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Research Article

Economics Analysis and Determinants of Profitability of Catfish Farming in Kaduna North Local Government Area, Kaduna State, Nigeria

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ABSTRACT

This study provides an economic analysis of the cost structure and how it influences the profitability of catfish farming in Kaduna North Local Government Area. The research specifically examines the determinants of profitability, but lays emphasis on the composition and behavior of production costs, categorizing them into fixed and variable costs, and ultimately tries to ascertain their effect on overall profitability. To this end, this study assessed the economics of catfish farming in Kaduna North Local Government Area of Kaduna State, Nigeria. A total of 60 table-sized catfish farmers were randomly selected from the list of Agricultural Development Program (ADP) contact fish farmers in the study area and interviewed through a structured questionnaire. Descriptive statistics, budgetary analysis, and a multiple regression model were employed in analyzing the data. Results revealed that table-sized catfish farmers were at most 40 years old (55.0%), male (70.0%), married (68.3%), had between 5-9 years of experience in catfish farming (58.3%), with no access to farm credit (61.7%). The cost of feeds per kg of table-sized catfish was estimated at N238.39, while the seed fingerling cost N6.56, constituting 80.6% and 2.2% of the total cost per kg of catfish produced. The labour cost per kg of the fish was N10.2, constituting 3.4% of the total cost per kg of the fish. The profitability statistics, including Rate of Return on Investment (RRI) and Profitability Index (PI), were estimated at 35.1% and 26%. The regression analysis shows that the estimated F-value of 16.578 was significant at 1% level, with an R2 estimated at 0.565, indicating both the fitness of the models and data captured, which all indicated that table-sized catfish farming is profitable in the study area. It is recommended that catfish farmers in the study area pay special attention to the cost of feeds, as it could be critical to the profitability of the fish farming enterprises.

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1 Introduction

Aquaculture, a subset of agriculture, plays a vital role in improving food security, employment, and income generation. Population growth has increased fish demand, as it is currently the most important single source of high-quality protein and accounts for about 16% of the world's annual protein consumption (FAO, 1997).

Nigeria's annual domestic fish demand is about 1.4 million tons, while domestic supply is about 780,000 tons, making a deficit of about 0.7 million tons, leading to the import of fish worth $667 million to become the highest importer of fish in Africa; thus, catfish farming is expected to cover this demand-supply mismatch (Miller, 2007). The domestic supply is from artisanal, commercial trawler, and aquaculture (fish farming) sources, with the artisanal fishery contributing more than 80% of the domestic production (Federal Department of Fisheries, 2007). However, the performance of artisanal fishing has been steadily decreasing due to overfishing and rises in aquaculture (Adekoya & Miller, 2004). While its contribution in percentage terms of artisanal fishing is decreasing, that of aquaculture increased by about 200% from the year 2000 to 2007 (Ogundari & Akinbogun, 2010).

Aquaculture refers to the deliberate and controlled cultivation of aquatic organisms in enclosed water bodies; these include ponds, cages, tanks, dams, etc. (Verdegem et al., 2023), which highlights the economic potential embedded in the fish aquaculture expansion programme in Nigeria. Adeogun et al. (2007) noted that the fish aquaculture industry is capable of reversing the declining supplies from captured fisheries, while Olopade and Dienye (2020) and Kehinde et al. (2009) observed that fish farming is quickly gaining increased relevance as a way of reducing the present demand-supply gap in the country. For fish farming to continue to attract investors and farmers, it has to be profitable, and this is primarily done in earthen or concrete ponds. Hence, there is a constant need to assess the profitability of the catfish farming enterprise. There is even more reason to do such an assessment in Northern Nigeria, where agriculture provides a very good opportunity to wean the States' economies from overdependence on handouts from the center.

As in many African countries, the most commonly cultured species in Nigeria include catfish (*Clarias gariepinus*) (Ekunwe & Emokaro, 2009). Many fish farmers, however, focus on catfish as they can have a market value of two to three times that of tilapia (FAO, 2007). According to Ekunwe and Emokaro (2009), some 60% of the fish consumed is catfish, and it is increasing as more farmers and investors embrace catfish farming.

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Catfish farming is mainly practiced on a small-scale commercial basis by smallholder farmers (Emokaro et al, 2010). These resource-poor smallholder farmers contribute more than 90% of agricultural output in Nigeria in particular (Fakoya et al., 2021) and in Sub-Saharan Africa in general, and must be assisted to rise beyond the level of subsistence to higher levels of profitability through a more profitable way of doing the fish farming business. To this end, this study was conducted. The broad objective of this study is an economic analysis of catfish farming in the study area. The specific objectives are to:

i. Describe the socio-economic characteristics of catfish farmers in the study area.
ii. Estimate the cost structure and profitability of catfish farming in the study area; and
iii. Assess the socio-economic correlates of profitability in catfish farming in the study area.

2 Literature Review

The literature reviewed the cost functions that were assessed to ascertain their influence on the profitability of catfish farming in the local government. Fixed costs are costs that are independent of output. These costs remain constant throughout the relevant range (not relevant to output decisions). Fixed costs often include rent, buildings, machinery, etc. It is part of the budget that stays the same regardless of whether one produces a lot, a little bit, or has zero production level. Variable costs are costs that vary with output. Generally, variable costs increase at a constant rate relative to labour and capital. Variable costs may include wages, utilities, and materials used in production. Variable costs are expenses that change in proportion to the activity of the business (Garrison, 2000). Variable cost is the sum of marginal cost over all units produced. It can also be considered to be a normal cost. It is that part of the total cost that varies when one produces more or less of a product. In catfish farming, variable costs of production include the cost of labour (man-days), transportation, fingerlings, feed, etc.

Feed constitutes the major cost of catfish production. According to Raufu et al. (2011), feed cost constitutes more than 20% of catfish production cost. Cost of feed has been found to have a positive relationship with yield performance (Raufu et al., 2011). Depreciation is the anticipated reduction in the value of the asset over time brought about through physical use or obsolescence (Gittinger, 1982). It is often computed by using the straight-line method based on replacement cost, estimated economic life, and salvage value of the pond, electrical panel, and equipment. Investment interest is the opportunity cost of capital used to purchase land, design and construct pond structures, buy and install farm and electrical equipment. Interest on average investment is usually estimated using a percentage annual interest rate on average investment. Average investment is equal to half the replacement cost of depreciable assets and the full amount of land and surveying costs.

Fish farms can carry three types of farm liability insurance coverage. These include general farm liability, equipment coverage, and workman's compensation. Farms with only family labour, however, would not carry workman's compensation. The cost of the insurance coverage is often calculated on tractors, feeders, feed bins, vehicles, and aeriation equipment, etc. Returns to catfish farmers come from catfish sales (table size) to those that engage in table size production, and fingerlings sales for those that specialize in fingerling production. This is defined as the net revenue or the difference between total revenue and total cost (Adebayo & Adesoji, 2008).

3 Methodology

3.1 Study Area

The study was conducted in Kaduna North Local Government Area, Kaduna State, Nigeria. Kaduna North is a Local Government Area in Kaduna State, Nigeria (Figure 1). Its headquarters is in the town of Doka, and it is part of the Kaduna Metropolis (Muhammad & Abubakar, 2025). Kaduna State is mostly populated by Hausa, Gwari, Kataf, and Bajju ethnic communities.

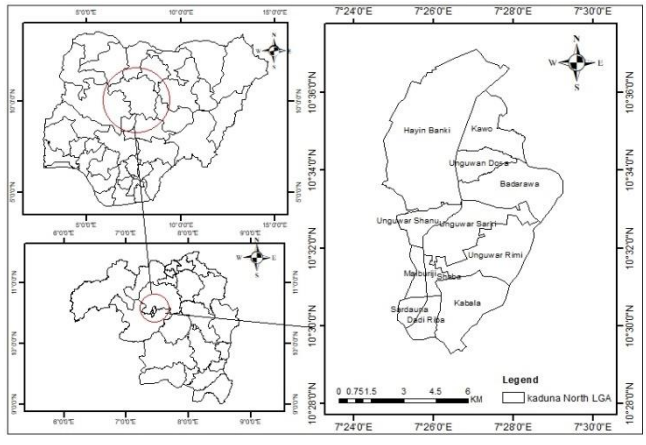

Figure 1: Nigeria showing Kaduna State, and Kaduna North LGA

Source: Adopted from Muhammad and Abubakar, 2025

3.2 Sampling Technique

A simple random sampling technique was used in selecting 60 catfish farmers from the list of Agricultural Development Project (ADP) contact farmers operating within the Local Government Area in Kaduna State. Data were collected with the aid of a structured questionnaire.

3.3 Method of data analysis

Descriptive statistics, including frequency distribution tables and percentages, were used in describing the socio-economic characteristics of the respondents, while the budgetary analytical model was used in analyzing the cost

structure and profitability of catfish farming in the study area. A multiple regression model was used in analyzing the correlates of catfish farming profitability in the study area. The Budgetary model is specified thus:

$$\pi = TR - TC \quad (1)$$

$$TR = PQ \quad (2)$$

$$TC = TVC + TFC \quad (3)$$

$$GM = TR - TVC \quad (4)$$

$$NI = GM - TFC \quad (5)$$

$$PI = \frac{NI}{TR} \quad (6)$$

$$RRI = \frac{NI}{TC} \quad (7)$$

Where:

π = Profit
TR = Total revenue from catfish sales
TVC = Total variable cost (including seed, feed, labour, and water costs)
TFC = Total Fixed Cost
TC = Total Cost
GM = Gross Margin
PI = Profitability Index
RRI = Rate of Return on Investment

The Multiple regression model is specified as follows:

$$Y = f(X_1, X_2, X_3, X_4, \ldots, X_n) + = e \quad (8)$$

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \cdots + \beta_9 X_9 + e \quad (9)$$

Where;

Y = Net income per kg of catfish harvested and sold
X_1 = Age of farmer (years)
X_2 = Formal education (years)
X_3 = Religion (Islam = 1, 0 = otherwise)
X_4 = Access to farm credit (Had access = 1, 0 = otherwise)
X_5 = Primary occupation (Catfish farming = 1, 0 = otherwise)
X_6 = Household size (number)
X_7 = Dependency ratio in farmers' household (Number of non-working household members/ household size)
X_8 = Annual Income (Naira)
X_9 = Experience in catfish farming (years)
e = Error term

4 Results and Discussion

4.1 Socio-economic characteristics of the respondents

Table 1 revealed the socio-economic characteristics of the fish farmers, revealing that the majority were at most 40 years old (55.0%), male (70.0%) with at most 6 individuals as household size (71.7%), married (68.3%) with 5-9 years of experience in catfish farming (58.3%), were members of one social group or the other (76.7%), owned the ponds used in catfish farming (71.7%) but had no access to farm credit (61.7%).

Table 1: Socio-Economic Characteristics of the respondents

Variable	*Value*	*Frequency*	*Percentage*	*Cumulative frequency*
Age	≤30	10	16.7	16.7
	31—40	23	38.3	55.0
	41-50	16	26.7	81.7
	51-60	11	18.3	100.0
Sex	Male	42	70.0	70.0
	Female	18	30.0	100.0
Household size	1-3	17	28.4	28.4
	4-6	26	43.3	71.7
	7-9	11	18.3	90.0
	≥10	6	10.0	100.0
Marital status	Single	6	10.0	10.0
	Married	41	68.3	78.3
	Divorced	3	5.0	83.3
	Widowed	10	16.7	100.0
Experience (years)	<5	21	35.0	35.0
	5-9	35	58.3	92.3
	≥10	4	6.7	100.0
Membership of a social group	Member	46	76.7	76.7
	Non-member	14	23.3	100.0
Ownership of ponds used	Owned	43	71.7	71.7
	Leased	17	28.3	100.0
Access to farm credit	Had access	23	38.3	38.3
	No access	37	61.7	100.0

4.2 Cost Structure and Profitability of Catfish Farming in the Study Area

Budgetary analysis was used to analyze the cost and return structure and profitability of fingerlings production in the study area. The results obtained were presented in Table 2.

The cost of fingerlings per kg of table-sized catfish produced was estimated at ₦6.56, while the cost of feed per kg of catfish produced was ₦238.39. The labour cost per kg of table-sized catfish produced was ₦10.21, while the transportation and medication cost per kg of the table-sized catfish was 99 kobo and ₦1.39, respectively. The total variable cost (TVC) per kg of catfish produced was ₦257.53, unlike the total fixed cost (TFC) estimated at ₦38.30. The composition of the fixed cost includes rent on pond/farmland, depreciation on equipment, and interest on farm credit estimated at ₦18.26, N8.83, and ₦11.21, respectively.

In terms of cost structure, the seed and feed costs constituted 2.2% and 80.6% of the total cost (TC), respectively. The labour, transportation, and cost of medication were estimated at 3.4%, 0.3%, and 0.5% of the TC, respectively. The rent on pond/farmland, depreciation on equipment, and interest on farm credit constituted 6.2%, 3.0%, and 3.8% of the total cost of production.

The total cost (TC), net income (NI), and gross margin (GM) were estimated at ₦295.83, ₦103.82, and ₦142.12 per kg of the table-sized catfish produced in the study area. The profitability statistics, including rate of return on investment (RRI) and profitability (PI), were estimated at 35.1% and 26%, respectively, indicating that table-sized catfish farming in the study area was profitable.

Table 2: Cost structure and profitability of catfish farming in the study area

Cost/Return statistics	All Farms (60)		Per kg of catfish
		% of TC	
Revenue (TR)	16,154,250		399.65
Variable Inputs:			
Fingerlings (seed)	265,000	2.2	6.56
Feeds	9,635,873	80.6	238.39
Labour	412,530	3.4	10.21
Transportation	39,870	0.3	0.99
Medication	56,345	0.5	1.39
Total Variable Cost (TVC)	10,409,618	87.1	257.53
Fixed Inputs:			
Rent on pond/farmland	738,000	6.2	18.26
Depreciation on equipment	356,973	3.0	8.83
Interest of farm credit	453,000	3.8	11.21
Total Fixed Cost (TFC)	1,547,973	12.9	38.30
Total Cost (TC)	11,957,591	100.0	295.83
Net Income (NI)	4,196,659		103.82
Gross Margin (GM)	5,744,632		142.12
Rate of Return on Investment (RRI)	35.1		
Profitability Index (PI)	0.26		

4.3 Socioeconomic correlates of profitability in catfish farming in the study area.

A multiple linear regression model was used in analyzing the socio-economic correlates of profitability in catfish farming in the study area, and the results are presented in Table 3. Nine variables were fitted to the model, including age, education, religion, access to farm credit, primary occupation, household size, dependency ratio, annual income, and experience in catfish farming. The F-value estimated at 16.578 was significant at 1% level, implying that the model is a good fit to the data. The Adjusted R^2estimated at 0.565 indicates that the variables fitted to the data captured about 56.5% of the explained variation in profitability of the catfish farms in the study area.

Out of the nine (9) variables fitted to the data, five (5) were found to significantly ($p<0.1$) correlate with the profitability of the catfish farms. The significant variables include education, access to farm credit, dependency ratio, annual income, and experience in catfish farming. All the variables positively associate with the profitability of catfish farming in the study area, except for the dependency ratio, which had a negative association with the profitability of the catfish farms. These findings imply that, *ceteris paribus*, given a unit increase in the level of education, access to farm credit, annual income, and experience in catfish farming (say by 1%), there will be an increase in the profitability of catfish farming in the study area. These findings are in line with a *priori* expectations. A unit increase in the dependency ratio of the farmer's household will reduce the profitability of the farms.

Table 3: Regression analysis of socio-economic correlates of profitability of catfish farming in the study area

Variable	Coefficient	T-value
Constant	-0.779	-0.487
Age (X_1)	-0.057	-0.501
Education (X_2)	8.18E-006***	5.152
Religion (X_3)	0.002	1.155
Access to farm credit ((X_4)	7.55E-006***	10.480
Primary occupation (X_5)	5.00E-005	1.221
Household size (X_6)	0.006	0.616
Dependency ratio (X_7)	-0.031*	-1.793
Annual income (X_8)	0.048**	2.081
Experience in catfish farming (X_9)	0.145***	3.124
F-value	16.578***	
R Square	0.601	
Adjusted R^2	0.565	

5 Conclusion

The study assessed the economics of catfish farming in the study area, focusing on socio-economic characteristics of the table-sized catfish farmers, the cost structure and profitability of the catfish farming business, and its socio-economic correlates. It was found that table-sized catfish farmers in the study area were youths in their prime, predominantly male, with moderate household size, considerably good experience level, belonging to one social group or the other. Most of the catfish farmers owned their ponds instead of leasing them, but had no access to farm credit. Table-sized catfish farming was profitable in the study area. The feed cost constituted the highest single cost of production, being as high as 80.6% of the production total cost. This was followed by rent on ponds or family, coming distant second with just 6.2% of the total cost. Education, access to farm credit, dependency ratio, annual income and experience in catfish farming were the significant correlates of profitability of table-sized catfish farming in the study area. It is recommended that the farmers pay special attention to the feed cost (may be focusing on feed efficiency) to avoid a serious possibility of loss and maintain or improve the profitability of the table-sized catfish farming enterprises.

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