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TECHNICAL EFFICIENCY AND PROFITABILITY ANALYSIS OF CATFISH FARMING IN ONDO STATE, NIGERIA

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ABSTRACT

Catfish farming is a popular agricultural business in Nigeria because of its short production cycle and a quick return on investment. The objectives of the study were to determine the economics and technical viability of catfish farming in Ondo State, Nigeria. Purposive and simple random sampling methods were used to select 171 catfish farmers from five local government areas of the state, using structured questionnaires. Analytical techniques used were stochastic frontier production model, the net farm income analysis, and descriptive statistics. Nearly 70% of the catfish farmers were in the productive and active range of 20 – 49 years and roughly 67.25% of them had post-secondary education. The profitability analysis indicated that a kilogramme of food-size catfish was sold for ₦938.96, while the total production cost was ₦952.30, leading to a loss of ₦13.34 per kg of food-size catfish. Estimates of the maximum likelihood of the stochastic frontier production model showed that variables such as pond size (t = 2.809), fish seeds (t = 14.065), feed (t = 9.548), and labour (t = 8.915) were significant and had a direct relationship with the amount of catfish output. Mean technical efficiency level was 0.88, while the value of returns to scale was 1.65, indicating increasing returns to scale. The study concluded that the efficiency level among catfish farmers was high and that catfish farming or production in the study area was not profitable due to the high cost of catfish feed. It is recommended to use supplementary feed, such as maggots, to reduce the astronomical cost of feeding catfish.

Keywords: Catfish, inputs, costs, culture, profit, efficiency

INTRODUCTION

Catfish farming is the rearing of catfish in a partially-regulated habitat. The mode of farming or culturing can be intensive, semi-intensive, or extensive. Culturing can be done in an earthen pond, a concrete pond, a fibre glass pond or in a collapsible (tarpaulin) pond. Catfish farming is a popular agricultural business in Nigeria because of its short production cycle and a quick return on investment. Catfish is a well-known cultured fish in Nigeria because it can tolerate unfavourable factors such as varying degrees of salinity, reduced oxygen level and low acidity; other factors that make it popular among fish farmers include its quick growth rate, increased consumers' preference, excellent feed conversion ratio and its ability to be raised in a confined and partially-controlled environment (Olagunju, 2020; Van-Anrooy *et al*., 2022). Notable among commonly farmed catfish species in Nigeria include: *Clarias gariepinus*, *Clarias lazera*, *Heterobranchus bidorsalis* etc. (Adewumi & Olaleye, 2011; Amosu *et al*., 2017).

Catfish is particularly significant to the Nigerian economy since it generates cash and employment opportunities for catfish farmers, middlemen and processors, among whom are a significant number of women who engage in the value chain aspect of the business. The business of raising catfish will continue to thrive so long as the human population keeps increasing. According to the Organization for Economic Cooperation and Development/Food and Agriculture Organization [OECD/FAO] (2018), the proportion of fish raised for human consumption that comes from aquaculture is expected to rise globally.

The disparity between Nigerian fish production and consumption calls for serious concern in spite of her fish production capacity. The challenge is that total fish production is not enough to meet fish demand locally. FAO (2022) estimated that Nigeria's yearly fish demand was approximately 3.2 million metric tonnes, while local fish production was approximately one million metric tonne, implying a shortfall of 2,126,941 metric tonnes that needed to be filled. This is demonstrated by the fact that Nigeria continues to import frozen fishes (Mackerel, Herring, Horse Mackerel, and Blue Whiting etc.) to supplement local fish production. In the last two years, Nigeria imported fish products equivalent to $2.14 billion (Jaiyeola, 2022). The constant importation of fish threatens the Nigerian economy; depletes the nation's financial reserves; and eliminates job prospects for Nigerians, especially the poor. Despite the huge potential of catfish farming to close the supply-demand imbalance for fish, many farmers have left the industry due to the exorbitant cost of feed, sub-standard feed, low price of food-size catfish at harvest, and poor quality fish seed that fail to reach maturity quickly. The aim of this research is to examine and determine the technical efficiency and profitability of catfish production in the study area. Although, some studies exist on the profitability of catfish production in the state (Folayan & Folayan, 2017; Olutumise *et al*; 2020), not much has been done in the area of technical efficiency and profitability of catfish production in a single study.

MATERIALS AND METHODS

Study Area

Akure South, Akure North, Owo, Akoko North-East, and Okitipupa were selected for this research. These local government areas (LGAs) were chosen due to their vital contributions to the catfish industry in the state. The projected population of Ondo State in 2022 was 5,414,807 based on an annual population growth rate of 2.80% (Ondo State Bureau of Statistics, 2022). 14,788.723 square kilometres make up the State's land area (Ondo State Bureau of Statistics, 2022). The State is located between Latitudes $5^0$45' and $7^0$52'N and Longitudes $4^0$20' and $6^0$5'E (Sunshine Liberation Forum, 2011).

Daramola *et al.* (2010) described the state based on certain features such as climate, vegetation, soil, etc. With its unique wet and dry seasons, the state is located in a rain forest belt. In the south, average monthly temperature is 27°C while the northern part has an average monthly temperature of 30°C

(Daramola *et al.*, 2010). The state's climate is generally good for catfish farming.

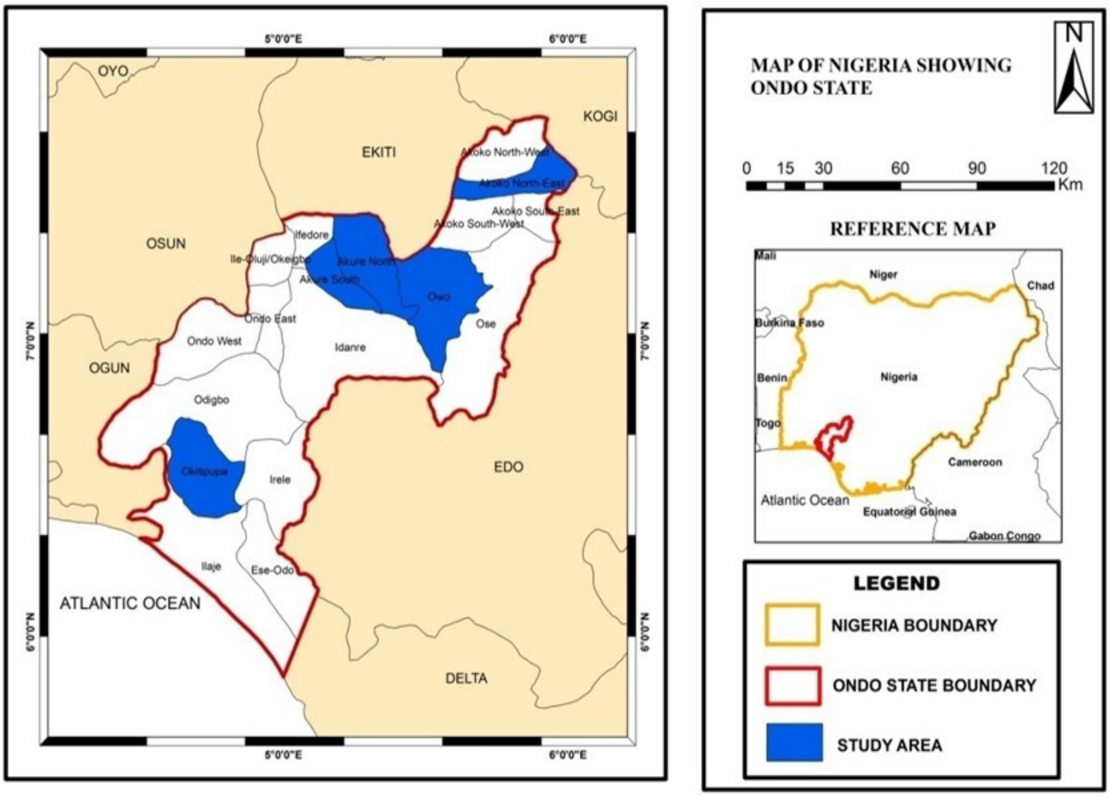

Figure 1: Map of Ondo State with focus on the study area

Source: Authors (2022).

Data Collection and Sampling Technique

An interview schedule and structured questionnaire were used in this research to gather cross-sectional data. The selection of local government areas and catfish producers was done using basic random and purposive sampling methods. Five local government areas (LGAs) namely: Akure South, Owo, Akure North, Akoko North-East, and Okitipupa out of the State's 18 LGAs were deliberately chosen for the first stage as a result of their pivotal contributions to catfish production, as attested to by a list provided by the Ondo State Catfish Farmers' Association (2019). The study applied proportional sampling as used by Duniya (2014); 80% of the farmers from each chosen LGA were chosen through random sampling in the second stage, yielding a total of one hundred and seventy one catfish farmers (Table 1). The research covered 2019-2021 production cycles.

Table 1: Sample frame and sample size of catfish farmers

Local Government Areas	Sampling Frame	Sample Size (80% of sampling frame)
Akure North	47	38
Akure South	89	71
Owo	43	34
Akoko North-East	21	17
Okitipupa	14	11
Total	214	171

Source: Ondo State Catfish Farmers' Association (2019) and authors' computation

Method of Data Analysis

Data obtained from the study were analysed using stochastic frontier production model and net farm income model.

Model specification

Stochastic frontier production analysis

The study used the stochastic frontier production model to evaluate factors influencing catfish production's technical efficiency. The model in its broad form is:

$Y_i = f(X_i;\beta)+E_i$ ………………………………………………………. (1)

Where,

Y_i is catfish output;

X_i is a vector of inputs used by catfish farmers;

$f(X_i;\beta)$ is the production frontier and

β is a vector of parameters to be estimated

$E_i = V_i - U_i$

V_i = random error that incorporates or captures factors outside farmers' control.

U_i = the component that incorporates the technical inefficiency of the producer or farmer.

This study, adopted the Cobb-Douglass stochastic frontier production function as used by Hassan *et al.* (2014).

$InY_i = \beta_0 + \beta_1 InX_{1i} + V_i - U_i$ …………………………………………..(2)

The explicit form of the model is:

$InY = \beta_0 + \beta_1 InX_1 + \beta_2 InX_2 + \beta_3 InX_3 + \beta_4 InX_4 + V_i - U_i$………………(3)

Y_i = Fish output (kg);

X_1 = Pond size (m^3);

X_2 = Feed (kg);

X_3 = Fish seed (number);

X_4 = Labour (man days) and

In = Natural logarithm to base e.

Inefficiency effect model

In the production process or farming activity, not every producer or farmer is able to utilize resources efficiently to get the best possible output. Producers or farmers who operate on the frontier are regarded as being technically efficient while those who operate below the frontier are considered to be technically inefficient. In consonance with the studies of Ray (1988) and Sharma *et al.* (1999), factors that contribute to technical inefficiency can be estimated as:

$U_{it} = \delta_0 + \delta_i Z_{it}$ ……………………………………………….(4)

Where;

U_{it} = Technical inefficiency;

Z_{it} = Vector of explanatory variables associated with technical inefficiencies and

δ_i = Vector of unknown parameters to be estimated.

An explicit form of the equation can be written as:

$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6$ ………….(5)

Where;

Ui = Technical inefficiency of catfish farmers;

Z_1 = Age of catfish farmers (years);

Z_2 = Household size (number of persons);

Z_3 = Catfish farming experience (years);

Z_4 = Educational level (schooling years);

Z_5 = Extension contact (number of contacts);

Z_6 = Sex (dummy: male = 1, female = 0) and

δ's = Parameters to be estimated.

Net farm income analysis

The catfish production profitability of the research area was evaluated using net farm income analysis. The money that has been returned to the catfish farmer or business owner for their labour, management, and other resource investments is essentially known as the net farm income. This method of analysis was utilized to calculate the profit or loss in catfish farming, which is the difference between total revenue and total production expenses (Olukosi & Erhabor, 1988). The model's details are as follows:

$$\sum_{i=1}^{n} NFI_i = \sum_{i=1}^{n} TR_i - \sum_{i=1}^{n} TC_i \quad \text{..(6)}$$

Where,

Σ = Summation symbol

NFI = Net Farm Income,

TR = Total Revenue and

TC = Total Cost (Total Variable Cost + Total Fixed Cost)

The fixed inputs are typically not depleted in a single agricultural cycle. The straight-line approach in line with Abbas (2015), as shown below was used to depreciate the fixed inputs.

$$D = \frac{P - S}{N} \quad \text{..(7)}$$

Where;

D = depreciation,

P = purchased value,

S = salvage value and

N = life span of asset

RESULTS AND DISCUSSION

Socio-economic Characteristics of Catfish Farmers

The catfish farmers were 43 years old on average (Table 2), which shows that they fall within the category of economically-active adults. Farmers around this age, according to Baruwa *et al.* (2019), are fit and strong enough to meet the demands of farming due to the fact that they are still viewed as being productive. This suggests that these farmers are still capable of overcoming challenges related to catfish farming and are readily motivated to adopt new ideas that can help with planning and increasing catfish production. About 70% of the catfish farmers were found to be between the ages of 20 and 49. Since these catfish farmers are still agile, belonging to this age group helps them to manage any stress caused by catfish production. According to other comparable studies (Gbigbi, 2020; Ikpoza *et al.*, 2021; Oke *et al.*, 2021), farmers in this age group, whether they raise crops or catfish, are very active and productively committed, which bodes well for the future of the business.

About 50.3% of the catfish farmers had 1-5 years of experience (Table 2), indicative of the fact that they were relatively new in the business. People with experience in any type of business or agricultural activity tend to be more productive and informed about that particular enterprise or industry. This is consistent with a study conducted by Esiobu *et al.* (2022). About 34.5% of the catfish farmers had 6-10 years of experience in catfish production, 5.8% had 11-15 years of experience, 5.3% had 16-20 years of experience, and 3.5% had 21-25 years of experience while 0.6% had 26-30 years of experience in catfish production.

67.25% of the catfish farmers sampled in the research area had tertiary education, showing that they were well-educated (Table 2). This result implies that they will be receptive to useful inventions that enhance their capacity to produce catfish, reduce expenses, and, ideally, boost earnings. This outcome is in line with research findings conducted by Baruwa *et al.* (2019). High level of post-secondary education among Kaduna State's small-scale fish farmers was also documented by Sambo *et al.* (2021). The state government's prioritization of education may have contributed to the high level of post-secondary education seen in the research area.

Gender is an important consideration in any energy-intensive industry, including agriculture. About 93% of the farmers sampled were males, whereas 7.02% were females. This suggests that men predominate, which may have something to do with the fact that it involves some energy in the form of sorting, harvesting, and other tasks that some women may find uninteresting. This result conforms to a similar study conducted by Olagunju (2020) that aquaculture business is a male-dominated agricultural business. Justifying this result is another study by Onyekuru *et al.* (2019) who reported a larger percentage (83%) of male catfish farmers as indicated in their study. Catfish production is an agricultural activity that is predominantly carried out by men in Nigeria, according to studies conducted by a number of authors (Emaziye, 2020; Ikpoza *et al.*, 2021; Obianefo *et al.*, 2020; Ochiaka & Obasi, 2019; Okoror *et al.*, 2017; Olaoye *et al.*, 2013).

About 82% of the farmers who raised catfish were married (Table 2). This suggests that jobs related to catfish production can be completed by family labor. This result is in line with the findings of Ikpoza *et al.* (2021), who observed that 70% of catfish producers in their study were married. Aasa *et al.* (2020), Oke *et al.* (2021) and Onyekuru *et al.* (2019) also revealed a noteworthy percentage of married catfish farmers. Catfish farmers who were single were only 16.96% (Table 2) as well as the marital status of other sampled catfish farmers.

Many catfish producers live in households with many people. In the survey, 73.1% of the catfish farmers had homes with one to five individuals. More household members indicate the availability of greater number of people that can be utilized as labourers for catfish production. Large household size offers a veritable source of cheap labour that can be drawn from at any time. Baruwa *et al.* (2019), Gbigbi and Ndubuokwu (2022) also agreed on this. Gbigbi (2020) also indicated that more household members indicate that more family members will be available for catfish farming. The proportion of catfish farmers who had more than five persons in their households was 26.9%.

No agricultural business can survive or flourish without adequate financing, and that is why farmers should have access to adequate credit at the right time to buy necessary farm inputs either for crop or animal production and also for postharvest activities. About 74.85% of catfish farmers could not access credit. This outcome is consistent with a study conducted by Esiobu *et al.* (2022), who claimed that a large portion of Imo State's catfish farmers were unable to obtain credit, which would have allowed them to make timely purchases of essential agricultural inputs. Only about 25% of the farmers or catfish producers in the research area had access to finance.

The functions of extension agents cannot be ignored in catfish production. Extension agents disseminate and demonstrate new research findings to farmers. About 4% of the farmers had interactions with extension agents, suggesting that they were aware of relevant information or the most recent scientific advancements that could help them produce catfish (Table 2). According to Chukwu (2014), consistent extension interactions support farmers' efforts to raise their output, revenue, and overall catfish production.

Table 2: Distribution of catfish farmers according to their socio-economic features

Variables	Frequency	Percentage (%)	Mean
Age			
20-29	16	9.36	43
30-39	49	28.65	
40-49	54	31.58	
50-59	35	20.47	
60-69	13	7.6	
70-79	4	2.34	
Total	171	100	
Years of experience			
1-5	86	50.3	7
6-10	59	34.5	
11-15	10	5.8	
16-20	9	5.3	
21-25	6	3.5	
26-30	1	0.6	
Total	171	100	
Educational status			
No formal education	9	5.26	
Primary school	7	4.09	
Secondary school	40	23.4	
Tertiary education	115	67.25	
Total	171	100	
Gender			
Male	159	92.98	
Female	12	7.02	
Total	171	100	
Marital status			
Single	29	16.96	
Married	139	81.29	
Divorced	1	0.58	
Widow	2	1.17	
Total	171	100	
Household size			
1-5	125	73.10	4
6-10	44	25.73	
11-15	2	1.17	
Total	171	100	
Credit accessibility			
No	128	74.85	
Yes	43	25.15	
Total	171	100	
Extension contact			
No	62	36.26	
Yes	109	63.74	
Total	171	100	

Source: Computed from field data, 2022.

Determinants of Technical Efficiency among Catfish Farmers

The estimated coefficient of all the productive inputs (variables) such as pond size, feed, fish seeds and labour were significant and positive (Table 3); which also conform to *a priori* expectation. This indicates that the estimated production function is an increasing function justifying the assertion of Ogunmefun and Achike (2018). Among all the determinants of technical inefficiency, age was significant at 5% and its coefficient was negative, sex was also significant at 10% while household size, catfish farming experience, educational level, and extension contact were insignificant (Table 3). The goodness of fit of the model was indicated by the sigma-squared value, which was significant at 1%. The gamma value of 0.948 indicates that 94.8% of the variation in fish output was due to inefficiency factors while 5.2% of the variation in fish output was due to random error term. The one-sided error feature was confirmed by the log likelihood ratio test value of 41.68, proving that an ordinary least square estimation would not have adequately represented the data.

Pond size coefficient was significant and positive at 1% level of probability. This is consistent with several similar studies by other researchers (Ikpoza *et al*., 2021; Ogunmefun & Achike, 2018; Okoror *et al*., 2017). This indicates that a unit increase in pond size will lead to 0.031 increase in Catfish output (Table 3). This means that there is 0.069 chance of increasing catfish out by increasing pond size.

At 1% probability level, the coefficient of the amount of feed consumed by catfish was positive and significant. This is consistent with the results of similar investigations conducted by other researchers (Ikpoza *et al*., 2021; Ogunmefun & Achike, 2018; Ogunnaike *et al*., 2021; Okoror *et al*., 2017). This demonstrates that a unit increase in feed amount will lead to 0.357 increase in catfish output; and it also demonstrates that there is a 0.643 chance of increasing catfish output by increasing the quantity of feed supplied to catfish (Table 3).

At 1% level of probability, the coefficient of fish seeds (fingerling, juvenile, or post juvenile) used in producing food-size catfish was positive and significant. This is in line with the results of comparable studies (Ajiboye *et al*., 2020; Okoror *et al*., 2017; Ume & Ochiaka, 2016). This indicates that the output of catfish will grow by 0.575 for every unit increase in fish seeds. This suggests that by increasing the quantity of fish seeds, there is 0.425 chance for improving catfish output.

The coefficient of labour was positive and significant at 1% probability level. This agrees with a comparable research carried out by Oyakhilomen *et al.* (2016). This shows that a unit increase in labour will increase catfish output by 0.687 and this further implies that there is that window or opportunity of increasing catfish output by 0.317 through increase in labour usage (Table 3).

Age had a negative and significant coefficient at 1% level of probability and this justifies the assertion of Kainga *et al.* (2019). This suggests that a unit increase in age will reduce technical inefficiency by 0.036. This suggests that as catfish farmers advance in age, they become more technically efficient. So in a technical sense, older farmers are technically more efficient than younger farmers.

At 10% probability level, the sex coefficient was significant and positive (Table 3). This is in conformity with Fasakin and Omonona (2020) research that female catfish producers typically use inputs more effectively from a technical standpoint. This might be because they didn't divert resources intended for catfish production to support other sources of income.

Table 3: Maximum likelihood estimates of technical efficiency of catfish farmers

Variable	Parameter	Coefficient	Standard error	T-ratio
Production Model				
Constant	β_0	-3.465***	0.439	-7.901
Pond size	β_1	0.031***	0.011	2.809
Feed	β_2	0.357***	0.037	9.548
Fish seeds	β_3	0.575***	0.041	14.065
Labour	β_4	0.687***	0.077	8.915
Inefficiency Model				
Constant	δ_0	-2.623	1.661	-1.579
Age	δ_1	-0.036**	0.018	-1.964
Household size	δ_2	0.084	0.069	1.223
Catfish farming experience	δ_3	-0.011	0.017	-0.639
Educational level	δ_4	0.0005	0.0184	0.027
Extension contact	δ_5	0.005	0.039	0.135
Sex	δ_6	2.236*	1.27	1.761
Model Fitness				
Sigma-squared	δ^2	0.275***	0.099	2.759
Gamma	γ	0.948***	0.023	41.816
Log Likelihood		58.299		
LR test of the one-sided error		41.682		
Mean technical efficiency		0.88		
Returns to scale		1.65		
Number of Observations		171		

***Significant at 1%, **Significant at 5%, *Significant at 10%.
Source: Computed from field data, 2022.

Efficiency Level of Catfish Farmers

The average technical efficiency level was 0.88 (Table 4), and this indicates that on average, the catfish farmers got 88% of possible output through a combination of productive inputs (pond size, feed, fish seeds, and labor) and the best catfish production practices, which is similar to the findings of Ogunmefun and Achike (2018). The implication of this mean level of efficiency is that catfish farmers, in the short run, have a 12% opportunity of increasing catfish output by improving efficiency of input usage or by adopting excellent management techniques that will increase catfish output. A sizeable number of the catfish farmers (56.73%) demonstrated an exceptionally high level of efficiency ranging from 0.9-0.99 (Table 4).

Table 4: Frequency distribution of technical efficiency of catfish farmers

Efficiency level	Frequency	Percentage (%)
0.2-0.29	1	0.58
0.3-0.39	0	0
0.4-0.49	1	0.58
0.5-0.59	0	0
0.6-0.69	6	3.51
0.7-0.79	9	5.26
0.8-0.89	57	33.33
0.9-0.99	97	56.73
Total	171	100
Minimum	0.27	
Maximum	0.97	
Mean	0.88	
Standard deviation	0.087	

Source: Computed from field data, 2022.

Elasticity of Production and Returns to Scale in Catfish Production

The production elasticity of each of the productive variables was positive and the value of returns to scale was 1.65 (Table 5) indicating increasing returns to scale, which suggests that a unit increase in input will yield 1.65 increase in catfish output which is similar to the findings of other researchers (Onoja & Achike, 2011; Ume & Ochiaka 2016) who observed increasing returns to scale in their studies. The value of the returns to scale was obtained through the summation of all the coefficients of the productive inputs (Table 5). Labor had the highest coefficient among all the variables, suggesting it is the most important productive input because labor is needed in feeding catfish, pumping water into ponds or changing the water when it is dirty, treating the fish when they suffer from diseases, and cropping them when they have matured or reached food size.

Table 5: Distribution of production elasticity

Variables	Production Elasticity
Pond size	0.031
Feed	0.357
Fish seeds	0.575
Labour	0.687
Returns to scale	1.65

Source: Computed from field data, 2022.

Profitability Analysis

The average total cost of producing one kilogramme of food-size catfish was ₦952.30, while average revenue was ₦938.96, resulting in a loss of about ₦13.34 per kilogramme (Table 6). This result aligns with Olagunju's (2020) research, who opined that small- and medium-sized catfish production in Nigeria's Federal Capital Territory were not profitable. This outcome also runs contrary to the conclusions drawn by other authors (Busari, 2018; Ochiaka & Obasi, 2019; Ume *et al.*, 2016), who claimed that catfish farming is a lucrative enterprise in Nigeria. Since feed is essential to the production of catfish, feed costs accounted for 89.76% of the overall production costs. This is consistent with the findings of Olagunju's (2020) study, which showed that 83% of the overall production costs were incurred in the purchase of fish feed.

Fish feeds, whether they are imported or made locally, are highly costly. The cost of a bag of feed is always going up due to the nation's high rate of inflation, which makes it harder and harder for most farmers to continue in business. The nation's domestic fish production has decreased as a result of some catfish farmers ceasing operations due to financial difficulties. Cost of stocking pond with fish seed which could be fingerling, juvenile or post juvenile was 5.82% of the total cost of production while that of labour was 2.52%. Variable costs accounted for 99.30% of the overall production cost while fixed costs accounted for 0.70% (Table 6) corroborating the findings of Olagunju (2020) who reported that variable cost accounted for 98% of the total production cost while fixed cost made up only 2% in catfish farming. Umar (2017) found in his study that variable costs accounted for 94% of overall production costs.

In all, a total of about 338,870 kg of food-size catfish was produced from a total pond size of 69,132.97m^3 in one production cycle. A total revenue (TR) of ₦318,184,250 was realized while

Table 6: Total costs and returns of catfish farming per production cycle

Items	Total cost	Cost/kg	Percentage of cost (%)
A. Variable costs (₦)			
Feed	289,652,675.00	854.76	89.76
Fish seed	18,788,900.00	55.45	5.82
Labour	8,145,000.00	24.04	2.52
Drugs	1,307,510.00	3.86	0.41
Fuel	665,200.00	1.96	0.21
Cover net	1,617,675.00	4.77	0.5
Miscellaneous	255,000.00	0.75	0.08
Total Variable Costs (TVC)	320,431,960.00	945.59	99.3
B. Fixed costs (₦)			
Cost of renting pond	271,250.00	0.8	0.08
Pond	1,137,025.00	3.36	0.35
Water pump	503,773.10	1.49	0.16
Weighing scale	138,420.70	0.41	0.04
Drag net	172,466.93	0.51	0.05
Water storage tank	48,158.33	0.14	0.02
Total Fixed Costs (TFC)	2,271,094.10	6.71	0.7
Total Costs (TC)	322,703,054.00	952.3	100
C. Total Revenue (₦)	318,184,250.00	938.96	
D. Net Farm Income (₦)	-4,518,804.00	-13.34	

Cost/kg = cost of producing one kilogramme of food size Catfish

Source: Computed from field data, 2022.

CONCLUSION

Catfish producers in the study area had an average technical efficiency level of 0.88.
By using the most effective catfish production techniques along with productive inputs like labor, fish seeds, feed, and pond size, the farmers were able to harvest 88% of the total potential yield on average.

Catfish farmers have a 12% chance of raising catfish output by enhancing the efficiency of input utilization or by using optimal management methods that will enhance catfish output.

Catfish production is a vital agricultural enterprise that could generate enough revenue and profit for individuals that participate in it so as to improve their standard of living and get them engaged productively in the long run.

Catfish farming is no longer a profitable business the way it used to be some years back as evidently indicated by economic losses recorded by catfish producers in the research area.

RECOMMENDATIONS

It is advised to use alternative feeds (such as chickens' intestines, insects (maggots), etc.) as supplementary feeds to conventional feeds in order to reduce the excessive expense of feeding catfish.

There is also a need to identify locally-available and easy to afford fish feed ingredients or raw materials to replace the expensive fish meal that can be used to make high-quality and affordable catfish feed and reduce farmers' production costs significantly. The capacity of catfish farmers needs to be enhanced in terms of training by the government through active extension services so that they can compound catfish feed and spend less on different types of catfish feed.

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