International Journal of Agricultural Science, Research and Technology in Extension and Education Systems (IJASRT in EESs)
Available online on: http://ijasrt.iau-shoushtar.ac.ir
ISSN: 2251-7588 Print
ISSN: 2251-7596 Online
2024: 14(4): 229-239

Received: 02 September 2024
Reviewed: 25 October 2024
Revised: 05 November 2024
Accepted: 20 December 2024

Technical Efficiency of Homestead Fish Production in the Coastal Communities

Olaniran Anthony Thompson[1], Lawrence Olusola Oparinde[1], Olaitan Olubunmi Olajuyigbe[2], Ebinimi Joseph Ansa[3] and Taiwo Timothy Amos[1]

[1]Department of Agricultural and Resource Economics, Federal University of Technology, P.M.B. 704, Akure 0034, Ondo State, Nigeria.
Corresponding Author: looparinde@futa.edu.ng
[2]Nigerian Institute for Oceanography and Marine Research, Victoria Isaland, Lagos. P.M.B. 12729, Victoria Island, Lagos
[3]African Regional Aquaculture Centre/Nigerian Institute for Oceanography and Marine Research, Aluu, River State, Nigeria.

Abstract

The manuscript examines the demography features of homestead fish farmers, measure the profitability of homestead fish production, estimate the technical efficiency of homestead fish farmers and examine the limitations connected with homestead fish production in the area of study. 180 homesteads fish farmers were selected from three coastal areas of Delta, Lagos and Ogun State in Nigeria. Demography features of homestead fish farmers in the area of study was analysed with descriptive statistics. Net Profit Margin Ratio (NPMR) was estimated to quantify the profitability of homestead fish production. Cobb Douglas stochastic frontier production function was employed to evaluate the efficiency (Technical Efficiency) of homestead fish farmers. Inefficiency model was employed to ascertain the variables inducing inefficiency of homestead fish farming in the study area. The manuscript reveal that homestead fish production is lucrative in the area of study. Cost of feeds is the most crucial cost in the homestead fish production in the area of study. The manuscript shows that few (28.3%) homestead fish farmers were operating in an optimum technical efficiency above 70% and educational level and farm experience of the homestead fish farmers were among the variables that determine the technical inefficiency of homestead fish production in the area of study. High cost of feeds and inadequate fund were among the major limitation facing the homestead fish farmers in the area of study. Therefore, it is suggested that homestead fish farming should be promoted, because it is lucrative.

Keywords: Homestead Fish Production, Coastal Communities, Technical Efficiency, Cobb Douglas stochastic frontier production

1. Introduction

There is an urgent need to ameliorate nutrition deficiency in Nigeria and most emerging countries of World. Fish has been discovered to be one of the cheapest means of arresting this awkward situation (Adeyemi et al., 2023). The importance of fish in providing sustainable animal protein cannot be overemphasized among Nigerian households. Insufficient supply of fish in Nigeria is one of the major problem that has led to importation of fish. Though, there are several programmes and projects to increase domestic supply of fish in the country, however, the impact of such programmes and projects are yet to be felt (Boyd et al., 2022). There is need to intensify the efforts to increase domestic fish supply in Nigeria, hence, the need to encourage homestead fish production to reduce the gap between supply and demand for fish in Nigeria. The population growth rate of 3.8% and 15% children under five years' risk of acute malnutrition in Nigeria, government at all levels need to harness all possible means to ensure availability and sustainability of animal protein (Desyibelew et al., 2020). Several children (> 5 years) in Nigeria do not have access to sufficient protein, especially children living in the rural area of Nigeria (Egbon et al., 2022). Reasonable percentage (over 80%) of total domestic fish production in Nigeria is from artisanal small fisher folks in the riverine communities of Nigeria (Odioko and Becer, 2022). However, due to climate change and oil pollution in the area, most fisher folks

are augmenting fish catch with homestead fish production (Danet et al., 2024). From existing data, there was an increased in fish catch from 467,095 metric tons in 2000 to 817,516 metric tons in 2010 in Nigeria. By 2015, fish catch was 1,027,058 metric tons and 1,080,855 metric tons in 2021 (Thompson et al., 2024). However, fish catch increase is yet to lessen the gap between demand and supply. The amount spent on fish importation in Nigeria is huge and seriously affecting the foreign trade balance (Odioko and Becer, 2022). As known all over the world that agriculture entails production of crops, breeding of livestock and forest nurturing which are very germane to the economy of Nigeria and other nation of the world (FAO, 2023). Most rural dwellers which accounts for 65.73% of the Nigeria population are involved in agricultural value chain (i.e. input dealer, production, processing and marketing) (Adigun and Olaniran, 2021). Thus, the sector is adding judiciously to the Nigeria economy. Hence, agricultural sector of the Nigeria economy is very germane to the economic development of the country. Its contribution to the supply of raw materials for the Small and Medium Scale industries can be underestimated neither can its contribution to the foreign exchange earning can be underplayed (Adegboyo et al., 2021).

Homestead fish farming which is aquaculture fish farming on a small scale that is operating within close boundaries. It enhances food security, contribute to self-reliance and livelihood sustainability (Verdegem et al., 2023). Taking these prospects into consideration offer motivation and understanding of homestead fish farming among the rural and urban dwellers. Homestead fish production offers a reliable source of nourishing food to achieve the Sustainable Development Goals (SDGs) 2 which is zero hunger (Thilsted, 2021). Homestead fish production can be designed to operate in accord with the environment, decreasing the influence on biodiversity (Moss, 2023). Homestead fish farming give room for accountability of resources and sustainable practices like efficient use of water, reduction in carbon footprint, and waste management control (Jiang et al., 2022)**.** Incorporating homestead fish farming into livelihood system enable individuals to boost their economic self-reliance. This improved self-sufficient becomes apparent during times of uncertainty, such as unusual tragedies or interruptions in the supply chain of food (Ignowski et al., 2023). Therefore, the manuscript examines the demography features of homestead fish farmers, measure the profitability of homestead fish production, estimate the technical efficiency of homestead fish farmers and examine the limitations connected with homestead fish production in the area of study.

2. Materials and Methods

2.1 Sample and Sampling Techniques

A multi-stage sampling method was utilized for the research. Coastal communities of Nigeria were selected because of large number of homestead fish farmers. Three states namely Delta, Lagos and Ogun State were intentionally sampled because the three states account for 53.1% of homestead fish production in the coastal areas of Nigeria (National Bureau of Statistics (NBS), 2023). From each state; two Local Government Areas (LGAs) that are known for homestead fish production were deliberately chosen for the research. In each LGA, three communities that are known for homestead fish production were chosen for the study and in each community, 10 homestead fish farmers were chosen for the research. Therefore, 180 homestead fish farmers were selected for the study. The area of study is as shown in Table 1.

Table 1. Area of Study

SN	State	Local Government Areas	Communities	Number Sampled
1	Delta	Sapele	Arun-owun Zion Community	10
			Arun	10
			Pontu	10
		Warri North	Abigborodo	10
			Koko II	10
			Koko III	10
2	Lagos	Epe	Afuye	10
			Ebute Afuye	10
			Epe	10
		Yaba/Lagos Mainland	Makoko	10
			Ebute Akoka	10
			Ebute Bariga	10
3	River	Andoni	Ajakajak	10
			Samanga	10
			Ibotirem	10
		Bonny	Ajokolo 1	10
			Agiokolo 2	10
			Lighthouse	10
Total				180

2.2 Sample Analysis

Diverse analytical methods were employed to analyse the data collected from the field. Demography features of homestead fish farmers in the area of study was analysed with descriptive statistics. Net Profit Margin Ratio (NPMR) calculation was done to quantify the profitability of homestead fish production in the area of study. The NPMR is calculated thus:

$NI = TR - TC$ (1)

$NPMR = \frac{NI}{TR} \times 100$ (2)

Where:

NI = Net Income

TR = Total Revenue

TC = Total Cost (TVC + TFC)

Cobb Douglas stochastic frontier production function was employed to evaluate the technical efficiency of homestead fish farmers while efficiency model was employed to ascertain variables inducing efficiency of homestead fish farming in the area of study. The technical efficiency is stated thus:

$InY = \alpha_0 + \alpha_1 InP_1 + \alpha_2 InP_2 + ---- + \alpha_n InP_n + (V_i - U_i)$ (3)

Where;

InY = Quantity of homestead fish produced (Table size).

P_1 = Pond size (Cubic meter)

P_2 = Feeds (Kg)

P_3 = Fertilizer (Kg)

P_4= Lime (Kg)

P_5 = Net (number)

P_6 = Fingerlings (number)

α_1 - α_n = Coefficients of parameters estimated

α_0 = Intercept

V_i = Random statistical disturbance term which captures the effects of weather and other factors outside the control of the homestead fish farmers.

U_i = homestead fish farmers' specific characteristics related to production inefficiency.

Inefficiency model was employed to ascertain the variables inducing the homestead fish farmers' technical inefficiency in the study area (Aremo and Thompson, 2023). The model is specified as:

$U_{ij} = \delta_0 + \delta_1\omega_1 + \delta_2\omega_2 + \delta_3\omega_3 + \delta_4\omega_4 + ----------+ \delta_n\omega_n + \mu$ (4)

U_{ij} = technical inefficiency of the ith homestead fish farmer and jth observation of the homestead fish farmer.

ω_1 = Age (years)

ω_2 = Age^2 (years)

ω_3 = Gender (1 = male; 0 = female)

ω_4 = Marital Status (married = 1 and 0, otherwise)

ω_5 = Educational level (years)

ω_6 = homestead fish farming experience (years)

ω_7 = Pond size (Cubic meter)

ω_8 = Family labour (man day)

ω_9 = Access to credit (yes = 1, otherwise = 0)

ω_{10} = Household size (number)

ω_{11} = Association/Cooperative membership (yes = 1, otherwise = 0)

δ_0 = Constant

$\delta_1 - \delta_n$ = Unknown parameters to be estimated

μ = Error term

δ's, β's, γ coefficients are unknown variables to be evaluated with other variables which are expressed in terms of

δs^2 (sigma square) = $\delta v^2 + \delta u^2$

γ (gamma) = $\frac{\delta u^2}{\delta s^2}$

The "γ" variable has value between zero and one, ($0 \leq \gamma \leq 1$). The variables of stochastic frontier production function (SFPF) model were obtained by maximum likelihood evaluation technique using computer programme, frontier version 4.1

To investigate and decide the significant limitations encountered by homestead fish farmers in the area of study, 4-points Likert Rating Scale (LRS) was employed to describe how vital the limitations were to the homestead fish

farmers in the area. The 4-point LRS ranges from 1 to 4 (I.e. Very serious, serious, mild and not at all). Relative Important Indices (RII) was employed to ascertain the vital limitations. The RII equation is as follows:

$$RII = \frac{\varepsilon W}{AN} \quad (5)$$

Where:

W is the weighting given to each problem by respondents (1 to 4)

A is the highest weight (4 in this case)

N is the total number of respondents

3. Results and Discussion

3.1 Socioeconomic Characteristics

Descriptive statistics of the homestead fish farmers in the area of study is shown in Table 1. From the Table, 66.0% of the respondents were male, showing that 34.0% were female. This buttress the findings of Hossain et al., (2024) that homestead fish farming in most emerging countries of the world are mostly undertaking by male and females because it is done within accessible environment and under control environment, hence, it is not stressful. The mean age of almost 55 years attest to the fact that most of the respondents are close to sixty (60) years. Though they are in their active age but mostly above fifty years, they are into homestead fish farming to enhance their livelihood. So, homestead fish farming is an additional source of income. This buttress the findings of Al Mahadi et al., (2022) that most homestead fish farmers in less developed countries have other sources of income like the case of Bangladesh.

Most (75.0%) of the respondents are highly educated as shown in the Table. They are graduates of University or other Higher Institutions (HI), appropriation of knowledge gained from training, seminars and workshop will be enhanced. They will make excellent use of their research findings, adoption of new innovation and technology will be very easy for them. Applying knowledge gained from reading scientific journals and articles on how best to improve homestead fish production will be very easy. Ninh, (2021) confirmed that there is positive relationship between educated farmers and their efficiency as observed in findings from Vietnam. Mean household size of the respondents was six (6). The mean household size of six (6) lay credence to use of family labour, most especially when they homestead fish farming is not in large scale. Most homestead fish farmers make use of their domestic servants such as house-help and gateman to work in their homestead fish farm. According to Mabika and Utete, (2024), most small scale homestead fish farmers are risk averter, hence, they do not invest much into the agribusiness as the case of homestead fish farmers in Zimbabwe. About 92.2% of the homestead fish farmers interviewed were married. There is likelihood of husband and wife involvement in the farming business. In most cases, the woman will often involve in value addition, such as smoking and packaging to sell. The production aspect of the value chain lies within the purview of the husband, and the value addition and marketing aspect lies within the purview of the wife. This is in tandem with the findings of Akyuz et al., (2923), that the value chain (i.e. production, processing, packaging and marketing) of agricultural produces in most developing countries revolve within the family. Since they are peasant farmers who cannot produce on large scale because of lack of finance and technology.

More than 70% of the respondents had less or equal 15 years' experience of homestead fish farming with mean homestead fish farming experience of 15.1 years. This presume that the respondents are not greenhorn in the business of homestead fish farming. Therefore, they are knowledgeable in the act of homestead fish farming. Nelson et al., (2023) suggested that the more experience a farmer is in farming, the more knowledgeable he/she will be in the act. Therefore, the more his/her efficiency, because farming is act that require mastery overtime. The mean pond size of 1,320m^3 of the respondents reveals that they are small scale homestead fish farmers according to Thompson et al., (2022). Most homestead fish farmers in Nigeria are most small scale fish farmers unlike their counterpart in the developed countries of the World. Less than 27.2% of the respondents are member of an association or cooperative society. This is not a good development, Majority (72.8%) will not have access to pricing and marketing information, credit facilities and extension agents. This is one of the key benefits of belong to an association of cooperative organization (Nelson et al, 2023). This is buttress with just 20.0% of the respondents having access to credit facilities. It is always easier for financial organisations to support farmers through credit facilities. Credit recovery is stress-free with farmers-based association or cooperative (Thompson et al., 2022).

3.2 Estimation of profitability of homestead fish production in the study area.

As presented in Table 2, mean Total Revenue (TR) of respondents was ₦979,400 ($890,36). The mean homestead fish quantity sold by the respondents was 236kg fish in a year in two cycles. The mean price of 1kg fish in the area of study was ₦4150 ($3.77) directly from the homestead fish farmers. The mean quantity of feeds used by the farmers was 15 bags per annum. The cost of feeds is the most important cost in homestead fish production accounting for 76.45% of the Total Cost (TC). The commonest starting feed for homestead fish production in the study area was allerqua, while blue crown was used in grower stage and eco float was to finish production. Some of the materials used in compounding the feeds are imported, the average price per bag was ₦28,500 ($25.91).

Table 2. Homestead Fish Farmers' Socioeconomic Characteristics

Variable	Homestead Fish Farmers' Key Socioeconomic Characteristic Values	
	Mean	Dominant Indicator
Distribution of Respondents by Sex		66.0 were male
Age	54.8	91.7% falls below or equals 55 years (active)
Education Level		75.0% had Higher Institution education (B.sc/HND)
Household Size (Number)	6	84.5% between 1and 6 persons
Marital Status		92.2% married
Fish Farming Experience (Years)	15.1	73.3% less or equal 15 years
Pond Size (Square M^2)	1,320m^3	75.5% had more than or equal to 1,130m^3
Membership of Cooperative/Association		27.2% belong to cooperative society or association
Access to credit		20.00% of the respondent claimed they have access to credit

Note: \$1 = ₦1100 official Central Bank of Nigeria (CBN) rate as at the time of this study.

In June 2023, there was about 100% increase in the price of the feeds, which was due to the Central Bank of Nigeria (CBN) unification of all segments of the forex market by ensuring one single window exist. This was one of the reform in the monetary policy of the Nigeria government to ensure improvement in foreign exchange market, enhance its liquidity and stability (Central Bank of Nigeria (CBN), 2023). In Nigeria, there were two windows to access dollars, pounds and euros which are black market and CBN which is regarded as official. So, this has cost upsurge in the price of the feeds and is impacting negatively on the production cost of homestead fish in Nigeria.

From Table 2, the operating cost which is the Total Variables Costs (TVCs) was ₦476,700 (\$433.36) which accounted for 85.25% of the respondents' total cost of homestead fish production in the area of study. The Total Fixed Cost (TFC) which include depreciation cost of pond and net was ₦82,500 (\$75.00) which accounted for 14.75% of the total cost of homestead fish production. The Gross Margin (GM) and the Net Income (NI) of the respondents was ₦502,700 (\$457.00) and ₦420,200 (\$382.00). This buttress the findings of Bolarinwa and Fakumoju, (2020) that homestead fish farming is profitability. Though most of the respondents are on different economic of scale production, on the average, homestead fish farming was profitable. To quantify the efficiency of capital invested on homestead fish production by the respondents, profitability analysis which is the best techniques was used (Thompson et al., 2024). So, Net Profit Margin Ratio (NPMR) which show the full picture of firm efficiency showing returns on investment for any firm and give room to compare performance between two or more firms overtime was estimated.

The net profit margin ratio with higher value shows higher return on the capital invested on the homestead fish production. Therefore, the net profit margin ratio with higher value means that the firm was able to increase its sales and reduce its operating expenses. So, 42.90% Net Profit Margin Ratio (NPMR) of the respondents reveals that homestead fish farmers were operating at their optimum. The expected minimum standard value of NPMR of any efficient business is 25% (Parker, 2022).

3.3 Estimate Results of Stochastic Production Function

The maximum likelihood result evaluation of stochastic production function is presented in Table 4. The significant and high values of sigma square (δs^2) shows a goodness of fit and correctness of distributional form presumed for the composite error term in the model. Again, 0.983 gamma (γ) value was significant statistically showing that about 98% residual variation in homestead fish production, which cannot be explained by the function, was due to inequality in inputs and technology. Based on this peculiar feature of stochastic production function, it is the most suitable model for this analysis. The ordinary least square (OLS) estimate cannot explain inefficiency differentials among the homestead fish farmers' in the area of study. While the Wald Chi-Squared is a way to find out if explanatory variables in a model are significant.

As shown in Table 4, the coefficient of fingerlings and feeds quantity were significant and had positively relationships with the quantity of homestead fish produced in the area of study. This implies that increase in these variables would lead to increase in homestead fish production. The quantity of feeds is statistically positive and significant at 1% showing that production of homestead fish is positively correlated with the quantity of feeds used in the area of study. Therefore, the more the quantity of feeds used by the homestead fish farmers', the more the quantity of homestead fish produced. This is in line with the findings of Kong et al., (2022) that there is positive correlation between the quantity of feeds and quantity of aquaculture fish produced, based on his finding in Taiwan. Thus, 1% increase in the feeds used by the homestead fish farmers would lead to an increase of 59.94% in output of homestead fish in the study area.

Table 3: Average Estimated Costs and Returns of Homestead Fish Production Per Year

Item of Cost	Quantity	Unit Cost ₦	Total Revenue ₦ $	
A. Revenue	236.00kg	₦4150/kg	979,400	
Quantity of fish sold			890.36	
Item of Cost	Quantity	Unit Cost ₦	Total Cost ₦ $	% of TC
B. Variable cost				
Fingerlings	280	65	18,200 16.55	3.25
Feeds	15bags	28,500 per bag	427,500 388.64	76.45
Net	2	7,500	15,000 13.64	2.68
Fertilizer			8,200 7.45	1.47
Lime			7,800 7.09	1.39
Total Variable Costs (TVC)			476,700 433.36	85.25
Gross Margin (GM)			502,700 457.00	
C. Fixed cost				
Depreciation (ponds/equipment)			79,500 72.27	14.21
Depreciation (Net)			3,000 2.73	0.54
Total Fixed Cost (TFC)			82,500 75.00	14.75
Total Costs (TC) (B+C)			559,200 508.36	
Net Income			420,200	
C - (A+B)			382.00	
Net Profit Margin Ratio = NI/TR x 100			42.90%	

Note: $1 = ₦1100 official Central Bank of Nigeria (CBN) rate as at the time of this study.

Table 4. Maximum Likelihood Estimate of Stochastic Production Function

Variable	Parameter	Coefficient	Stand. Error	T-value
Constant	P_0	2.8714***	0.7507	3.82
InFingqty	P_1	0.2843**	0.1392	2.04
InFeedqty	P_2	0.5994***	0.1312	4.57
InPondqty	P_3	0.1666	0.2713	0.61
InNetqty	P_4	0.0094	0.2647	0.04
InFertqty	P_5	-0.2049	0.5813	-0.35
InLimeqty	P_6	-0.5780	0.3961	-1.46
$InSig^2v$	δ^2_v	-2.9563**	1.3848	-2.13
$InSig^2u$	δ^2_u	0.5419**	0.3205	1.69
Gamma	γ	0.983***	0.1011	9.7230
Number of Observation = 180				
Wald $chi^2(3)$ = 149.53				
Prob>chi2 = 0.0000				
Log likelihood = -60.190				

Equally, the evaluated value of quantity of fingerlings is statistically positive and significant at 5% showing that output of homestead fish production is positively correlated with increase in the quantity of fingerlings used in the area of study. This supports the findings of Hamilton et al., (2022) that increase in seedlings (fingerlings) in farm activities is directly proportional to increase in farm output. So, increase in the quantity of seedlings (fingerlings) will lead to increase in farm output ceteris paribus (all other things been equal). Therefore, 1% increase in the quantity of fingerlings used would lead to 0.28.43% increase in output of homestead fish produce in the area of study.

3.4 Technical Efficiency Analysis Results of Homestead Fish Farmers

Technical efficiency which is connected with the probability of a firm producing at optimal level of output from a given bundle of inputs or producing certain output at a minimal cost. Therefore, technical efficiency implies a firm making maximum use of its inputs optimally (ter Bogt, 2021).

3.4.1 Technical Efficiency Analysis Results of Homestead Fish Farmers

The Technical Efficiency (TE) result is presented in Table 5. TE of the homestead fish farmers ranges between 0.158 and 0.912. From the Table, about 38.3% of homestead fish farmers were technically efficient because they were operating at 60% or above 60% technical efficiency level (Ahimbisibwe et al., 2024). According to Zwilling (2024), for a farm business to be efficient, such farm business must be operating at least 60% technical efficiency. Very few (3.3%) of homestead fish farmers attained between 90% to 99% technical efficiency, 13.3% of them attained between 80% and 89%, and about 11.7% of them attained between 70% to 79% technical efficiency. The finding shows that few (28.3%) homestead fish farmers were operating in an optimum technical efficiency above 70%. This infer that such were making optimum use of capital and labour to achieve an increase output. Such homestead fish farmers were making effective use of their inputs to achieve maximum output (Aremo and Thompson, 2023). The Total Physical Productivity (TPP) increases at increasing rate.

The average technical efficiency of the homestead fish farmers in the area of study was 49.9% which implies that on the average, homestead fish farmers were able to obtain 49.9% level of optimal output from a given set of inputs. The implication of this result is that an average homestead fish farmer needs about 10.1% and 20.1% cost savings to attain efficiency and optimum efficiency status. The least and highest efficiencies were 13.9% and 91.3% respectively. The least homestead farmer needs about 46.1% cost savings to become an efficient business firm. This support the assertion of Dhillon and Moncur, (2023) that in most developing countries due to policy instability, most of the agribusiness are not attaining expected sustainable efficiency level. In most cases, they are in stage III in their production function. Their Total Physical Productivity (TPP) decreases at increasing rate. This collaborate the result on Table 5, that the respondents on the average are technically inefficient.

Table 5. Distribution of Technical Efficiency among Homestead Fish Farmers

TE	Frequency	Percentage (%)
< 2.0	31	17.2
0.20 – 0.29	14	7.8
0.30 – 0.39	28	15.6
0.40 – 0.49	14	7.8
0.50 – 0.59	24	13.3
0.60 – 0.69	18	10.0
0.70 – 0.79	21	11.7
0.80 – 0.89	24	13.3
0.90 – 0.99	6	3.3
Total	180	100
Mean	0.4987	

Minimum = 0.139. Maximum = 0.913. Standard Deviation = 0.213.

3.4.2 Estimate Results of Factors Influencing Technical Inefficiency of Homestead Fish Production

As revealed in Table 6, 0.897 is the value of R square showing that 89.7% of variation in the efficiency of homestead fish production was accounted for by the explanatory variables in the model and the remaining 10.3% was explained by the random error. The significance value of F which is 5.419 shows that the explanatory variables exerted significant influence on the efficiency of homestead fish production jointly in the area of study.

The technical inefficiency model shows that marital status, educational level, homestead fish farming experience, pond size and access to credit made negative and significant contributions to the inefficiency of homestead fish production in the area of study. This shows that as these variables decreases the inefficiency of homestead fish

production increases in the area of study. From Table 6, marital status was negative and 10% significant with the inefficiency of homestead fish farmers in the area of study. This tally with findings of Agrawal and Jaggi, (2023) that most small scale farmers often make use of their family members as labour to cut cost of production in most emerging countries like Nigeria. Therefore, a unit decrease in the number of married homestead fish farmers will lead to 22% increase in technical inefficiency of homestead fish farmers in the area of study.

Educational level of the homestead fish farmers was negative and 5% significant. A unit decrease in the educational level of the homestead fish farmers in the area of study will lead to 28.40% increase in their technical inefficiency. So, the more educated the homestead fish farmer are, the higher their technical efficiency. According to Workalemahu and Mume, (2021), education enhances the production capability of farmers, it widens their horizon with respect to knowledge and ability to make use of research findings. Homestead fish farming experience was negative and significant at 1% level of significance. Indicating that a unit decrease in the homestead fish farming experience will lead to 60.18% increase in their technical inefficiency. Farming experience is very important, the more experience a farmer is in planting or cultivating a particular crops or livestock, the higher his/her technical efficiency (Gwazani et al., 2022). Mastery of agricultural good practices is a function of experience and this often translate to higher technical efficiency among farmers.

The pond size was significant negatively at 10% level of significance. This buttress the findings of Khan et al., (2024) that the bigger the pond size of an aquaculture farmer, the higher the technical efficiency of such farmer. Therefore, a unit decrease in the pond size of the homestead fish farmers in the area of study will lead to 34.32% increase in their technical efficiency. Likewise, there was negative and significant relationship between technical inefficiency of homestead fish production and access to credit facilities at 5% level of significance. Therefore, a unit decrease in access to credit will lead to 28.09% increase in technical inefficiency of homestead fish production in the area of study. This buttress the assertion of Eyayu et al., (2023) that access to credit facilities often boost the effective and efficient farming activities. It enables farmers to buy inputs in bulk and at cheaper rate, its enhance access to inputs at the appropriate.

Table 6. Determinant of Factors Influencing Efficiency of Homestead Fish Production

Variables	Parameters	Coefficients	Standard Errors	T- values
Constant	δ_0	2.5692*	0.6719	3.8238
Age	ω_1	0.0269	0.5410	0.05
Age^2	ω_2	0.0737	0.1501	0.49
Gender	ω_3	-1.0776	0.6755	-1.60
Marital Status	ω_4	-0.2200 *	0.0940	2.34
Educational level	ω_5	-0.2840**	0.0899	3.16
Homestead fish farming experience	ω_6	-0.6018***	0.1245	4.83
Pond size	ω_7	-0.3432*	0.1437	2.39
Family labour	ω_8	0.8643	0.7686	-1.12
Access to credit	ω_9	-0.2809**	0.0905	3.10
Household size	ω_{10}	-0.0125	0.0252	-0.05
Association/Cooperative membership	ω_{11}	1.1029	0.2331	4.73***
R - Squares		0.897		
F-value Statistics		5.419**		

***Significant at 1%, **Significant at 5%, *Significant at 10%

3.5 Estimate Results of Constraints Facing Homestead Fish Farmers in the Study Area

Table 7 shows the ranks of Relative Importance Index (RII) of the limitations faced by homestead fish farmers in the area of study. The Table revealed that high cost of feeds (99.03) was the major constraints facing the homestead fish farmers in the area of study. This aligns with assertion of Islam et al., (2023) that one of the critical problems hindering homestead fish production in developing countries is unstable price of inputs such as feeds. Inadequate fund (96.81%) was the second most important constraint facing homestead fish farmers in the study area. Availability of fund in farming activities is very important, farmers both crop and livestock farmers needs fund as at when due to produce optimally. Why most farmers in emerging countries of the World cannot compete with farmers from developed countries is lack of adequate fund, innovation and technology (Zwilling, 2024). The third main constraint facing homestead fish farmers (93.06%) in the area of study was Shortage of improved seeds (Fingerlings). According to the farmers, most times they are deceive to buy fingerlings that have stunted growth. So, when the farmers hope to sell within six (6) months, such fingerlings will not grow to Table size that will enable the farmer to sell at the expected Table size price. Therefore, farmers' projection will be distorted and very frustrating (Hamilton et al., 2022).

Lack of structural market (88.76%). Organized market for agricultural produce often shields the farmers from been ripe off by the middlemen who are the beneficiaries of the lack of structural market for agricultural produces in an emerging economy like Nigeria (Agrawal and Jaggi, 2023). Homestead fish farmers often labour for the middlemen who buy in bulk at farm gate (cheaper) price and sell to restaurants and hotels at almost double price. Extension services in agricultural activities is very crucial. Lack of access to extension agents (84.31%) was another problem militating against the homestead fish farmers in the area of study. Extension agents guide the farmers on good agricultural practices, introduce new innovation and technology to them, encourage them to embrace research findings and teach them how best to apply such research finding (Eyayu et al., 2023). According to most them, they could not afford the services of an extension agents, because they small scale homestead fish farmers. Poor water quality (82.78%) was another major constraint facing the homestead fish farmers in the study area. Most of the homestead fish farmers make use of runoff water, stream water and well water, these water are not treated water which often affects their productivity buttressing the findings Mabika and Utete, (2024) that untreated water is inimical to homestead fish production.

Table 7. Distribution by Rank of Constraints Faced by Homestead Fish Farmers

Constraints	Very serious (4)		Serious (3)		Mild (2)		Not at all (1)		RII	Rank
	Freq	%	Freq	%	Freq	%	Freq	%		
High cost of feeds	173	96.11	7	3.89	0	0	0	0	99.03	1st
Inadequate fund	157	87.22	23	12.78	0	0	0	0	96.81	2nd
Shortage of improved seeds (Fingerlings)	140	77.78	30	16.67	10	5.56	0	0	93.06	3rd
Lack of structural market	127	70.56	25	13.89	28	15.56	0	0	88.76	4th
Lack of access to extension agents	86	47.78	75	41.67	19	10.56	0	0	84.31	5th
Poor water quality	112	62.22	30	16.67	20	11.11	18	10.0	82.78	6th

4. Conclusion and Recommendations

Homestead fish production which is cultivating fish in a control environment and is becoming popular in Nigeria, most especially in the coastal communities of the country. The study reveal that homestead fish production is profitable (Above the expected margin of 25%) in the study area. Cost of feeds is the most important cost in the homestead fish production in the area of study. Quantity of feeds and fingerling were among the variables that positively influence the quantity of homestead fish production in the coastal communities of Nigeria. The study shows that few (28.3%) homestead fish farmers were operating in an optimum technical efficiency above 70% and educational level and farm experience of the homestead fish farmers were among the variables that determine the technical inefficiency of homestead fish production in the area of study. High cost of feeds and inadequate fund were among the major constraints facing the homestead fish farmers in the study area.

Therefore, it is recommended that homestead fish farming should be promoted, because it is profitable. In doing so, government at all levels, non-governmental organisations and other international organisation who are interested in intervening in fisheries sector of Nigeria should consider how best to reduce the cost of feeds, ensure good fingerlings are produced to the homestead fish farmers at reasonable and affordable prices. Homestead fish farmers should be encouraged to develop themselves educationally, this will reduce their technical inefficiency. Homestead fish farmers should be assisted by giving the opportunity to access credit facilities at minimal interest, this will boost their technical efficiency and improve their productivity.

Acknowledgement:

The authors acknowledged the funding received from the Tertiary Education Trust Fund (TETFund) through the 2022 National Research Fund (NRF) grant for this study (TETF/DR&D/CE/UNI/AKURE/IBR/2022/VOL.II). The Federal University of Technology, Akure, Nigeria is also appreciated for providing a conducive environment & facilities support.

References:

1. Adegboyo, O.S., Keji, S.A. and Fasina, O.T. (2021). The impact of government policies on Nigeria economic growth (case of fiscal, monetary and trade policies). Future Business Journal. 7: 59. https://doi.org/10.1186/s43093-021-00104-6

2. Adeyemi,, O., Bold, M., Nisbett, N and Covic, N (2023). Changes in Nigeria's Enabling Environment for Nutrition from 2008 to 2019 and Challenges for Reducing Malnutrition. Food Security. 15(2), 343–361. https,//doi.org/10.1007/s12571-022-01328-2.

3. Adigun, A and Olaniran, M. (2021. Statistical simulations of infectious diseases in Southwestern Nigeria (A case study of Ekiti and Oyo State). Journal of Public Health and Diseases. 4(1),1-10. https,//doi.org/10.31248/JPHD2020.088.

4. Agrawal, R.C and Jaggi, S. (2023). Transforming Agricultural Education for a Sustainable Future. In: Bansal, K.C., Lakra, W.S., Pathak, H. (eds) Transformation of Agri-Food Systems. Springer, Singapore. https://doi.org/10.1007/978-981-99-8014-7_25

5. Ahimbisibwe, V., Zhunusova, E., Kassa, H and Günter, S. (2024). Technical Efficiency Drivers of Farmer-Led Restoration Strategies, and how Substantial is the Unrealised Potential for Farm Output?. Agricultural Systems, 213, https://doi.org/10.1016/j.agsy.2023.103799.

6. Akyüz, Y., Salali, H. E., Atakan, P., Günden, C., Yercan, M., Lamprinakis, L., Kårstad, S., Solovieva, I., Kasperczyk, N., Mattas, K., Lazaridou, D., Yener, G., Alayidi, A., Kunchulia, I., Basilidze, L and Knez, M. (2023). Case Study Analysis on Agri-Food Value Chain: A Guideline-Based Approach. Sustainability, 15(7), 43 6209; https://doi.org/10.3390/su15076209-56.

7. Al Mahadi, M.S., Rahman, M.S., Islam, M.S. et al (2022). Fish farming and its effect on household income: micro-level study in Bangladesh. Letters Spatial Resource Science, 15:255–277. https://doi.org/10.1007/s12076-022-00303-x

8. Antle, J.M and Ray, S. (2020). Challenges of Sustainable Agriculture in Developing Countries. In: Sustainable Agricultural Development. Palgrave Studies in Agricultural Economics and Food Policy. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-34599-0_4

9. Aremo, A. M., and Thompson, O. A. (2023). The Efficiency of Hard Wood Industry in Ondo State, Nigeria. Advanced Journal of Social Science, 12(1), 1–15. https://doi.org/10.21467/ajss.

10. Bolarinwa, J. B and Fakumoju, F. A. (2020). Homestead Catfish Farming: A Way out of Covid-19 – Induced Economic Recession. African Scholar Publications & Research International. 18(1). 1-8

11. Boyd, C. E., McNevin, A. A and Davis, R. P. (2022). The Contribution of Fisheries and Aquaculture to the Global Protein Supply. Food Security. 14, 805–827 (2022). https://doi.org/10.1007/s12571-021-01246-9

12. CBN (2023). Centre Bank of Nigeria. Operational Changes to the Foreign ExchangeMarket.https://www.cbn.gov.ng/Out/2023/CCD/Operational%20Changes%20to%20FX%20Market.pdf. Available online, June, 2023

13. Danet, A., Giam, X., Olden, J.D. et al (2024). Past and recent anthropogenic pressures drive rapid changes in riverine fish communities. Nature Ecology Evolution. 8, 442–453. https://doi.org/10.1038/s41559-023-02271-x

14. Desyibelew, H. D., Bayih, M. T. Baraki, A. G and Dadi, A. F. (2020). The Recovery Rate from Severe Acute Malnutrition among Under-five Years of Children Remains Low in Sub-Saharan Africa. A Systematic Review and Meta-analysis of Observational Studies. Plos one. 23, 1-18. https://doi.org/10.1371/journal.pone.0229698.

15. Dhillon, R and Moncur, Q. (2023). Small-Scale Farming: A Review of Challenges and Potential Opportunities Offered by Technological Advancements. Sustainability 15(21),154-178. DOI:10.3390/su152115478.

16. Egbon, O.A., Bogoni, M.A., Babalola, B.T. et al (2022). Under age five children survival times in Nigeria: a Bayesian spatial modeling approach. BMC Public Health. 22, 22-37. https://doi.org/10.1186/s12889-022-14660-1

17. Eyayu, A., Getahun, A. and Keyombe, J.L. (2023). A review of the production status, constraints, and opportunities in East African freshwater capture and culture fisheries. Aquaculture International, 31, 2057–2078. https://doi.org/10.1007/s10499-023-01071-1

18. FAO (2023). Nigeria Agriculture at a Glance. Food and Agricultural Organization of United Nation. https://www.fao.org/nigeria/fao-in-nigeria/nigeria-at-a-glance/en/ Available online: March, 2023.

19. Gwazani, R., Gandiwa, E., & Poshiwa, X. (2022). Rural small-scale aquaculture: An assessment of farmers' perceptions and technical efficiency in Masvingo, Zimbabwe. Cogent Food & Agriculture, 8(1). https://doi.org/10.1080/23311932.2022.2139817

20. Hamilton, S.F., Richards, T.J., Shafran, A.P and Vasilaky, K. N. (2022). Farm Labor Productivity and the Impact of Mechanization. American Journal of Agricultural Economics, 104(4), 1435-1459. https://doi.org/10.1111/ajae.12273

21. Hossain, M. B., Pingki, F.H., Sultana, M., Salim, N.M., Islam, M.M., Arifur Rahman, A.F.M.., Paray, B. A. and Arai, T. (2024) The contribution of homestead pond fish culture to household food security and dietary diversity in central coast of a developing country, Heliyon, 10(7), 23-35. https://doi.org/10.1016/j.heliyon.2024.e28598.

22. Ignowski, L., Belton, B., Ali, H. et al (2023). Integrated Aquatic and Terrestrial Food Production Enhances Micronutrient and Economic Productivity for Nutrition-Sensitive Food Systems. Nat Food 4, 866–873. https://doi.org/10.1038/s43016-023-00840-8

23. Islam, R.M., Olowe, O.S., Mely, S.S., Hossain, A., Das., M. and Zaman, F.U. (2023). Review of the Current Situation, Problems, and Challenges in Fish Seed Production and Supply for Bangladesh's Aquaculture Development. Aquat, Living Resour. 36 (32),1-13.

24. Jiang, Q., Bhattarai, N., Pahlow, M and Xu, Z. (2022). Environmental Sustainability and Footprints of Global Aquaculture, Resources, Conservation and Recycling,180, https://doi.org/10.1016/j.resconrec.2022.106183.

25. Khan, F. U., Nouman, M., Negrut, L., Abban, J., Cismas, L. M., and Siddiqi, M. F. (2024). Constraints to agricultural finance in underdeveloped and developing countries: a systematic literature review. International Journal of Agricultural Sustainability, 22(1). https://doi.org/10.1080/14735903.2024.2329388.

26. Kong, W., Huang, S., Yang, Z. et al (2020). Fish Feed Quality Is a Key Factor in Impacting Aquaculture Water Environment: Evidence from Incubator Experiments. Scientific Reports, 10(187). https://doi.org/10.1038/s41598-019-57063-w

27. Mabika, N and Utete, B. (2024). Complexities and Opportunities: A Review of the Trajectory of Fish Farming in Zimbabwe. https://onlinelibrary.wiley.com/doi/full/10.1002/aro2.57. Available online, May, 2023.

28. Moss, D. (2023). National Oceanic and Atmospheric Administration (NOAA). Growing Seaweed: Aquaculture in Harmony with the Environment. https://www.fisheries.noaa.gov/feature-story/growing-seaweed-aquaculture-harmony-environment. Available online: February 2024.

29. NBS, (2023). National Bureau of Statistics. Quarterly Report. 23(4), 67-72

30. Nelson, E., Hargreaves, S., and Muldoon, D. (2023). Farmer knowledge as formal knowledge: A case study of farmer-led research in Ontario, Canada. Journal of Agriculture, Food Systems, and Community Development, 12(4), 15–38. https://doi.org/10.5304/jafscd.2023.124.010

31. Ninh, L.K. (2021), "Economic role of education in agriculture: evidence from rural Vietnam", Journal of Economics and Development, 23(1):47-58. https://doi.org/10.1108/JED-05-2020-0052

32. Odioko, E and Becer, Z. A. (2022). The Economic Analysis of the Nigerian Fisheries Sector: A Review. Journal of Anatolian Environmental and Animal Sciences. 7(2), 216–226. https://doi.org/10.35229/jaes.1008836

33. Parker, T. (2022). What's a Good Profit Margin for a New Business? Small Business How to Start A Business. https://www.investopedia.com/articles/personal-finance/093015/whats-good-profit-margin-new-business.asp. Available online, October, 2023

34. ter Bogt, H.J. (2021). Efficiency, Types of. In: Marciano, A., Ramello, G.B. (eds) Encyclopedia of Law and Economics. Springer, New York, NY. https://doi.org/10.1007/978-1-4614-7883-6_43-2

35. Thilsted, S.H (2021). Diversifying Aquaculture Systems to Nourish Nations. Nature Food 2, 450–451. https://doi.org/10.1038/s43016-021-00326-5

36. Thompson, O. A., Amos, T.T., Oparinde, L. O., and Omosowone, O. O. (2024): Determining Operational Efficiency in Aquaculture Enterprise to Boost Fish Production for Improved Food Security in Southwest, Nigeria. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development. 24(3), 56 -65

37. Thompson, O. A., and Akintuyi, O. B., Omoniyi, L. O. and Fatoki, O. A. (2022). Analysis of Land Use and Land Cover Change in Oil Palm Producing Agro-Ecological Zones of Nigeria. Journal of Agroforestry and Environment. 15(1): 30-41. DOI: https://doi.org/10.55706/jae150XX

38. Verdegem, M., Alejandro H., Buschmann, U., Latt, W. Anne J. T. and Dalsgaard, A. L. (2023). The Contribution of Aquaculture Systems to Global Aquaculture Production. The Journal of World Aquaculture Society. 54(2), 206-250. https://doi.org/10.1111/jwas.12963

39. Workalemahu, S and Mume, I. D. (2021). Smallholder Farmers' Adaptation Strategies, Opportunities and Challenges to Climate Change: A Review. International journal of food science and agriculture. 5(4):592-600. DOI:10.26855/ijfsa.2021.12.005

40. Zwilling, B. (2024). Operational Ratios for Evaluating the Farm Business. farmdoc daily (14),94, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign. https://farmdocdaily.illinois.edu/2024/05/operational-ratios-for-evaluating-the-farm-business.html. Available online, May 2024.