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ECONOMIC EFFICIENCY AND PROFITABILITY ANALYSIS OF CATFISH *(CLARIAS GARIEPINUS*) PRODUCTION IN KADUNA STATE, NIGERIA

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Abstract

This study evaluated the economic efficiency and profitability analysis of catfish (*Clarias gariepinus*) production in Kaduna State, Nigeria. The sampling design employed for this research was a multi-stage sampling technique. A total sample size of 140 catfish farmers was selected. Primary sources of data were used and the data were obtained by administering a well-designed and well-structured questionnaire to the respondent. Data were analyzed using descriptive statistics, farm budgeting technique, gross margin analysis, financial analysis, stochastic production frontier efficiency model, Tobit dichotomous regression model, and principal component model. The results show that about 70% of the catfish farmers are male, and the average age of catfish farmers was 39 years. The types of fish ponds used include concrete, earthen, tarpaulin, cage, and plastic. The average capacity of fish ponds was 1706 fingerlings. The gross margin and net farm income was 886,250.51 Naira and 865,021.37 Naira per production cycle respectively. This implies that catfish production is profitable. The mean economic, technical and allocative efficiencies are 36.97%, 61.89% and 59.73% respectively. This left inefficiency gaps of 63.03%, 38.11% and 40.27% for improvement. The significant factors influencing the economic efficiency of catfish production include age, farming experience, educational level, fish feed, drugs, fingerlings, and pond size. The constraints facing catfish farmers include the lack of credit facilities, the high cost of fingerlings, the high cost of feeds, problems with pests, diseases, and predators, the lack of access to markets, and the lack of access to land. The study recommended that credit facilities should be provided for catfish farmers at a low interest rate devoid of cumbersome administrative procedures. The fish feeds, fingerlings, drugs, and chemical inputs should be provided for catfish farmers at affordable prices.

Keywords: economic efficiency, profitability analysis, stochastic production efficiency frontier, catfish production, Kaduna State, Nigeria

INTRODUCTION

In Sub-Saharan Africa, Nigeria is one the countries that has a very big potential to achieve a sustainable fish production considering the mangrove ecosystem available in the country (FAO, 2005). Fish farming is an aspect of aquaculture which focuses on rearing of fish under controlled or semi-controlled conditions for economic and social benefits (Anthonio and Akinwumi, 2002).

In Nigeria, fish farming as a form of aquaculture is gaining increasing importance for employment creation and income generation, particularly in the socio-economically weaker communities of fishermen, which represent the poorest sections of society in many developing countries (National Informatics Centre NIC, 2007). Fish farming creates jobs both directly and indirectly through the employment of individuals in industries related to fishing and other connected enterprises. Fish is a source of raw materials for related businesses and is significant for animal feed (Esu, Asa, & Iniedu, 2009). Nigeria produces a large amount of the catfish consumed in Africa. The country is often regarded in most studies as the largest producer of catfish alongside Hungary, Norway, the Syrian Arab Republic, Brazil, Cameroon, Kenya, the Netherlands, Mali, South Africa (FAO, 2010). Catfish can survive and grow well under a wide range of environmental conditions. It is the fastest growing fish species under confinement. Catfish is hardy and can tolerate dense stocking (Ume et al., 2016). Fish farming is a lucrative agri-business because it brings a good margin of returns when all the risks are properly managed. It provides a means of employment in rural areas and also plays a vital role in supplying good and quality protein in the diet of individuals. Catfish has the most demand among all other fish. It is cheap and widely consumed. Fish production can be carried out both on large-scale and small-scale (Adefalu et al., 2013). The majority of fish farmers in Nigeria venture into catfish production compared to other types of fish. Catfish also have good commercial values at markets and has more than three times the market value of tilapia (Ike and Chuks-Okonta, 2014). The majority of small-scale fish farmers grow and manage their fishes in tarpaulin ponds, tanks, earthen ponds, runways, glass tanks, plastic tanks, race-ways among others (FAO, 2010). Catfish farming requires a large amount of capital to start up in order to make a satisfactory amount of profit (Adebayo and Daramola, 2013). The demand for catfish has been on the rise among locals and the supply has fallen short. This unbalance between the demand and supply is putting an economic pressure on the price of catfish that could render the commodity unaffordable to many household consumers in Nigeria and further decrease the per capita fish consumption rate (FAO, 2010). Because of its quality as a very rich source of protein, the consumption of fish food has been on the rise and its acceptability indicates that catfish producers must meet the demand of locals (Tsue, Lawal & Ayuba, 2012). However, the FAO (2007) estimated that Nigeria imports roughly 560,000 tons of fish valued at about $400 million annually, compared to the country's projected 400,000 tons of annual domestic fish supply. Olagunju *et al*. (2007) reported that catfish production involves less land, less time, and less money and has a higher feed value. The production of catfish is crucial to the Nigerian economy since it provides a source of revenue, lowers the unemployment rate, and boosts the GDP. Anoop *et al*. (2009) reported that catfish is one of the safest sources of animal protein, provides food for the general population, and allows for improved protein nutrition due to its high biological value in terms of protein retention and assimilation in the body compared to other protein sources. It provides roughly 40% of the average Nigerian's daily requirement for animal protein (FDF, 2005). Around the world, there are many different species of farmed fish, but catfish is leading the pack due to its distinctiveness. About 50% of the deficit supply of catfish is met through importation, which constitutes a huge avoidable drain of Nigeria's scarce foreign exchange (Anko and Eyo, 2001). Catfish farming has a huge potential for contributing to the domestic fish production and reducing the amount of money spent on fish importation. Nigeria now imports 600,000 metric tons of fish annually, making it one of the largest importers in the developing nations of the world (Olagunju *et al*., 2007). Fish consumption in Nigeria is estimated to be 1.4 million metric tons annually. However, there are 0.7 million metric tons demand-supply gap in the country, and the imports are used to fill in the gap at a cost of roughly 0.5 billion US dollars annually.

Objectives of the Study

The broad objective was to evaluate the economic efficiency and profitability of catfish (*Clarias gariepinus*) production in Kaduna State, Nigeria. The specific objectives were:

(i) to describe the socio-economic and farm-specific characteristics of catfish farmers,

(ii) to analyze the costs, returns and profitability of catfish production,

(iii) to determine the economic efficiency (EE), technical efficiency (TE), and allocative efficiency (AE) scores of catfish farmers,

(iv) to evaluate the factors influencing the economic efficiency (EE) of catfish production, and

(v) to determine the constraints facing the catfish farmers in the study area.

METHODOLOGY

This research study was conducted in Kaduna States, Nigeria. Kaduna State occupies Longitudes 06° 15ǀ and 08° 50ǀ East and Latitudes 09° 02ǀ and 10° 36ǀNorth of the equator. The total land area of the state is 4.5 million hectares. The average rainfall is about 1,482mm. The state has a population of about 8.9 million people as of 2021. A multi-stage sampling technique was adopted. The sample frame of the catfish farmers in the area was 215. Primary sources of data were obtained. A well-designed and a well-structured questionnaire was administered to the respondents. This study used the formula advanced by Yamane (1967) in the calculation of the sample size. The formula is defined as follows:

$$n = \frac{N}{1+N(e^2)} = 140 \quad \ldots\ldots\ldots\ldots(1)$$

Where,

n = Calculated Sample Size

N = Sample Frame (Number)

e = Maximum Acceptable Margin of Error as Determined by the Researcher

Data were analyzed using the following descriptive and inferential statistics:

Descriptive Statistics

The study was based on the use of a mean, a standard deviation, percentages, and frequency distributions. This was used to summarize the socio-economic and farm specific characteristics of catfish farmers as stated in the specific objective one (i)

Farm Budgetary Technique

The gross margin (GM) and the net farm income analyses (NFI) of catfish production were estimated using the following models:

$$GM = TR - TVC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$NFI = \sum_{i=1}^{n} P_i Q_i - \left[\sum_{j=1}^{m} P_j X_j + \sum_{k=1}^{k} GK\right] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where

P_i = Price of Catfish ($\frac{₦}{Kg}$),

Q_i = Quantity of Catfish (Kg),

P_j = Price of Factor Inputs ($\frac{₦}{Unit}$),

X_j = Quantity of Factor Inputs (Units),

TR = Total Revenue obtained from the Sales of Catfish (₦),

TVC = Total Variable Cost (₦),

GK = Cost of all Fixed Inputs (Naira)

NFI = Net Farm Income (Naira)

The farm budgetary technique was used to analyze the costs, returns and profitability of catfish production as stated in the specific objective two (ii).

Financial Analysis

In the analysis according to Alabi et al. (2020), the gross margin ratio (GMR) is defined as:

$$Gross\ Margin\ Ratio = \frac{Gross\ Margin}{Total\ Revenue} \ldots (4)$$

According to Olukosi and Erhabor (2015), the operating ratio (OR) is defined as:

$$Operating\ Ratio = \frac{TVC}{GI} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where,

TVC = Total Variable Cost (Naira),

GI = Gross Income (Naira),

The rate of return per Naira invested (RORI) in catfish production is stated as follows:

$$RORI = \frac{NFI}{TC} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where,

NFI = Net Farm Income from Catfish Production (Naira),

TC = Total Cost (Naira)

The financial analysis was used to analyze the profitability of catfish production as stated in specific objective two (ii).

Stochastic Production Efficiency Frontier Model (SPEFM)

According to Alabi *et al*. (2022[a]), the stochastic production efficiency frontier model (SPEFM) is defined as follows:

$$Y_i = f(X_i, \beta_i)e^{v_i - u_i} \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

The stochastic production efficiency frontier model was used to estimate the technical, economic and allocative efficiency scores of catfish farmers as stated specifically in objective three (iii).

Economic Efficiency (EE)

Economic efficiency (EE) was derived from the multiplications of TE and AE for the individual catfish farmers. The EE of catfish production is therefore specified as:

$$EE_i = TE_i \text{ X } AE_i \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where,

EE_i= Economic Efficiency (Number)

TE_i = Technical Efficiency (Number)

AE_i= Allocative Efficiency (Number)

This was used to achieve specifically objectives three (iii) which is to determine the AE, TE, and EE scores of catfish farmers, and specific objective 4 (iv) which is to evaluate factors influencing the economic efficiency (EE) of catfish production in the study area.

Tobit Dichotomous Regression Model

This model was defined by following Gujarati (2004):

$$Y_i^* = X_i\beta + \varepsilon_i$$

$$Y_i^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \varepsilon_i \ldots\ldots\ldots (9)$$

$$Y_i = \begin{cases} 1 \ if \ Y_i^* \geq 1 \\ Y_i^* \ if \ 0 < Y_i^* < 1 \\ 0 \ if \ Y_i^* \leq 0 \end{cases}$$

Y_i^* = Latent or Unobserved Variable of Economic Efficiency (EE) Scores

Y_i = Economic Efficiency (EE) Score (Number)

X_1 = Age (Years)

X_2 = Farming Experience (Years)

X_3 = Educational Level (Years)

X_4 = Household Size (Number)

X_5 = Fish Feed (Kg)

X_6 = Drugs (Naira)

X_7 = Fingerlings (Number)

X_8 = Pond Size (M^2)

ε_i = Disturbance Term,

$\beta_1 - \beta_8$ = Regression Coefficients,

β_0 = Constant Term,

This was used to achieve the specifically objective 4 (iv) and evaluate factors influencing EE of catfish production.

Principal Component Analysis

The constraints faced by catfish farmers as stated in the specific objective five (v) were subjected to analysis using the principal component model. The model will reduce the many interrelated constraints of catfish farmers into a few unrelated ones.

RESULTS AND DISCUSSION

Socio-Economic, Institutional and Farm-Specific Characteristics of Catfish Farmers

Table 1 presents the socio-economic, institutional and farm specific characteristics of the catfish farmers. The variables under consideration include: sex, age, household size, level of education, farm experience, capacity of fish pond, access to credit facilities, and access to extension contact. About 70% (98) of the catfish farmers are male, while 30% (42) are female. This is in contrary to the findings of Ogidan (2023) who reported that about 77% (159) are female catfish farmers, while 22% (46) are male. Also, the mean age of the catfish farmers is 39 years. About 37.14% of the catfish farmers falls within the age limit of 21 to 40 years, while 55.86% of them are between 41 to 60 years. This implies that the catfish farmers are young, agile, energetic, productive in their youthful age. This is in line with the findings by Olasunkanmi (2012) and Emakoro and Ekunwe (2009) who reported that fish farmers are young and agile. The household sizes are large, about 93% of the catfish farmers have households between 6 to 10 members. Furthermore, 90% of the catfish farmers have formal education, while 10% have non-formal education. This is in line with Alabi and Anekwe (2022[b]) who reported that educated farmers can adopt innovations and new farming techniques. They also have the boldness, courage and the technical know-how required to apply to banks or financial institutions for credit or loan facilities. Averagely, the catfish farmers have 7 years' experience in catfish farming. About 32% of the catfish farmers have between 1 to 5 years' experience, while 50% of them have between 6 to 10 years' experience.

Miassi et al. (2023) reported that as farmers grow older, they increase their farm experiences and production. Experience acquired as well as income accumulated over the years are the features that allow them to increase their production. The various kinds of utilized fish ponds include the following: concrete (8%), earthen (9%), tarpaulin (33%), cage (16%), and plastic (32%). The mean capacity of a fish pond is 1706 of catfish. About 50.72% of catfish ponds had a capacity between 1,000 to 2,000 of fingerlings. In addition, 44.29% of the catfish farmers have had access to credit facilities, while 55.71% had no access to credit facilities. In line with this study, Adebayo *et al*. (2014) reported that the poor access to credit facilities could result in insufficient funding because the catfish industry necessitates high capital expenditures in order to make a reasonable profit.

About 62.86 % of the catfish farmers had no contact with an extension agent, while 37.14% had made such contact. Extension officers disseminate new research findings, innovations, new farm technologies to farmers.

Analysis of Profitability of Catfish Production in the Study Area

The various costs incurred and the revenue obtained in catfish production was presented in Table 2. The costs incurred and the revenue obtained was calculated based on the prevailing price as at the time the field survey was conducted. The total revenue was calculated at 2, 571, 772 Naira, the total variable cost (TVC) and total fixed cost (TFC) was calculated at 1,685,521 Naira and 21, 229.14 Naira respectively. The TVC accounted for 98.76% of the TC, while the TFC accounted for 01.24% of the TC. The TVC include water (2.38%), fingerlings (0.70%), drugs (0.038%), feeds (61.04%), transportation (01.00%), electricity (01.29%), labour (18.40%), and fuel (0.04%). The TFC include land (0.33%), borehole (0.22%), building (0.16%), nets (0.24%), generator (0.18%), taxes and interests (0.10). The TC was calculated at 1,706, 750.63 Naira. The gross margin (GM) and net farm income (NFI) was estimated at 886, 250.51 and 865,021.37 Naira respectively. This implies that catfish production is profitable in the study area.

Table 1: Socio-Economic, Institutional and Farm-Specific Characteristics of CatfishFarmers

Variables	Frequency	Percentage	Mean
Sex			
Male	98	70.00	
Female	42	30.00	
Age (Years)			
1 – 20	14	10.00	39.07
21 – 40	52	37.14	(SD = 13.38)
41 – 60	74	52.86	
Household Size (Number)			
1 – 5	22	15.71	
6 – 10	93	66.43	
11 – 15	25	17.86	
Level of Education (Years)			
Primary	33	23.57	
Secondary	54	38.57	
Tertiary	39	27.86	
Non-Formal	14	10.00	
Farm Experience (Years)			
1 – 5	45	32.14	
6 – 10	70	50.00	7.28
11 – 15	25	17.86	(SD =3.47)
Types of Fish Ponds			
Concrete	12	08.57	
Earthen	13	09.29	
Tarpaulin	47	33.57	
Cage	23	16.43	
Plastic	45	32.14	
Capacity of the Fish Pond			
(Number)	07	05.00	
100 – 500	12	08.57	
501 – 1,000	30	21.43	1706.54
1,001 – 1,500	41	29.29	(SD = 631.6)
1,501 – 2,000	38	27.14	
2,000 – 2,500	12	08.57	
2,501 – 3,000			
Access to Credit Facilities	62	44.29	
Yes	78	55.71	
No			
Access to Extension Contact	52	37.14	
Yes	88	62.86	
No	**140**	**100.00**	
Total			

Source: Field Survey (2023) SD = Standard Deviation

Table 2: Costs, Returns, and Profitability of the Catfish Production per Cycle

Variables	Amount (₦)	Percentage TC (%)
Total Revenue (TR)	2,571,772	
Variable Cost		
(a)Water	43,324.14	02.53
(b)Fingerlings	121,171.33	07.09
(c)Drugs	64,874.21	03.80
(d)Feeds	1,041,720.74	61.04
(e)Transportation	17,074.31	01.00
(f)Electricity	22,081.21	01.29
(g)Labor	314,201.34	18.40
(h)Fuel	61,074.21	03.57
Total Variable Cost (TVC)	1,685, 521.49	98.76
Fixed Cost (Depreciation)		
Land	5,604.12	00.33
Borehole	3,743.17	00.22
Buildings	2,814.47	00.16
Nets	4,132.13	00.24
Generator	3,214.15	00.19
Taxes and Interest	1,721.10	00.10
Total Fixed Costs (TFC)	**21,229.14**	01.24
Total Cost (TC)	**1,706,750.63**	**100.00**
Gross Margin (GM)	886,250.51	
Net Farm Income (NFI)	865, 250.51	
Gross Margin Ratio (GMR)	0.35	
Rate of Return on Investment (RORI)	0.51	
Operating Ratio (OR)	1.90	

Source: Field Survey (2023) 1 USD = 850 Naira

The gross margin ratio (GMR) and rate of return on investment (RORI) was calculated at 0.35 and 0.51 respectively. The GMR of 0.35, implies that for every one Naira invested in catfish production, 35 kobo covered interest, taxes, expenses, depreciation and profits. These findings agree with Adeniyi *et al*. (2015); Edet *et al.* (2018); who reported that catfish production was a profitable enterprise.

Distributions of the Economic (EE), Technical (TE)and Allocative Efficiencies (AE) Scores among the Catfish Farmers

The frequency distribution of the EE, TE, and AE scores of the catfish farmers as obtained from the stochastic production efficiency frontier model is presented in Table 3. The mean EE, TE, and AE scores are 0.3705, 0.6189, and 0.5973 respectively. The frequency of occurrences of the predicted EE, TE, and AE ranges show that the highest number of catfish farmers have EE, TE and AE scores between 0.00 – 0.40, 0.61 – 0.80, and 0.61 – 0.80 respectively. This efficiency ranges of the catfish farmers represent 60%, 45.71% and 43.57% of the total frequency respectively. The minimum EE, TE and AE scores are 0.04, 0.07, and 0.07 respectively, while the maximum EE, TE, and AE scores are 0.95, 0.98 and 0.98 respectively. This means that on the minimum level, the catfish farmers were 4% economically efficient, while on the maximum level, the catfish farmers were 95% economically efficient. The result of the stochastic production efficiency frontier model indicates that the technical efficiency varied widely (with a standard deviation, 0.1815) among the catfish farmers with minimum and maximum values of 0.07 and 0.98 respectively. The wide variations in the technical efficiency values are indication of the inefficient use of resources; traditional technologies or crude implements are still used in the production process. There are wide opportunities for improving the current level of technical efficiency. While the catfish farmers were not utilizing their production resources efficiently, they were not obtaining maximum output from their given quantities of inputs. Also, the estimated allocative efficiency varied widely (a standard deviation 0.1892) among the catfish farmers with minimum and maximum values of 0.07 and 0.97 respectively. The wide variations in the allocative efficiency values are indication that the catfish farmers still allocate their resources inefficiently in the production process and there are still existing opportunities for improving their current level of allocative efficiency. As far as the catfish farmers were not minimizing production costs, they were utilizing the inputs in wrong proportions. This result is consistent with the findings of Onuche & Oladipo (2020) and Asogwa et al. (2011). In addition, the study revealed that for the minimum EE, TE, and AE of catfish farmers to become the most EE, TE and AE, they will need to realize about 95.8% $[(1-\frac{0.04}{0.95})\times 100]$ output level closer to the production frontier, which means the output is closer to the maximum output obtainable from the resources, 92.8% $[(1-\frac{0.07}{0.98})\times 100]$ output and minimization of wastage of resources to be able to achieve TE in catfish production, and 92.78% $[(1-\frac{0.07}{0.97})\times 100]$ minimum wastage of resources to be closer to the frontier.

Table 3: Distribution of Economic, Technical, and Allocative Efficiency Scores among the Catfish Farmers in the Study Area.

	Economic Efficiency		**Technical Efficiency**		**Allocative Efficiency**	
Efficiency Score	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
0.00 – 0.40	84	10.00	12	08.57	16	11.43
0.41 – 0.60	32	30.00	47	33.57	49	35.00
0.61 – 0.80	14	45.71	64	45.71	61	43.57
0.81 – 1.00	10	14.29	17	12.14	14	10.00
Mean	0.3797		0.6189		0.5973	
Standard Deviation	0.1918		0.1815		0.1892	
Minimum	0.04		0.07		0.07	
Maximum	0.95		0.98		0.97	

Source: Field Survey (2023)

Factors Influencing the Economic Efficiency of Catfish Production

The maximum likelihood estimates of the Tobit dichotomous regression model for factors influencing the economic efficiency of catfish production is presented in Table 4. About eight (8) variables are included in the Tobit regression model, the variables under consideration are age, farming experience, educational level, household size, fish feed, drugs, fingerlings, and pond size. All the variables have a positive coefficient. The variables fish feed, drugs, and fingerlings are significant at 1% probability level. The variables age, farming experience, educational level, and pond size are significant at 5% probability level. The coefficient of education level is positive (0.3702), this implies that 1%

increase in the educational level of catfish farmers, holding all other variables constant, will lead to 16.22% increase in the output of catfish farmers. The coefficient of the fish feed is positive (0.4109), this signifies that 1% increase in the quantity of the fish feed utilized, holding all other variables constant, will result in 48.02% of output. This is consistent with the findings of Ogidan (2023), and Ogunniyi *et al*. (2012). The chi-square value of 87.45 is significant at (P<0.01). This confirms that the economic efficiency model is correctly specified. The maximum likelihood estimates show that the Log Likelihood value is -121.45, the Chi square value is 87.45 which is significant at 1% probability level. The Pseudo R square is 0.8147, this implies that 81.47% of variations in the economic efficiency of catfish productions are explained by the predictor variables included in the Tobit regression model.

Table 4: Maximum Likelihood Estimates of the Tobit Dichotomous Regression Model

Variables	Parameters	Coefficient	Standard Error	t-Value	ME
Constant	β_0	0.7214**	0.2585	2.79	0.0514
Age	β_1	0.3851**	0.1351	2.85	0.0507
Farming Experience	β_2	0.1472**	0.0551	2.67	0.1401
Educational Level	β_3	0.3702**	0.1327	2.79	0.1622
Household Size	β_4	0.1102	0.1091	1.01	0.0108
Fish Feed	β_5	0.4109***	0.1084	3.79	0.4802
Drugs	β_6	0.3902***	0.1112	3.36	0.4721
Fingerlings	β_7	0.3761***	0.1119	2.59	0.4431
Pond Size	β_8	0.3324**	0.1283	2.79	0.3291
Diagnostic Statistics					
Sigma	0.07521				
LR_{χ^2} (8)	87.45***				
Pseudo R^2	0.8147				
Log Likelihood	-121.45				
Prob $>_{\chi^2}$	0.00000***				

Source: Field Survey (2023), ME=Marginal Effect
*Significant at $(P < 0.10)$., **Significant at $(P < 0.05)$, ***Significant at $(P < 0.01)$.

Constraints Encountered by Catfish Farmers

Table 5 presents the constraints encountered by the catfish farmers in the study area. About eight (8) constraints with Eigen-values greater than one were retained by the principal component model. The lack of credit facilities with Eigen-value of 3.7041 is ranked 1st based on the perceptions of the catfish farmers. This explained that 37.19% of the variables retained by the model, the high cost of fingerlings and the high cost of feeds with Eigen-values 2.8172 and 2.6854 are ranked 2nd and 3rd respectively. The high cost of fingerlings and the high cost of feeds explained 17.52% and 7.86% of all constraints retained by the principal component model. The components captured in the model accounted for 79.39% of the variations in the constraints included in the model. At 1% level of significance, the Kaiser-Meyer-Olkin tests of sampling adequacy (KMO) of 0.6475, demonstrated the feasibility of using the data set for factor analysis. Many fish farmers encountered problems that need to be addressed in their large-scale or small-scale businesses. They need good skills in management, accounting and marketing to be able to address some of the problems. Other problems reducing the business profits of fish farmers are the following: flooding, poaching, diseases, high mortality, water scarcity, poor management practices and marketing (Tavares-Dias & Martins 2017).

Table 5: Constraints Faced by Catfish Farmers

Constraints	Eigen-Value	Difference	Proportion	Cumulative	Rank
Lack of Credit Facilities	3.7041	0.8869	0.3719	0.3719	1st
High Cost of Fingerlings	2.8172	0.1318	0.1752	0.5471	2nd
High Cost of Feeds	2.6854	0.2793	0.0786	0.6257	3rd
Problem of Pest, Diseases and Predators	2.4061	0.3897	0.0610	0.6867	4th
Lack of Access to Markets	2.0164	0.3877	0.0478	0.7345	5th
Lack of Access to Land	1.6287	0.7140	0.0594	0.7939	6th
Bartlett Test of Sphericity					
Chi Square	3147.24				
KMO	0.6475				
Rho	1.0000				

Source: Field Survey (2023)

CONCLUSION

This study has established that the catfish production is profitable in the study area. The catfish farmers are mostly male, young, agile, and productive with an average age of 39 years. The average capacity of a fish pond is 1,706 fingerlings. The gross margin and the net farm income of catfish production are 886, 250.51 Naira and 865,021.37 Naira respectively per production cycle. The mean economic, technical and allocative efficiencies are 37.97%, 61.89% and 59.73% respectively. The inefficiency gaps of EE, TE and AE among catfish farmers are 63.03%, 38.11% and 40.27% respectively. Among the significant factors influencing the economic efficiency of catfish production are age, farming experience, fish feed, drugs, fingerlings, and pond size. The constraints include lack of credit facilities, high cost of fingerlings, high cost of feeds, problem of pests, diseases and predators, lack of access to markets, and lack of access to land. Based on the findings of this study, the following recommendations are made:

(i) Credit facilities should be provided for catfish farmers at a low interest rate devoid of cumbersome administrative procedures,

(ii) Catfish farmers should be encouraged to form cooperative societies for easy access to credit facilities and farm inputs

(iv) Feeds, fingerlings, drugs, chemical inputs should be made available to catfish farmers at affordable prices.

(v) The catfish farmers should be provided with easy access to land input for achieving a high productivity and efficiency.

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