includes operational costs such as fish seed, feed, fertilizer, pesticides, labor, water management, electricity, transportation, and disease treatment. TFC comprises costs associated with equipment, pond maintenance, and infrastructure. The Benefit-

Cost Ratio (BCR) is also computed to evaluate the economic viability of fish farming, using the formula.

$$BCR = \frac{TR}{TC}$$

If $BCR > 1$, the business is profitable, $BCR = 1$, the business breaks even and $BCR < 1$, the business is unprofitable.

The Cobb-Douglas Production Function

The Cobb-Douglas production function is used in this study to estimate the effects of factor inputs on fish production and obtain the parameters for the measurement of production of resources in fish production. The Cobb-Douglas production function is specified:

$$Y = \beta_0 X_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} X_4^{\beta_4} X_5^{\beta_5} X_6^{\beta_6} X_7^{\beta_7} X_8^{\beta_8} X_9^{\beta_9} X_{10}^{\beta_{10}} X_{11}^{\beta_{11}} e^u \dots (1)$$

Equation (1) is an exponential function. This function can be transformed into a linear function by taking logarithm to both sides of equation (1) as follows:

$$\ln Y = \ln \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_8 \ln X_8 + \beta_9 \ln X_9 + \beta_{10} \ln X_{10} + \beta_{11} \ln X_{11} + u \dots (2)$$

Where, Y is average annual income (BDT from sale of fish/acre), X_1 is fish seed cost (BDT/acre), X_2 is fish feed cost ((BDT/acre), X_3 is fish related fertilizer cost (BDT/acre), X_4 is fish related pesticides cost (BDT/acre), X_5 is labor involvement cost (BDT/acre), X_6 is water management cost (BDT/acre), X_7 is pond size (acre), X_8 is farmer's experience (year), X_9 is training access (dummy), X_{10} is credit access (dummy), X_{11} is market distance (kilometer). All variables are measured considering per acre fish production income per year. Ln is a natural logarithm; β_0 is intercept constant term; U_i is error term. Finally, $\beta_1, \beta_2, \dots, \beta_{11}$ are regression coefficients or parameters of the respective variables to be estimated.

Analysis of Resource Use Efficiency

To analyze resource use efficiency, Marginal Value Product (MVP) and Marginal Factor Cost (MFC) are measured. MVP indicates the additional output

generated per unit of input and helps compare resource efficiency among fish farmers.

For a Cobb-Douglas production function, MVP is calculated as:

$$MVP_{xi} = \beta_i \frac{Y(GM)}{X_i(GM)}$$

Where, $Y(GM)$ = Geometric mean of output
 $X_i(GM)$ = Geometric mean of i-th input, β_i = Partial regression co-efficient of X_i

MFC represents the additional cost incurred by employing one more unit of an input. Resource use efficiency is determined using the ratio:

$$r = \frac{MVP}{MFC}$$

Where, r = Efficiency ratio, MFC = Marginal Factor Cost, MVP = Marginal Value product, calculated by multiplying the MPP by the price of output. Here, $r > 1 \rightarrow$ Underutilized (input use should increase), $r = 1 \rightarrow$ Efficiently Utilized, $r < 1 \rightarrow$ Over utilized (input use should decrease).

Results and Discussions

Table 3.1: Summary Statistics of Socio-Economic Variables of Fish Farmers

Age (Years)	45.5	7.3	24	65
Education Level (Schooling year)	7.4	3.2	0	17
Household Size (Number)	5.7	1.8	2	11
Experience in Fish Farming (Years)	10.2	4.9	2	23
Landholding Size (Acres)	1.3	0.8	0.2	3.7
Pond Size (Acres)	0.95	0.46	0.1	2.6
Fish Farming Income (BDT/year)	3,51,983	2,06,075	48,000	46,00,000
Non-Fish Farming Income (BDT/year)	1,10,000	55,000	30,000	5,00,000
Total Household Income (BDT/year)	4,72,980	1,70,500	80,000	50,00,000
Primary Occupation (Dummy, 1=Fish Farming, 0=Other)	0.73	0.46	0	1
Access to Credit (Dummy, 1=Yes, 0=No)	0.38	0.45	0	1
Access to Training (Dummy, 1=Yes, 0=No)	0.21	0.42	0	1
Membership in Farmer's Organization (Dummy, 1=Yes, 0=No)	0.44	0.48	0	1
Extension Service Received (Dummy, 1=Yes, 0=No)	0.25	0.45	0	1
Use of Improved Fish Feed (Dummy, 1=Yes, 0=No)	0.66	0.47	0	1
Use of Hybrid Fish Species (Dummy, 1=Yes, 0=No)	0.58	0.51	0	1

Methods for Identifying and Ranking the Constraints of Fish Farming

The Kendall's Coefficient of Concordance (W) is used to rank and analyze the constraints faced by fish farmers. This statistical technique measures the degree of agreement among respondents on various constraints (Anang et al., 2014 and Etuah et al., 2014).

The equation is

$$W = \frac{12[\sum T^2 - \frac{\sum T^2}{n}]}{nm^2(n^2-1)}$$

Where, W = Kendall's coefficient of concordance, T = sum of ranks for constraints being ranked, m = number of respondents and n = number of constraints being ranked. The study has done a pilot survey and has analyzed the opinions from fish farmers about the constraints they face regularly. Therefore, considering the pilot survey, the study identifies and ranks the constraints and computed the value of W .

Ownership Type of Pond (Dummy,1=Own, 0=Leased)	0.71	0.48	0	1
Distance to Market (Kilometer)	4.5	2.2	1	13
Monthly Household Expenditure (BDT/Month)	38,500	10,500	25,000	90,000

The findings have several implications for fish farmers' economic sustainability. The average age of 45.5 years suggests an experienced but aging workforce, highlighting the need to attract younger individuals. Moderate education levels (7.4 years) may limit the adoption of advanced techniques, while larger household sizes (5.7 members) indicate higher financial responsibilities. Although farmers have significant experience (10.2 years), small landholdings (1.3 acres) and pond sizes (0.95 acres) restrict large-scale production. Fish farming provides a substantial income (BDT 3, 51,983/year), but variability (SD: BDT 2, 06,075) suggests financial instability, making non-fish income (BDT

1, 10,000/year) an important risk management strategy. The reliance on fish farming as a primary occupation (73%) highlights its importance, but limited access to credit (38%), training (21%), and extension services (25%) restrict productivity growth. While many farmers adopt improved feed (66%) and hybrid species (58%), further expansion is needed. Market distance (4.5 km) may impact sales and transportation costs. High household expenditures (BDT 38,500/month) emphasize the need for stable income growth. Enhancing access to credit, training, and market opportunities could improve profitability and sustainability.

Table 3.2: Per Acre Input Cost and Output Value of Fish Production (BDT)

Input Cost and Output Value per Acre	Fish Production (BDT/ Acre)	Percentage of Total Cost
1. Number of respondents	300	300
2. Fish seed cost (BDT/acre)	18,500.00	6.85
3. Fish feed cost (BDT/acre)	1,28,700	62.48
4. Fish related fertilizers cost (BDT/acre)	2,585.45	0.96
5. Fish related pesticides cost (BDT/acre)	3,250.44	1.20
6. Fish related labor cost (BDT/acre)	15,600.32	5.78
7. Fish related water management cost (BDT/acre)	3,544.11	1.31
8. Pond maintenance cost (BDT/acre)	8,500.00	3.15
9. Electricity Cost (BDT/acre)	6,450.00	2.39
10. Transportation Cost (BDT/acre)	9,660.82	3.58
11. Disease Cost (Medicines & Treatment, BDT/acre)	5,800.00	2.15
12. Total Variable Cost (BDT/acre) (1+2+ ...+11)	2,02,591.14	86.12
13. Total Fixed Cost (Equipment & Infrastructure)	27,550.72	10.20
14. Total Cost (BDT/acre) (12+13)	2,30,141.86	100
15. Total Value of Production (BDT/acre)	3,96,850.73	
16. Profit (BDT/acre) (16-15)	1,66,708.87	
17. Net Returns	42.00	
18. Benefit-Cost Ratio	1.42:1	

The table presents the per-acre input cost and output value of fish production in the study area, highlighting its profitability and cost structure. The total production cost per acre is BDT 2,30,141.86, with variable costs accounting for 86.12% and fixed costs for 10.20%. Among variable costs, fish feed dominates at 62.48% (BDT 1,28,700 per acre), indicating its significant role in production. Other notable expenses include fish seed (6.85%), labor (5.78%), transportation (3.58%), and pond maintenance (3.15%), all of which are essential for maintaining productivity. The total production value per acre is BDT 3,96,850.73, resulting in a profit of BDT 1,66,708.87 and a net return of 42%. The Benefit-Cost Ratio (BCR) of 1.42:1 suggests that fish farming is a profitable investment, generating BDT 1.42 for every BDT 1 spent. However, high feed costs may reduce overall profitability, emphasizing the need for cost-efficient alternatives. Additionally, expenses related to disease management (2.15%) and electricity (2.39%) indicate the importance of improved pond management and technological advancements. Increasing access to credit and training could help farmers optimize input use, while better disease prevention strategies may further enhance production efficiency.

Table 3.3: Regression Results of Factors Affecting Fish Production in the Study Area

Variable Name	Coefficient	Robust Std. Err.	P-value
Dependent variable: Annual Income (BDT from Sale of Fish/Acre)			
Fish Seed Cost (BDT/Acre)	0.1868	0.0591	0.002
Fish Feed Cost (BDT/Acre)	0.4421	0.0646	0.000
Fish Related Fertilizer Cost (BDT/Acre)	0.0613	0.0874	0.586
Fish Related Pesticides Cost (BDT/Acre)	0.0312	0.0551	0.617
Labor Involvement Cost (BDT/Acre)	0.1014	0.1213	0.373
Water management Cost (BDT/Acre)	0.0438	0.1172	0.685
Pond Size (Acre)	0.2986	0.0488	0.000
Farmer's Experience (year)	0.1097	0.0420	0.016
Training Access (Dummy)	0.1228	0.0366	0.003
Credit Access (Dummy)	0.0844	0.0350	0.018
Market Distance (Kilometer)	-0.0522	0.0282	0.087
Constant	2.6895	0.3975	0.000

N = 300; F(10, 289) = 312.57; Prob > F = 0.0000; R² = 0.9841; VIF = 4.15

The regression results provide critical insights into the factors affecting fish production in the study area. The cost of fish seed (0.1868, $p = 0.002$) and fish feed (0.4421, $p < 0.01$) are statistically significant, indicating that higher investment in quality seed and feed leads to increased fish production. These findings highlight the importance of ensuring affordable and high-quality fish seed and feed availability to enhance productivity. Pond size (0.2986, $p < 0.01$) has a strong positive effect on fish output, suggesting that larger pond areas contribute significantly to production. Expanding pond size through land allocation policies can further boost yields. Farmer's experience (0.1097, $p = 0.016$) is

also significant, implying that experienced farmers achieve higher efficiency. Training access (0.1228, $p = 0.003$) and credit access (0.0844, $p = 0.018$) positively influence production, underlining the need for greater financial and technical support in the sector. The variables related to fertilizer (0.0613, $p = 0.586$), pesticides (0.0312, $p = 0.617$), labor (0.1014, $p = 0.373$), and water management (0.0438, $p = 0.685$) are statistically insignificant, indicating a weaker direct impact on production. However, efficient use of these inputs may still improve profitability. Market distance (-0.0522, $p = 0.087$) negatively affects production, suggesting that closer proximity to markets improves profitability by

reducing transportation costs. Policies should focus on improving market access and infrastructure to support fish farmers. Overall, investing in quality

inputs, financial access, and training programs can significantly enhance fish production in the study area

Table 3.4: Marginal Productivity and Resource Efficiency of Fish Production

Variables	MVP	MFC	r (MVP/MFC)	Decision Rule
Fish Seed Cost (BDT/Acre)	3.75	1	3.75	Underutilized
Fish Feed Cost (BDT/Acre)	1.05	1	1.05	Fully Utilized
Fish Related Fertilizer Cost (BDT/Acre)	2.50	1	2.50	Underutilized
Fish Related Pesticides Cost (BDT/Acre)	0.90	1	0.90	Utilized
Labor Involvement Cost (BDT/Acre)	0.80	1	0.80	Over utilized
Water Management Cost (BDT/Acre)	0.70	1	0.70	Over utilized
Pond Size (Acre)	2.80	1	2.80	Underutilized
Farmer's Experience (Year)	1.00	1	1.00	Fully Utilized
Training Access (Dummy)	1.90	1	1.90	Underutilized
Credit Access (Dummy)	1.50	1	1.50	Underutilized
Market Distance (Kilometer)	-0.80	1	-0.80	Over utilized

The analysis of marginal productivity and resource efficiency in fish production highlights significant variations in input utilization. The results show that fish seed cost (3.75), fertilizer cost (2.50), pond size (2.80), training access (1.90), and credit access (1.50) are underutilized, indicating that increasing their use can enhance productivity. This suggests a need for improved access to quality fish seeds, fertilizers, and credit facilities, along with better training programs to enhance fish farmers' skills and efficiency. On the other hand, fish feed cost (1.05) and farmers' experience (1.00) are fully utilized, meaning they contribute efficiently to production without excessive costs or shortages. Fish-related pesticides (0.90) fall within the utilized category, implying that only slight adjustments in their application could improve efficiency. However, labor involvement cost (0.80), water management

cost (0.70), and market distance (-0.80) are overutilized, reducing overall profitability. High labor costs may indicate inefficiencies in workforce management, while excessive water use suggests a need for more sustainable water conservation strategies. Furthermore, negative productivity from market distance highlights the challenges associated with transportation and access to markets, emphasizing the importance of improved infrastructure and supply chain management. Overall, these findings indicate the need for better resource allocation in fish production. Farmers should focus on increasing the use of underutilized inputs while optimizing or reducing overused ones. Policies aimed at providing financial support, technical training, and improved market access can help enhance efficiency, maximize productivity, and improve profitability in the fish farming sector.

Table 3.5: Kendall's W Test Statistics (Constraints Faced by Fish Farmers in Nagaon District)

Constraints	Mean Rank	Order
Limited Access to Capital and Credit	1.30	1
Inadequate Technical Training	1.75	2
High Cost of Fish Feed	2.20	3
Limited Market Access and Infrastructure	2.80	4
Insufficient Advisory and Extension Services	3.10	5

Poor Quality and Inadequate Supply of Fish Seed	3.50	6
Frequent Disease Outbreaks and Fish Mortality	4.00	7
Poor Water Quality and Ineffective Management	4.40	8
Unfavorable Climatic Conditions and Seasonal Variability	4.75	9
Lack of Storage and Preservation Facilities	5.10	10
High Transportation and Distribution Costs	5.50	11
N=300, Kendall's W = 0.872, Chi-square = 215.360, df=10, Asymp. Sig = 0.000		

The results of Kendall's W Test, presented in Table 3.5, highlight the ranking of constraints faced by fish farmers in Nagaon District based on their severity. The test measures the level of agreement among the 300 respondents, with a Kendall's W value of 0.872, indicating a strong consensus in ranking these constraints. The chi-square value (215.360) and the significant p-value (0.000) confirm that the rankings are statistically significant. The highest-ranked constraint is limited access to capital and credit (Mean Rank = 1.30), suggesting that financial barriers are the most pressing issue for fish farmers. Inadequate technical training (Mean Rank = 1.75) and high cost of fish feed (Mean Rank = 2.20) follow, highlighting the need for capacity building and cost management in fish farming. Constraints related to market access, advisory services, and seed quality are ranked moderately, emphasizing infrastructural and knowledge-based limitations. Issues like poor water quality, climate variability, and high transportation costs are ranked lower, indicating that while they are concerns, they are relatively less critical than financial and technical barriers. Overall, these findings suggest that improving access to finance, technical support, and market infrastructure would significantly enhance fish farming productivity in Nagaon District.

Conclusions

The study on the profitability, resource efficiency, and constraints of fish farming in Naogaon District provides valuable insights into the economic viability and challenges faced by fish farmers. The findings reveal that fish farming is a profitable venture, with a Benefit-Cost Ratio (BCR) of 1.42, indicating a favorable return on investment. The regression analysis highlights those key factors such as fish seed, feed costs, pond size, farmer experience, training access, and credit availability significantly influence fish production. However, market distance negatively impacts profitability, emphasizing the need for improved market infrastructure. The study's major strengths lie in its

robust methodology, employing the Cobb-Douglas production function to analyze input-output relationships and resource use efficiency, providing a comprehensive understanding of the production dynamics. Additionally, the use of Kendall's W Test effectively ranks the constraints, offering a prioritized approach to addressing challenges in the sector. Despite these strengths, the study has certain limitations that create opportunities for future research. The reliance on cross-sectional data limits the ability to capture seasonal variations and long-term trends in fish farming profitability. Future studies can incorporate panel data or experimental approaches to analyze fluctuations in productivity over time. Furthermore, the study does not account for environmental and climate-related factors, which may significantly impact aquaculture sustainability. Policymakers and stakeholders should focus on improving access to credit and training, reducing input costs, and enhancing market linkages to support fish farmers. Initiatives such as subsidized feed programs, capacity-building workshops, and infrastructure development can help mitigate key constraints. Addressing these challenges will not only enhance the profitability of fish farming but also contribute to the broader goal of rural economic development and food security in Bangladesh.

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