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Original Article

Benefit-cost implications of catfish production in Ibeno metropolis, Akwa Ibom State, Nigeria

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Samuel Preye JIMMY[1]*, Julius Emeka OMEJE[2] & Mary Ekere AKPENKONG[1]

[1]*Department of Agricultural Economics, Extension and Rural Development, Niger Delta University, Bayelsa State.*
[2]*National Institute for Freshwater Fisheries Research, New Bussa, Niger State.*

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ABSTRACT

The study investigated the benefit-cost implications of aquaculture catfish production in Ibeno metropolis, Akwa Ibom State, Nigeria. The study specifically described the socioeconomic characteristics of the respondents, estimated the cost and return in aquaculture catfish production, computed the benefit-cost implications of aquaculture catfish production, and evaluated the factors influencing the net income of aquaculture catfish producers. A multistage sampling procedure was used to select 105 catfish farmers. Primary data were collected using questionnaires that were administered using an interview schedule. Data were presented with descriptive statistics and analyzed using budgetary technique and multiple regression analysis. Results showed that 63.8% of the farmers were between 36-45 years old, with a mean age of 47 years. The majority (61%) had post-secondary education, while 49.5% had about 8 years of farming experience. The net income realized from 5 ponds stocked with about 1000 fingerlings for 2 cycles per year was ₦6,114,333, while the benefit-cost ratio was 1.98, indicating the viability of the catfish business. The major factors that influence net income were the quantity of fish sold, experience of fish farmers, education, and age. Therefore, it is recommended that more support for investment in catfish businesses be encouraged by state governments and other agencies for job creation, food security, and poverty reduction.

K E Y W O R D S : *Aquaculture, Catfish, Net farm income, Production, Returns*

INTRODUCTION

Aquaculture has become an important sector for food production, income generation, and employment in Nigeria. At present, the global aquaculture sector contributes almost half of all fish produced globally. This is as a result of a steady increase in production over the past three decades (Food Agriculture Organization, 2020). According to the National Bureau of Statistics (NBS), the Nigerian Fisheries sector contributed about 3.24% to the Gross Domestic Product (GDP) in the first quarter of 2021 (Ogunji & Wuertz, 2023). This growth has brought benefits such as a steady increase in (apparent) global average per capita fish consumption because of increased availability of fish (FAO, 2020) and direct access to fish for those involved in production, which both contribute to relevant nutritional and health benefits (Esiobu *et al.*, 2022). In Nigeria, it is reported that about 41% of protein requirement by an average Nigerian is gotten from the consumption of fish, even though it is below the average global intake of 13.3 kg per person per year (Enwelu *et al.*, 2023).

*Corresponding author: oyienpreyejimmy@gmail.com; +2348060916974

Aquaculture, which refers to the systematic cultivation of aquatic organisms, stands as a transformative force in Nigeria's the economic and nutritional tapestry. The history of aquaculture in Nigeria can be traced back to the early days of fish farming, which served as a source of food and commercial gains to those who practiced it. Fish farming is the most dominant component of aquaculture in Nigeria and some African countries, accounting for about 90% of aquaculture farmers in the country (Chan *et al.,* 2021). According to Oke *et al.,*(2021), the Nigerian Aquaculture is one of the fastest growing sector of livestock production with about 29% growth rate since 2006 as a result of an increase in demand due to the high population growth rate. The aquaculture sub-sector has witnessed an annual growth of about 12%, making Nigeria the largest producer of aquaculture fish in Sub-saharan Africa which surpasses global average growth rate of 8% (WorldFish, 2018). Catfish is the most farmed fish species in Nigeria, constituting over half of the total aquaculture production by volume (FAO, 2022). The most widely cultured Catfish species in Nigeria is *Clarias gariepinus*, commonly called African catfish. It is widely cultured because of its tolerance of the local environment, disease resistance, and high-quality traits that minimize loss for farmers (Enwelu, Onuorah and Iyere-Freedom, 2023).

Catfish farming in Nigeria's is one of the most important aquaculture sectors. The increasing demand for fish has shown that the country's catfish production and marketing sectors have promising futures (Ashley & Adelaja, 2022). This is because Nigeria is the largest consumer of catfish in Africa. It is estimated that the annual consumption of fish stands at about 3.6 million tons. This is more than double the amount of fish consumed in 2004 which was about 1.4 million tons (Ogunji & Wuertz, 2023). In a developing country like Nigeria with population of over 200 million, aquaculture catfish production is regarded as a viable enterprise with high profits. Catfish farming offers enormous potential in job creation opportunities, income generation, food security as well as poverty reduction (Enwelu *et al.,* 2023). According to Cowan (2021), the assessment of cost and benefits to determine the viability of the catfish enterprise constitutes the economic analysis associated with catfish production.

The benefit-cost ratio shows the economic viability of an enterprise at a glance. A benefit-cost ratio that is greater than one implies that the enterprise is viable. For instance, Namonje-Kapembwa and Samboko (2020) estimated the profitability of small-scale aquaculture production in Zambia and found that benefit-cost ratio was greater than one, implying that an investment in aquaculture was profitable over the useful life of 10 years. Similarly, a study by Muhammad *et al.,*(2020) in Punjab, Pakistan showed that the benefit-cost ratio in fish farming is estimated at 1: 3.61 which implies that the enterprise yields 3.61 rupees for every rupee invested. The benefit-cost ratio without a doubt presents a decision-making platform or indices for fish farmers, especially catfish farmers in Ibeno Metropolis, Akwa Ibom State, Nigeria.

The economic impact of aquaculture catfish production in Ibeno Metropolis is particularly pronounced. Beyond providing a source of income for those directly involved in aquaculture, the sector has spurred ancillary economic activities, including transportation, processing, and marketing. Moreover, the infusion of aquaculture Catfish production into the local economy has generated employment opportunities, fostering a ripple effect of economic growth that transcends the boundaries of fish farms. Despite the growing importance of aquaculture catfish production in Ibeno Metropolis, there exists a gap in our understanding of the benefit-cost implications of the economic activity in the area. The study specifically described the socioeconomic characteristics of the catfish farmers, estimated the cost and return in aquaculture catfish production, computed the benefit-cost implications of aquaculture catfish production and evaluated the factors influencing net income of aquaculture catfish producers.

MATERIAL AND METHODS

The study was conducted in Ibeno Local Government Area of Akwa Ibom State, an area situated between latitudes $4^{0}33^{1}54^{11}$ North and longitudes $8^{0}04^{1}21^{11}$ East in the south-south geopolitical zone, Nigeria. It is regarded as a fish center with a coastal area that occupies over 129 km (Latitudes, 2024). The diverse aquatic landscapes in the region serve as a foundation for various aquaculture activities, ranging from traditional fishery practices to modern aquaculture ventures.

Multi-stage sampling procedure was used in selecting 120 respondents for this study. The first stage involved a purposive selection of three communities, Mkpanak, Upenekang and Iwuoachang communities out of the six communities in Ibeno Local Government Area based on the preponderance of fish farming activities in those communities. Stage two involved the random selection of 40 respondents from each of the three previously selected communities to make up 120 respondents for the study. The sampling frame for the study was obtained from Akwa Ibom State Agricultural Development (AKADEP). Data for this study were collected from primary sources using questionnaire. Data collected were analyzed with descriptive statistics, budgetary technique and multiple regression models (Least Square Regression Model).

Budgetary Analysis

$TC = TVC + TFC$ (1)

$TR = Pr * Q * NC * NP$ (2)

$NI = TR - TC$ (3)

Where, TC = Total cost, TVC = Total variable cost, P= Price of commodity (N), Q = Quantity of fish harvested per Pond, NC=No. of Production Cycles, NP=No. of Ponds, TFC = Total fixed cost, NI = Net Income, TR = Total revenue.

$$\text{Net Profit Margin} = \frac{Net\ Income}{Revenue} * 100 \quad (4)$$

$$\text{Return on Investment} = \frac{Net\ income}{Total\ Expenses} * 100 \quad (5)$$

$$\text{Benefit-Cost Ratio} = \frac{Total\ Revenue}{Total\ Expenses} \quad (6)$$

Multiple Regression Model

Implicitly,

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, \varepsilon)$ (7)

Double Log Form

$$\ln Y = b_o + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + b_5 \ln x_5 + b_6 \ln x_6 + b_6 \ln x_6 + b_7 \ln x_7 + b_8 \ln x_8 + e \quad (8)$$

Where; Y = Net farm Income from Fish farming in Nigeria (₦), X_1 = Total kilogram of fish sold (₦), X_2 = Price per kilogram of fish (₦), X_3 = Farming experience (Years spent in fish farming), X_4 = Level of education (Years spent in formal education), X_5 = The transportation cost of catfish (₦), X_6 = Access to Credits (Dummy, 1 = yes, 0 = No), X_7 = Sex of respondents (Male = 1 and Female = 0), X_8 = Age of respondents (Years), U = error term, β_1- β_8 = Estimated regression parameters

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Aquaculture Catfish Farmers

Age Distribution: The majority of the aquaculture catfish farmers (63.8%) were aged between 36-45 years while the mean age was 47 years. A Similar age bracket of 41-50 years has been reported by Omeje *et al.* (2021) among catfish farmers in Kainji Lake Basin, Nigeria. This age distribution indicates that individuals within the economically active age are actively involved in aquaculture catfish production in the area. Hence, this suggests youth involvement in fish production. Hence, giving credence to Chipfupa &Tagwi, (2021) that youth are the future of agriculture in sub-saharan Africa.

Educational Level: Education-wise, majority (61.0%) had attained post-secondary education. Higher educational levels among catfish farmers may indicate a potential for innovation and adoption of modern farming techniques. Also, according to Solomon and George (2019), catfish farmers with high literacy levels tend to manage their farms more effectively than farmers with low literacy levels. This implies that the educational level of catfish farmers is an added advantage to effective management and ease of adoption of technologies for higher productivity.

Family Size: the result showed that majority (68.6 %) of the catfish farmers had family size of 5-10 persons while the average family size was 6 persons per each household of the catfish farmers. This conforms with Gbigbi (2021) that the major household size of Catfish farmers is between 6-10 persons. The implication is that a catfish farmer with a large family size will most likely resort to the use of family labour for the operations on the farm.

Number of Ponds: The average number of ponds per catfish farmer was 5 ponds while quite a number (52.4 %) of the fish farmers had about 4-6 ponds. This suggests that the fish farmers had a reasonable level of investment in fish ponds for higher net income in catfish production.

Farming Experience: The result of years of experience in catfish farming showed that 49.5% had about 5-10 years of experience in catfish farming while 36.2% had about 11-15 years of experience in fish farming. This suggests that a significant portion (about 85.7 %) of the fish farmers have acquired experience of between 5-15 years in catfish production. Catfish farmers with longer years of experience are better off in adopting innovations for better productivity in their farm enterprise (Enwelu *et al.*, 2023).

Cost and return in aquaculture catfish production

The result on the cost and return in aquaculture catfish production is presented in Table 2. The result of the analysis showed that Catfish production is a profitable enterprise. This is because of the positive net-income (₦ 6,114,333) that was derived from the revenue (₦ 12,350,000**)** which was in excess of Total Cost (₦ 6,235,667). The result agrees with similar study by Gbigbi (2021) that catfish farming is a profitable business venture. However, cost of feed constitute the highest cost (74.35%) incurred in catfish production. This clearly showed that any investor in the catfish production enterprise must have necessary requirements to ensure steady feeding of fish for maximum expected output.

Table 1: Socioeconomics characteristics of aquaculture catfish farmers (N=105)

Variables	Frequency	Percentage	Mean
Age (years)			
25-35	3	2.9	
36-45	67	63.8	47 years
46-55	15	14.2	
≥ 56	20	19.1	
Education qualification			
Primary Education	26	24.8	
Secondary Education	15	14.2	
Post-Secondary Education	64	61.0	
Family size (persons)			
5-10	72	68.6	6 Persons
11-15	33	31.4	
Number of Ponds			
1-3	25	23.8	
4-6	55	52.4	5 ponds
≥ 7	25	23.8	
Farming experience (years)			
5-10	52	49.5	
11-15	38	36.2	8 years
16-20	15	14.3	

Source: Field Survey, 2024

Table 2. Costs and return to catfish production in the study area

Item	Cost (₦)/ Number	% contribution
Fixed Cost (depreciation)		
Pumping machine	26,000	0.41
Wheel barrow	1400	0.02
Weighing Scale	1,667	0.03
Pond	11,000	0.18
Total Fixed Cost	4,0067	
Variable Cost		
Water	40,000	0.64
Fingerlings	60,000	11.22
Feed	3,904,000	74.35
Transportation	190,000	3.05
Drugs	72,000	1.15
Labour	408,000	6.54
Liming material	120,000	0.32
Fueling	129,600	2.08
Total Variable Cost	6,195,600	
Total Cost	6,235,667	
Revenue		
A). number of cycles	2	
B). Av. No. of Ponds	5	
C). Kg per Pond	650	
D). price per kg	1900	
Total Revenue=A*B*C*D	12,350,000	
Net Income	6114,333	

Source: Field Survey, 2024

Benefit-Cost Implications of Aquaculture Catfish Production

The result of the analysis of benefit-cost implications of aquaculture catfish production is shown in Table 3. The result showed that the profit margin is 49.5% which implied that to every 1 naira of sales, about 50 kobo is realized as profit. This means that the margin of profit realized in aquaculture catfish production is quite good and attractive for investors in the fishery industry. Also, the return on investment (ROI) was 98.05% which implies that for every 1 naira invested in the business, 99.05 kobo was received as ROI while the Benefit-Cost Ratio was 1.98 which indicates that about 100% was received as net sales in aquaculture catfish production. This result is similar to Ikechukwu (2023) and Enwelu *et al.* (2023) that catfish farmers earn a high return on investment; thus, confirming the profitability of catfish business. The analysis clearly showed that an investment in catfish production yields high returns for the investor. Investment in the sector should be encouraged by the government and relevant agencies for youth employment and poverty reduction.

Table 3: Benefit-Cost Implications of Catfish Production

Items	Percentage (%)
Net Profit Margin	49.51
Return on Investment	98.08
Benefit-Cost ratio	1.98

Source: Computation from field survey, 2024

Factors influencing net income of aquaculture catfish producers

The results of the multiple regression analysis that was used to determine the factors influencing net income of aquaculture catfish farmers is presented in Table 4. The double log function was the lead equation based on the diagnostic statistics and econometrical considerations. Also, it has the highest number of significant independent variables. The coefficient of determination (R^2) was 0.6620 which signified that about 66.20% of the total variation observed in the dependent variable was explained by the explanatory variables ($X_1 – X_8$) in the model. Hence, the remaining (33.8%) was due to random disturbance. The F–statistic was significant at a 1% probability level, denoting that the estimated R– square was significant and by implication, the estimated equation had the goodness of fit.

The coefficient of quantity of fish sold was statistically significant ($p<0.05$) and positively related to the net income in aquaculture catfish production. The positive significant relationship between the quantity of fish sold and the amount of net income in aquaculture catfish production is expected because the profit from the business depends mostly on quantity of fish sold such that when more fish are produced, more profit from fish will be expected.

The coefficient of experience was positive and statistically significant at ($p<0.01$) on net income. This implies that a unit increase in the year of experience of the farmer will result to a positive increase in the net income of catfish producers. According to Omeje *et al.* (2021), fish farmers with longer years of experience possess the technical know-how on how to effectively and efficiently utilize production resources. Catfish producers with ample experience would know the best investment strategies to improve production and increase his/her return on investment.

The coefficient of education was positive and significantly ($p<0.05$) related to net income. This implies that a unit increase in the years of education of the respondents will increase the net income of catfish producers. The implication is that farmers with advanced years of education tend to adopt technologies that could help expand their production and in turn increase their income. Similarly, Oke *et al.* (2021) posited that additional years of education are expected to increase the output of farmers. This results to more revenue with a corresponding positive net-income.

The coefficient of age was significant at ($p<0.01$) level and positively related to net income of aquaculture catfish producers. This implies that an increase in the age of a farmer will increase net-income from aquaculture catfish production. This finding is in consonance with Esiobu *et al.* (2022) that an increase in the age of catfish farmers is positively related to the profits realized. Catfish producers who are advanced in age are more likely to invest in aquaculture catfish production business due to their experience in the business.

Table 4: **Factors influencing net income of aquaculture catfish producers**

Variables	Coefficients	T
Constant	12.3116	3.061***
Quantity of Fish sold	23316.1	2.374**
Price per kg	0.10299	0.219
Experience	10840	7.015***
Education	10351.4	2.754***
Transportation	0.07264	0.2461
Access to Credit	0.39055	0.784
Sex	−0.08115	−0.626
Age	5520.12	2.640***
R^2	0.6621	

Source: Computation from field survey data 2024

Note: ***significant at 1% **significant at 5% *significant at 10%. Figures in the brackets are respective t-ratio *lead equation is Double log

CONCLUSION AND RECOMMENDATION

The study established that aquaculture catfish production is a viable business venture with a good return on investment. The major factors which influence the net income of catfish farmers were; the quantity of fish sold, experience of fish farmers, education and age. Therefore, it is recommended that more support for investment in catfish business be encouraged by the State government and other agencies for job creation, food security and poverty reduction.

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Author's Contribution

SPJ and MEA managed data collection, interpretation of data and wrote the first draft. JEO and SPJ did literature search edited the first draft, improved on the manuscript and wrote the second draft. All authors read and approved the final manuscript

Ethical Statement

Not applicable

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