ECONOMIC ANALYSIS OF FISH FARMING ON FARMERS HOUSEHOLD INCOME IN OGUN STATE, NIGERIA

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ABSTRACT
This study examined the economic analysis of fish farming on farmers household income in Ogun state. A multistage sampling procedure was used to obtain the sample size for this study. A sample size of 150 fish farmers was used. Data obtained were analysed using descriptive statistics, Tobit regression model and Net farm income analysis. The results show that both genders were involved in fish farming, and they were within their productive age (41-50years). The majority were married (66.7%) and educated (40.0%) with relatively large households. Most (66.7%) of the farmers rely on loans to finance their operations. The study further revealed that BCR was greater than 1, which is an indication that fish farming is very profitable in the study area. Factors such as size of ponds, number of ponds owned, fish feed, initial capital investment, and labour were significant factors influencing the intensity of fish farming. The study concluded that fish farming is a profitable business and recommends measures to enhance productivity, improve access to capital, and strengthen market linkages to further boost the profitability of fish farming in Ogun State.
Keywords: Fish, Income, Output, Ogun State, Production

INTRODUCTION

Nigeria is the second-largest producer of fish in Africa after Egypt (FAO, 2020), rated 64th among other nations in terms of fish consumption (Ashley-Dejo *et al.,* 2019). Nigerians consume less protein on a daily basis than is ideal. The contribution from animal sources is also below average. As a result, there is a growing understanding of the importance of getting enough protein in the human diet. In Nigeria, where agriculture made up 22% of GDP, the fisheries industry contributed 0.88% of the country's agricultural Gross Domestic Product (GDP). Furthermore, 8.632 million people in the primary sector and 19.55 million people in the secondary sector can find work in the fisheries subsector (FDF, 2018). Nigeria as a country has one of the most vibrant economies in Africa and is going through a demographic shift. By 2023, it is anticipated to overtake other Sub-Saharan African nations as the region's largest economy in terms of GDP (Frontier Strategy Group, 2018). However, compared to economies of comparable size in other regions, Nigeria is anticipated to continue to face persistent challenges such as high rates of poverty, income inequality, governance issues, a difficult business environment, and a relatively constrained public spending budget (Frontier Strategy Group, 2018). But as the world's population is increasing, so too does the need for fish. Nigeria has a population of over 200 million people and is predicted to consume 17.5 kg of fish annually per person (FAOSTAT, 2019). However, it is clear that Nigeria needs more than 1.61 million metric tons of fish annually to meet the dietary needs of its population, which is estimated to be over 200 million people (FAOSTAT, 2019). Despite these projections, Nigeria, the greatest fish producer in Africa, now has a shortfall of 2.5 million metric tons of fish. According to Olaoye and Ojebiyi (2018), the nation's overall fish production, including imports, is insufficient to satisfy fish demand. The current estimate of the annual fish demand in Nigeria is 2.66 million metric tonnes, however only 800,000 metric tonnes can be produced domestically, leaving a gap of 1.2 million metric tonnes. As a result, the government imports 1.90 million metric tonnes of fish annually for a cost of N125 billion (Olaoye and Ojebiyi, 2018), which is a waste of resources. Hence, Nigeria has become the largest importer of frozen fish in Africa due to this significant reliance on imports. This emphasizes the substantial gap in fish supply within the country (Adeleke *et al.,* 2020). Nevertheless, the considerable amount of money spent annually on fish imports in Nigeria could instead be directed towards investing in fish farming. By substituting fish importation with domestic production, Nigeria could generate employment opportunities, alleviate poverty in rural areas where 70% of the population resides, and improve the country's balance of payments situation (Galappathithi *et al.,* 2020).

An examination of various food production systems highlights the significance of aquaculture (fish farming) as a crucial strategy in the global fight against hunger, malnutrition, and poverty, especially in developing nations like Nigeria (Jerimoth *et al.,* 2017). Fish farming plays a crucial role in providing employment opportunities, household income, and food security for numerous individuals (Galappathithi *et al.,* 2020). Small-scale fish farming serves as a vital safety net for vulnerable households, offering income security to those who face sudden income declines due to factors such as crop failure, fish farming challenges, economic

downturns at the local or national level, civil conflicts, population displacement, and natural disasters (Wally, 2016). In such circumstances, individuals often turn to fish farming as an additional or alternative source of income, food, or employment. Given the current economic situation in Nigeria, there is a pressing need to adopt a result-oriented, economically viable, and environmentally friendly agricultural system that can effectively supplement household income. Therefore, the study specifically described the socio-economic characteristics of the respondents, estimated the cost and returns of fish farm business in the study area, estimated the net farm income and benefit cost ratio of fish farming in the study area, identified constraints to fish farming involvement and analysed the factors affecting the intensity of fish farming in the study area.

METHODOLOGY

The study was carried out in Ogun State, Southwest Nigeria. Ogun State is bordered to the south by Lagos State, to the north by Oyo and Osun States, to the northwest by Ondo State, and to the west by the Republic of Benin. The headquarters and most populous city of Ogun State is Abeokuta. Other significant cities in the state include Sagamu, Sango Ota, and Ijebu Ode, the old royal capital of the Ijebu Kingdom. The majority of Ogun State is the rain forest zone, and the northwest region is of the woody savanna zone. Ogun State was the 16th most populous state in Nigeria in 2006 with a total population of 3,751,140 people. Ogun State has a surface area of 16,762 km^2, making it the 24th largest state in Nigeria by total area (Olaoye *et al*., 2017).

The population of the study consisted of fish farmers in Ogun State. However, due to high population in Ogun-State, a multi-stage random sampling procedure was adopted for this study. In the first stage, Ijebu-Ode and Odogbolu Local government areas were purposively selected.

The second stage involved a random selection of five (5) towns/settlements each in the selected local government areas, which include Itamerin, Odogbolu, Okun owa, Imagbon and Araromi from Odogbolu Local government and Eriwe, Atiba, Ososa, Iwata and Ogbo from Ijebu-ode Local government. At the third stage, fifteen (15) fish farmers were sampled from each selected town through a snowball technique. Overall, a total of one hundred and fifty (150) fish farmers were sampled as the population size for this study.

Data were obtained from both primary sources. The primary source of data was the aid of structured interview schedules with the fish farmers in the study area Data obtained from the study was analysed using descriptive statistics, Tobit regression model and Net farm income analysis with the aid of Statistical Package of Social Sciences (SPSS)

Descriptive statistics was used to describe and summarize the data. This involved the use of frequency tables and percentages. These tools were used to achieve socio economic characteristics of fish farmers, species of fish and culture systems and constraints to fish farming involvement. Also, Tobit regression model was used to examine factors such as size of pond, number of ponds, farming experience, initial capital investment, fish feed, labour and level of education which influence the intensity of fish farming. The Tobit regression analysis was used to achieve factors influencing the intensity of fish farming.

The Tobit model is expressed thus:

$Y_i^* = \alpha + \sum X_i\beta_j + \mu_i$, $\mu_i \sim N(0, \sigma^2)$

$Y_i = Y_i^*$ if $Y_i^* > 0$

$Y_i = 0$ if $Y_i^* \leq 0$

Y_i^* = Latent variable

Y_i = Dependent variable

X_i = Vector of explanatory variables

β_j = Parameters to be estimated

μ_i = Error term

Where,

Y_i = Net farm income

The independent variables specified as factors influencing the intensity of fish farming were defined as follows:

X_1 = Size of pond (m^2),

X_2 = Ponds owned (number),

X_3 = Fish feed (kg),

X_4 = Initial capital investment (Naira),

X_5 = Labour (man days),

X_6 = Farming experience (number of years)

X_7 = Educational level (years)

Net Farm Income and Benefit Cost Ratio Analysis

Net farm income analysis was used to determine how profitable fish farming business is in the study area. The net farm income specifically provided the amount of money that has been returned to the owner of the farm or business for their investment of labour, management and other resources. This analytical technique was used to estimate the profit or the net income which is the difference between the gross farm income and the total costs of production (Olukosi and Erhabor, 1988).

The model is specified as follows:

NFI = TR-TC

Where;

NFI = Net Farm Income,

TR = Total Revenue and TC = Total Cost (Total Variable Cost + Total Fixed Cost).

Benefit cost ratio = Total revenue ÷Total cost

RESULTS AND DISCUSSION

Socio economic characteristics of fish farmers in the study area

Table 1 presents the socio-economic characteristics of fish farmers in the study area and reveal that 82% were male, indicating the involvement of both genders in fish farming in Ogun State. This finding aligns with previous studies by Oladimeji *et al.,* (2017), Olaoye *et al.,* (2017), and Folayan (2017), which also reported male dominance in the fish farming sector. Regarding age distribution, majority (42.7%) were between 41-50 years old. This implies that a significant proportion of respondents were in their productive years, which can greatly influence resource allocation, reasoning, and management abilities, as described by and Ashley-Dejo *et al.* (2017) and Oke and Kehinde (2019) who identify the age range of 41-50 years as productive and economically active. Moreover, 56.7% had a household size of 5-8 people. Regarding education, the majority (40.0%) had post-secondary education. This indicates that most respondents had average educational attainment, suggesting that they might possess the necessary skills to carry out their fishing activities without significant external assistance. Approximately 60% of the respondents reported an estimated monthly income ranging between N50,000 to N100,000. However, in terms of attraction to fish farming, 40% of the fish farmers were attracted to it as a means of supplementing their household income. This finding suggests that most respondents were drawn to fish farming to diversify their income. Majority (66.7%) of the respondents obtained capital through loans. This indicates that access to capital is an important factor in fish farming, with many farmers relying on loans to finance their operations. Nevertheless, as for the nature of involvement in fish farming, 73.3% of the respondents engaged in it on a part-time basis. This suggests that many respondents may have other sources of income besides fish farming. This finding aligns with the work of Ele *et al.* (2013) on the economic analysis of fish farming in Calabar, Nigeria, which reported that 89% of farmers practicing aquaculture were part-time fish farmers. Furthermore, the selection of the species to be cultured is crucial for the success of any aquaculture venture (Ugwumba and Ugwumba, 2003). The results reveal that 66.7% of the respondents cultivated catfish. This indicates that catfish is the most popularly cultivated fish in the study area. It was also observed that the majority (80.0%) fingerlings/juvenile from external hatcheries. This indicated that fish farmers in the study area depend on external sources for their fingerlings/juveniles. In addition, the study revealed that the majority (65.3%) used both earthen pond and concrete tank facilities. This indicates that earthen pond facilities are the most used culturing facilities in the study area. This finding aligns with that of Ele *et al.,* (2013) who reported that earthen pond facility is the most preferred culture facility in Nigeria. Choice of this culture facility might be due to ease of management and faster production facilitated by the addition of natural food to supplement artificial feed.

Table 1. Distribution of respondents by socio-economic characteristics

Variables	Frequency	Percentage
Sex		
Male	123	82
Female	27	18
Age (Years)		
20-30	11	7.33
31-40	45	30.0
41-50	64	42.7
> 50	30	20
Marital status		
Single	25	16.7
Married	100	66.7
Divorced	15	10.0
Widowed	10	6.7
Religion		
Christianity	120	80.0
Islam	20	13.3
Traditional	10	6.7
House hold size		
1-4	30	20.0
5-8	85	56.7
> 9	35	23.3
Educational status		
No formal education	15	10.0

Variables	Frequency	Percentage
Primary school	30	20.0
Secondary school	45	30.0
Post-Secondary education	60	40.0
Estimated monthly income (N)		
< 50,000	20	13.3
50,000 – 100,000	90	60.0
> 100,000	40	26.7
Years of farming experience		
< 5	40	26.7
6 – 10	45	30.0
11 – 15	30	20.0
≥ 16 years	35	23.3
Attraction to fish farming		
Self-employment	45	30.0
Supplement household income	60	40.0
Parents are into it	15	10.0
It is highly profitable	20	13.3
It is my profession	10	6.7
Source of capital for fish farming		
Personal savings	50	33.3
Loan	100	66.7
Source of loan		
Banks	45	30.0
Friends	15	10.0
Cooperative societies	25	16.7
Family members	15	10.0
Nature of involvement in fish farming		
Full time	110	26.7
Part time	40	73.3
Species of fish cultivated		
Catfish	100	66.7
Tilapia	20	13.5
Both	30	20.0
Source of fingerling and juveniles		
Purchased from fish farms with hatchery	120	80
Purchased from fish farms and self-hatchery	14	9.3
Self-hatchery	16	10.7
Rearing facilities		
Concrete	11	7.3
Concrete and earthen	32	21.3
Plastic	9	6
Earthen	98	65.3

Source: Field survey, 2023

Cost and return of fish farming in the study area

Table 2 illustrates the expenses and earnings of fish farming per production cycle. The total variable cost (TVC) amounted to ₦922,861.82 while total fixed costs (TFC) was ₦17,012.04. The TVC accounted for 98.2. Notably, the cost of feed alone constituted approximately 77.9% of the total cost figure. The table also presents the revenue generated from the production cycle. The total revenue (TR) was ₦2,481,888. With gross margin of ₦1,542,014.14. Overall, this table provides a comprehensive overview of the costs and returns associated with fish farming in this specific production cycle. The positive gross margin indicates profitability in the fish farming enterprise during this cycle.

Table 2. Costs and returns of fish farming per production cycle

Items	Cost
A. Variable cost (Naira)	
Fish feed	732,488.23
Fingerling/juveniles	98,246.55
Lime and fertilisers	7,223.62
Drugs/supplement	6,775.11
Labour	70,353.08
Fuel	4,320.00
Miscellaneous	3,455.23
Total variable costs (TVC)	₦922,861.82
B. Fixed costs (Naira)	
Cost of renting pond	1,800.14
Cost of renting pumping machine	150.23
Cost of renting net	500.00
Pond	5,231.31
Pumping machine	3,482.32
Nets	5,003.42
Weighing scale	844.62
Total fixed costs = (TFC)	₦17,012.04
Total cost = (TVC+ TFC)	₦939,873.86
C. Revenue (Naira)	
Average fish quantity harvested	3,012.00kg
Average price of fish per kg	₦824
Total Revenue (TR)	₦2,481,888

Source: field survey, 2023

Net Farm Income and Benefit Cost Ratio (BCR)

From Table 2.

Net Farm Income (NFI) = TR – TC

NFI = ₦2,481,888 – ₦939,873.86

NFI = ₦1,542,014.14

Benefit cost ratio = Total revenue ÷Total cost = ₦2,481,888 ÷ ₦939,873.86

BCR = 2.6

The BCR greater than 1 reveals further that Fish farming is very profitable in the study area.

Constraints to fish farming involvement

The results in Table 3 indicate that the most identified constraint were high feed prices (48%), inadequate funding (41.3%) and unsuitable market (32.7%). This finding aligns with the analysis of costs and returns, where the cost of feed constituted 77.9% of the total cost of production for the farmers. The increase in feed prices could be attributed to the importation of most commercial feed and the associated problems with importation and distribution. These commercial feeds are preferred by fish farmers due to their floating and high protein qualities.

Table 3. Distribution of respondents on constraints to fish farming involvement

Constraints	Frequency	Percentages	Rank
High feed prices	72	48.0	1st
Inadequate funding	62	41.3	2nd
Unsuitable market	49	32.7	3rd
Poor extension services	36	24.0	4th
Insufficient fingerlings	43	28.7	4th
Poaching	26	17.3	6th
High expense of drilling borehole	18	12.0	7th

Source: Field survey, 2023

Factors influencing the intensity of fish farming in the study area

Table 4 displays the results of a regression analysis to determine factors that influence the fish farming net farm income in the study area. It presents the coefficients, standard errors, and t-ratios for each variable included in the regression model. The constant coefficient of 0.6211 represents the baseline level of fish farming intensity when no other variables are present. The coefficient for pond

size is 0.0010, indicating that for every unit increase in pond size, fish farming intensity increases by 0.0010 units, assuming all other factors remain constant. The t-ratio of 3.525*** demonstrates that this coefficient is statistically significant at the 1% level. The coefficient for the number of ponds owned is 0.1123, suggesting that for each additional pond owned, fish farming intensity increases by 0.1123 units, holding all other factors constant. The t-ratio of 6.621*** indicates that this coefficient is statistically significant at the 1% level. The coefficient for fish feed is 0.6421, indicating that for every unit increase in the amount of feed used, fish farming intensity increases by 0.6421 units, assuming other factors remain constant. The t-ratio of 3.481*** demonstrates that this coefficient is statistically significant at 1% level. This result aligns with the findings of Onoja and Achike (2011) on resource productivity in small-scale catfish farming, which highlighted the significant contribution of fish feed to fish output. The coefficient for initial capital investment is 0.5111, implying that for each unit increase in start-up capital, fish farming intensity increases by 0.5111 units, assuming other factors remain constant. The t-ratio of -3.8421*** indicates that this coefficient is statistically significant at the 1% level.

The coefficient for labour is -0.006, suggesting that for every unit increase in labour, fish farming intensity decreases by 0.006 units, assuming other factors remain constant. The t-ratio of -3.6231*** indicates that this coefficient is statistically significant at the 1% level. The coefficient for farming experience is 0.0105, indicating that for each unit increase in years of farming experience, fish farming intensity increases by 0.0105 units, assuming other factors remain constant. The t-ratio of 0.746* shows that this coefficient is statistically significant at the 10% level. This finding contradicts the work of Ele *et al.* (2013) on economic analysis of fish farming in Calabar, Cross River State, Nigeria, which reported that extensive experience is not a prerequisite for entering fish production. The coefficient for educational level is 0.0178, suggesting that for every unit increase in educational level, fish farming intensity increases by 0.0178 units, assuming other factors remain constant. The t-ratio of 2.387** indicates that this coefficient is statistically significant at the 5% level.

The table includes 150 observations, and the sigma value is 0.2895 with a standard error of 0.0231, representing the degree of variability in the data. The log likelihood value is -26.721, which reflects how well the regression model fits the data. Overall, the Tobit regression results indicate that size of ponds, number of ponds owned, fish feed, initial capital investment, and labour are significant factors influencing the intensity of fish farming in the study area.

Table 4. Tobit regression analysis on factors influencing the intensity of fish farming

Variables	Coefficients	Standard error	t-ratio
Constant	0.6211	0.1532	3.841***
Size of pond ($m^{2)}$	0.0010	0.0004	3.525***
Ponds owned	0.1123	0.0213	6.621***
Fish feed (kg)	0.6421	0.1321	3.481***
Initial capital investment (Naira)	-0.5111	0.2888	-3.8421***
Labour	- 0.006	0.0003	-3.6231***
Farming experience	0.0105	0.00048	0.746*
Educational level	0.0178	0.00081	2.387**
Sigma	0.2895	0.0231	15.901***
Log likelihood	-26.721		

*** Significant at 1%, **Significant at 5%, * Significant at 10%, SE = Standard error

CONCLUSIONS AND RECOMMENDATION

In conclusion, the study revealed a diverse group of fish farmers, with both male and female engaged in the sector, predominantly in their productive years. Fish farming was primarily seen as a means of income diversification, often financed through loans. Catfish emerged as the preferred fish species. However, the study's economic analysis indicated that fish farming in the area was highly profitable, with a benefit-cost ratio of 2.6, highlighting its economic viability. From the study it was observed that fish farming is a profitable sector capable of enhancing household income through income diversification. To enhance productivity, fish farmers should endeavour to improve access to capital, and strengthen market linkages to further boost profitability of the enterprise.

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