Technical efficiency and profitability of Aquaculture System in Niger State, Nigeria.

Omitoyin S. A.,[1]* and Ajayi C.T[1]
[1]Department of Aquaculture and Fisheries Management,University of Ibadan, Ibadan, Oyo State
**Corresponding author: sbomitoyin@yahoo.com*

Abstract
Aquaculture holds the key in addressing food insecurity, malnutrition, unemployment, hunger and economic growth and is the fastest growing production sector which bridges the wide gap between demand and supply of fish, reduces pressure on wild catch and fish importation. These has led to intensification in aquaculture and has thus raised concern on its sustainability. This study therefore examined economic sustainability of aquaculture in Niger State. A multistage sampling technique was used to select 165 respondents proportionate to size from Kontagora zone of Niger State, an area which is predominantly known for fish farming. New Bussa Sub zone was purposively selected from Niger State Agricultural and Mechanization Development Authority (NAMDA) zoning pattern because of the concentration of fish farming activities. Four blocks and two cells each were also randomly selected. One hundred and twenty copies of the questionnaires were retrieved. Descriptive statistics was used to analyze the socio-economic characteristics of the respondents, while inferential statistics was used to analyze the economic parameters which include Profitability Ratios: Return on Investment, Benefit Cost Ratio, Gross Revenue Ratio, Fixed Ratio, Operating Ratio, Linear Regression analysis and Technical Efficiency. Results showed that Return on Investment was 0.62, Benefit Cost Ratio (BCR) was 1.26, Gross Revenue Ratio was 0.79, Fixed Ratio of 28% and Operating Ratio was 0.51. Age, years of experience in fish production, and gender were significant at 1%. The adjusted R^2 is 0.7668. The mean technical efficiency was 0.893067718. The indicators used showed aquaculture production system in Niger State is economically sustainable.

Keywords: Aquaculture systems, Economic indices, Economic sustainability, Economic viability

Introduction

According to FAO (2018), development in aquaculture has been unprecedented among animal productions and is one of the fastest-growing food-producing sectors worldwide, making it desirable to assess the sustainability of its systems. In Nigeria, the annual fish demand is 2.66 million metric tonnes with supply being only 1.32 million metric tonnes. Out of this figure, local production is 0.62 million metric tonnes while 0.7 million metric tonnes are from importation of fish and other fish products. Aquaculture accounts for only 200,000 metric tonnes of the total fish supply. The current aquaculture production is a far cry from its potential production of 2.5-4.0 million metric tonnes (Ayinla, 2012; FAO, 2018).

Sustainability is the management of financial, technological, institutional, natural and social resources, ensuring the continuous satisfaction of human needs for the present and future generations (Deloitte, 2013). According to Wagner *et al.,* (2018), sustainable aquaculture is the production of aquatic organisms using efficient and cost-effective methods to improve human capacity, utilise and conserve available resource and protect the environment.

Aquaculture development has yielded many positive socio-economic results nonetheless, the impact of aquaculture farming on the environment and the prospects for its sustainability have raised concern since the early 1990s (Samuel-Fitwi *et al.,* 2012 and Perdikaris *et al.,* 2016). Sustainability in aquaculture systems is viewed by scientist in three main dimensions namely: economic sustainability, environmental sustainability and social sustainability (Kimpara*et al.,* 2017). Economic sustainability of aquaculture systems as a tool for aquaculture enterprise must be a viable business with good long-term prospects. The economic sustainability indicators reveal the degree of efficiency in using financial resources, the economic feasibility, resilience and the capacity to absorb negative external costs and to generate funds for reinvestment.

According to estimates, Nigeria is the largest aquaculture fish producer in sub-Saharan Africa and close to 19 million people directly and indirectly are employed in the fisheries industry (Chowdhary, 2020). Despite growing leaps and bounds through aquaculture, there are several significant challenges face by the country (ELI, 2010). According to a 2018 – 2022 report from WorldFish Nigeria Strategy, Nigeria produced over 1 million metric tons of fish but left a deficit of 800,000 metric tons, which is imported from other countries every year. Also, the WorldFish study on Nigerian Aquaculture shows that to meet the growing demand, fish production needs to be doubled by 2030 and losses after harvest should be reduced. Due to the economic recession and lack of income, high cost of feed, alongside many of the current aquaculture activities which are causing environmental pollution and fish kills, the profits made by fish farmers are minimal and many are discouraged to continue in the business. Thus, fish farmers in Nigeria needs to learn sustainable aquaculture practices that can benefit fish farming business and maximize high-quality output. There is also an urgent need to increase the production of fish in a sustainable manner which will boost the growth rate of the sector and deliver profits for the fish farming community. This will encourage more people to get into the fish farming business. Moreover, it will help in generating employment, improving income and supplying nutrition to the people in Nigeria. This paper thus investigated the economic sustainability of aquaculture systems among fish farmers in Niger state.

Materials and Methods

Description of the study area

The study was conducted in *New Bussa Sub Zone, located in the Southern* part of Niger state in North Central Geo-Political zone of Nigeria on Latitude of 9° 52' 19" N and Longitude of 4° 30' 53" (NPC, 2006). The land area is about 11,782.5 square kilometers and the population of the area is reported to be over 187,000 with a mean annual rainfall of 1,000 – 1500 mm (N.S.B.S, Niger State, 2011). The climatic condition, soil type, topography and vegetation cover in the state support the cultivation of several crops of economic importance like cassava, vegetable, millet, rice, yam, cowpea, sorghum, cotton, water melon etc. The favourable climatic condition makes it possible for livestock farming. *Hydro power station is situated in Kainji and River Niger running through it.*

Research Design

Data were obtained from both primary and secondary sources. The study adopted survey method *using structured questionnaire and* interviews *to collect primary data (quantitative and qualitative) on socio demographic characteristics, production systems, occupational status, income and fish production data while t*he secondary sources include literature materials from the libraries, journals, government ministries and agencies, international agencies and non-governmental organizations.

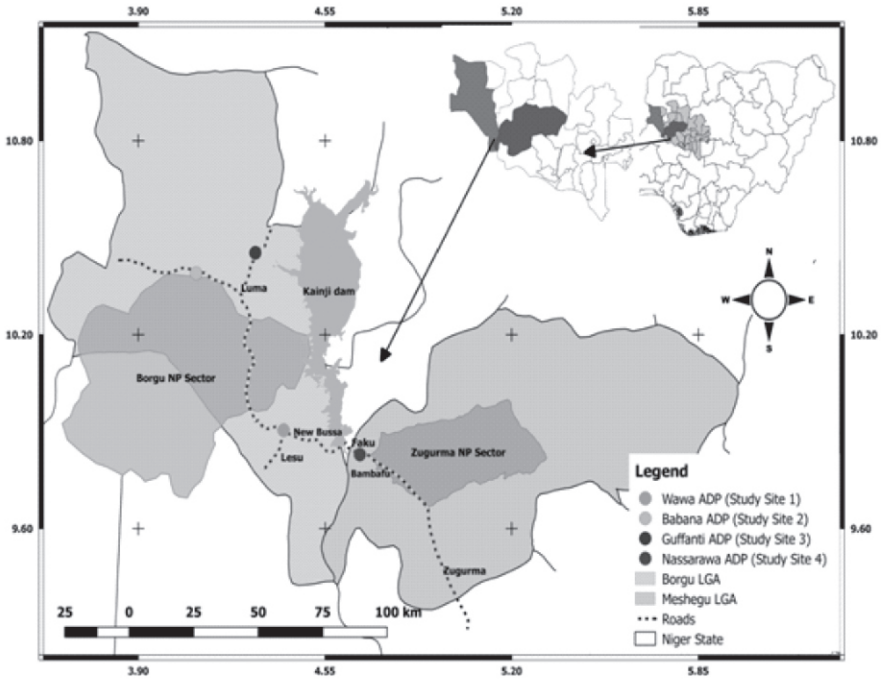

Fig. 1: Map of Niger state showing the study area

Sampling Techniques

The study adopted multi-stage sampling techniques with purposive selection of Niger state, due to the large availability of water from rivulets and rivers (River Niger and River Kontagora) and its proximity to different large markets in Abuja, Kaduna. New Bussa Sub zone from the Kontagora Zone (stage 2) and four blocks from the subzone (stage 3) were purposively selected using the Niger state Agricultural and Mechanization Development Authority (NAMDA) zoning structure. The blocks selected are: Wawa, Guffanti, Babanna and Nassarawa. This was done based on statistics showing the area has the largest cluster of fish farmers and the highest population of fish farmers in the state (Adedeji et al., 2016) while Simple random selection of two cells from each block using the NAMDA zoning pattern was Stage 4. Questionnaire were distributed

proportionate to size in the eight cells from the four blocks. The inclusion criteria for the respondents was based on age range to be between 15 – 65 years, which represents the most active age range or period of residency in the community i.e. the respondents must have been resident in the community for a minimum of six month, which is a full-time culture period for aquaculture business.

Statistical tools

Descriptive statistics, Net Farm Income (NFI), Profitability Ratio, budgetary analysis and Linear regression analysis were used to describe the socio-economic characteristics of farmers, determine the profitability of catfish production and relationship between variables.

Profitability ratio

The performance and economic worth of the respondents was determined by the use of the following Profitability ratios:

i. Benefit Cost Ratio; BCR =Total Revenue (TR) / Total Cost (TC)

ii. Expense Structure Ratio; ESR = Fixed Cost (FC) / Variable Cost (VC)

iii. Gross ratio; GR = Total Cost (TC) / Total Revenue (TR)

Cost and return analysis was used to investigate the profitability of the fish production in the study area as a major indicator of the economic sustainability. Cost and return analysis was done using Gross Margin and Net Farm Income analyses. The variables analyzed using these analytical tools are the Total Revenue, Total Variable Cost and the Total Fixed Cost. The average total revenue accrued from the sale of mature catfish was used in calculating the cost and returns of catfish production.

Linear Regression Analysis

Linear regression measures the extent of interrelationship between two variables which are simultaneously changing with mutually extended effects. In some cases, the changes in one variable are brought about by changes in a related variable but there need not be any mutual dependence. In order words, one variable is considered to be dependent on the changes in the other variables.

Linear regression is a reliable method of identifying which variables have impact on another of interest, the process allows for confidently determine which factor matter most, which factors can be ignored and how these factors influence each other.

$Y = a + bX_1 + bX_2 + bX_3 + \epsilon$

- Y – Dependent variable (Fish Production)
- X_1, X_2, X_3 – Independent (explanatory) variables
- a – Intercept
- b_1, b_2, b_3 - Slopes

ϵ – Residual (error)

X_1 = Age (years)

X_2 = Female (Yes=1, No=0)

X_3 = Secondary Education (Yes =1, No=0)

X_4 = OND/NCE (Yes = 1, No=0)

X_5 = HND/BSc (Yes = 1, No=0)

X_6 = Post graduate (Yes=1, No=0)

X_7 = Household size (Actual number)

X_8 = Income (₦)

X_9 = Income earners (Number per Household)

X_{10} = Years of experience (Years)

X_{11} = Size of farm (acre.)

Results

Socio-Demographic Information of Respondents

The result of the Socio-Demographic characteristics of Respondents from Table 1 showed that 72.5% of the respondents were male while 27.5% were female. Majority of the fish farmers were between the ages of 31 to 40 years with mean age at 39.85±7.384. The result showed that all respondents have one form of education or the other with HND/BSc having the highest percentage (30.8%) followed by OND/NCE (29.2%), Post Graduate (19.2), Secondary education (15.8%) and Primary education (5%) respectively. A high percentage (77.5%) of the respondents were married, 1.7% were divorced while 20.8% were single.

Table 1: Percentage Distribution of the socio-economic characteristics of respondents (n=120)

Variable	*Categories*	*(%)*
Age	21-30 years	10.0
	31-40 years	47.5
	41-50 years	35.0
	> 50 years	7.5
Gender	Male	72.5
	Female	27.5
Educational Status	Primary education	5.0
	Secondary education	15.8
	OND / NCE	29.2
	HND / B.Sc.	30.8
	Post Graduate	19.2
Marital Status	Single	20.8
	Married	77.5
	Divorced	1.7
Household Size	0 – 3	38.3
	4 – 6	41.7
	7 – 9	5.0
	10 – 12	10.8
	= 13	4.2
Years of Experience	0-5	39.2
	6-10	37.5
	11-15	17.5
	15-20	5.8
Source of labour	Skilled labour	35.8
	Unskilled labour	26.7
	Family labour	11.7
	Hired worker	
Is fish farming your primary occupation	Yes	70.0
	No	30.0
Other Primary Occupation	Agro-Chemical	1.7
	Civil Servant	22.5
	Crop Farming	1.7
	Panel Beating	1.7
	Retiree	2.5
Pond size	<0.5	95.8
	0.5-1.0	2.5
	> 1.0	1.7
Average Annual income	< N100,000	19.2
	N100001 - N200000	16.7
	N200001 - N400000	9.2
	N400001 - N600000	19.2
	N600001 - N800000	10.8
		6.7
		18.3

The household size ranged from 1 to 15 members of which majority of the households had between 4-6 members (mean = 4.59±3.499). Household size range of 0-3 represented 38.3% of the respondents. The source of labour for fish farming activities shows thatskilled labour had the highest percentage 35.8%, followed by family labour with 26.7%, then unskilled labour with 25.8% and lastly by hired worker represented 11.7%. About one quarter (26.7%) of the respondents use family labour for work on the farm. Years of experience of the fish farmers is between 2 to 20 years with (mean = 8.34). The longest years of experience falls within 5 to 10 years (39.2%) followed by 6-10 years (37.5%), then 11-15 years (17.5%) and 16-20 years (5.8%). The result showed that 70% had fish farming as their primary occupation, while 22.5% are civil servants. The pond size of 98.5% of the fish farmers in the study area was <0.5 ha followed by 0.5-1.0 ha (2.5%) and >1.0 ha (1.7%).

Economic Analysis of the Respondents

The result of the economic analysis as presented in Table 2 shows the various costs incurred in fish production. These include the fixed and variable cost of production. Total Fixed Cost was ₦ 213,640.00, while Total Variable Cost was ₦ 386,035.00 giving the total cost (TC) of ₦599,675.00. Total revenue (TR) of ₦758,400.00 was realized with a returning gross margin (GM) of ₦372,365.00 and a net farm income of ₦158,725.00. This is the outcome of one production cycle with the expectation that there could be about two cycles within a year depending on the size of fish raised.

Costs and Returns of fish farming

The analysis indicating total fixed cost (TFC), total variable cost (TVC), gross margin (GM), net farm income (NFI) are shown in Table 2. The gross margin and net farm income (NFI) from catfish production per production cycle (average of 7 months from fingerlings stage) were ₦372,365.00 ($931) and ₦158,725.00($396.81) respectively.

Table 2: Economic Analysis of the Respondents (N=120)

Items	Amount (?)	%Total cost
Variable cost		
Cost of feed	205,625.00	0.34
Repairs	3,950.00	0.01
Cost of Fingerlings	47,250.00	0.08
Water Pumping	23,490.00	0.04
Lime	2,290.00	0.00
Drugs	7,390.00	0.01
Bowl	8,260.00	0.02
Skilled Labour	21,000.00	0.04
Unskilled Labour	26,450.00	0.05
Other Variable asset	40,330.00	0.07
Average variable cost	**386,035.00**	**0.64**

Fixed cost		
Earthen Pond	35,690.00	0.06
Generator	30,450.00	0.05
Implements	17,500.00	0.03
Other fixed assets	130,000.00	0.22
Total fixed cost	**213,640.00**	**0.36**
Total cost	**599,675.00**	
Total revenue	**758,400.00**	
Gross Margin	**372,365.00**	
Net Farm Income	**158,725.00**	

Source: Field Survey, 2019

Profitability Ratios of Economic Analysis

The result of the profitability ratio is as presented in Table 3. The Benefit-cost ratio (BCR) was 1.26 which is greater than 1. The returns on investment in fish farming in the study area was 0.62. Gross revenue ratio of 0.79 was obtained. The value of the operating ratio was 0.51 while the fixed ratio was 0.28

Table 3: Profitability Ratios of Economic Analysis

Ratios	Values
Return on Investment	0.62
Benefit Cost Ratio (BCR)	1.26
Gross Revenue Ratio	0.79
Fixed Ratio	0.28
Operating Ratio	0.51

Source: Field Survey, 2019

Regression Analysis

The outcome of the analysis shows that 76.68% of the variation in the output of fish farmers is explained by changes in age, female gender, number of income earners, years of experience, and farm size (Table 4). All the variables had a positive and significant effect on the output of the fish farmers ($p<0.005$). The result showed that there was a positive and significant relationship between the age of the respondents and total production. There was a positive and significant relationship between the female gender and total fish production. Although education at all levels was not significant in this study, level of education is believed to enhance innovation as well as enhance proper documentation in farm business.

Table 4: Regression analysis of factors influencing fish production in the Study Area Dependent Variable: Fish production

Independent variable	Coefficient	Standard Error	T- Statistics	Prob Value
Age	30090.43	8819.974	3.41	0.001*
Gender |				
Female	334026	104086.7	3.21	0.002*
Education				
Secondary	216816.2	220186.2	0.98	0.328
OND/NCE	24865.03	181086.1	0.14	0.891
HND/BSc	7618.19	176178.6	0.04	0.966
Post graduate	380637.1	202553.2	1.88	0.064
Household Size |	11224.09	19786.77	0.57	0.572
Income	.0180074	.0913988	0.20	0.844
Income earners	265508.8	112769.4	-2.35	0.021**
Years of Experience.	34621.11	14243.4	2.43	0.017**
Size of Farm				
<0.5 - 1.	508367.9	254962.4	1.99	0.049**
>2.0	4894833	285106.9	17.17	0.000*
Constant	-379756	397134	-0.96	0.342
R- Squared	0.7962			
Adjusted R^2	0.7668			

Source: Field Survey, 2019

Technical Efficiency

The technical efficiency ranging from 0.901 – 1.000 was in35.83% of the responses, while technical efficiency ranges of 0.801 – 0.900 and 0.701 – 0.800 had frequency percentages of 24.17% and 21.67 % respectively. The lowest frequency percentage (0.83%) technical efficiency level of 0.301 – 0.400, while the mean efficiency was 0.8931

Table 5: Distribution of the responses according to level of Technical Efficiency

Technical efficiency	Frequency	Percentage %
0.301 – 0.400	1	0.83
0.401 – 0.500	2	1.67
0.501 – 0.600	7	5.83
0.601 – 0.700	12	10
0.701 – 0.800	26	21.67
0.801 – 0.900	29	24.17
0.901 – 1.000	43	35.83

Mean efficiency = 0.893067718

Source: Field Survey, 2019Discussion

The greater percentage of male respondents in the study area is in accordance with the studies of Adewuyi *et. al*. (2010), Omitoyin and Adebayo (2012), Adedeji *et al.* (2016) and Omitoyin and Oladeji (2018) but in contrast with the findings of Dambatta *et al*. (2016) where more females were involved possibly as a result of more processing and marketing activities being carried out. Also, the high male participation may be because fish production requires high capital for its operation which might not be readily available to the female folk as men have higher financial capability to execute projects (Ume and Okoronkwo, 2013).

The age range is of respondents follow a similar pattern as with the studies of *Esu et al. (2009),*George *et al. (*2010), Adedeji *et al.* (2016) and Omitoyin and Oladeji (2018) who asserted from their findings that the mean age of fish farmers is between 35 and 42 years. T*his showed that it is better to get involved in fish farming at the youthful and most active age.* Oyinbo *et al.* (2016) opined that fishers' age and educational quantification have mixed impacts on technical efficiency while young and educated fishers are likely to take advantage of their youthfulness to gain technical skills whereas, experience is gained with age and is an invaluable contribution to the success of farm management.

*Education is very important in every aspect of life and plays a vital role in aquaculture development by enhancing easy assimilation, awareness and receptivity to innovation (*Dambatta *et al., 2016) to improve fish production. Another implication of this is that the respondents are likely to be very receptive to new innovations in their methods of production and thus enhance the need for sustainability in aquaculture system production. This is supported by the work of Omitoyin and Oladeji, (2018) and Omitoyin and Adeyeye, (2018) who reported that all farmers in Oyo state have at least one form of education.*

The pattern of the marital status is similar to the findings of Omitoyin and Fawahinmi, (2016) in their work in Osun State where married people are viewed culturally as more responsible and may be able to access some inputs such as micro-credit more readily. Also, the ability of the household to supply the needed labour in the farm business depends to a large extent on the marital status of the households (Agbugba *et al.,* 2014). Being married is an added advantage to production potential of the catfish business (Onyekuru *et al.,* 2019).

The household size corresponded with the report of Adedeji *et al.* (2016) that the mean household size of fish farmers was 5. This

small family size could be attributed to the fact that most of the famers are enlightened and highly educated. Also, small family size will not put pressure on the finances of the household head thus making investment in fish farming possible. Small household size affects credit demand and use. The larger households tend to have higher financial needs than small ones (Omitoyin and Fregene 2009). The household size may suggest the possibility of using family labour as observed by Edward *et al.* (2010), that family members play both domestic and farm roles in fish production. It also agrees with Garner and Paula de la O Campos (2014) who said that the number of persons in a family could encourage the use of family labour. Menberu and Yohannes, (2014) however reported that a large household size is an obvious advantage in terms of labour supply.

The years of experience shows that fish farming is a young but growing business enterprise in the area with 76.7% having less than 10 years of practice. Most of the fish farmers are new entrants into fish farming. This may not be unconnected with declining fishermen catch on Lake Kainji (Abiodun, 2003), which had been a major source of income and coinciding with the Nigerian-German (GTZ) Kainji Lake Fisheries Promotion Project intervention (Umar and Illo, 2014). This encouraged diversification into fish farming to reduce fishing pressure that has taken its toll on the Lake (Raji *et al.,* 2012, Omeje *et al.,* 2020). However, managerial decisions and activities in catfish production can be influenced to a reasonable degree by the experience of fishers (Oyinbo *et al.,* 2016). Also, FAO, 2015 corroborated that rural families pursue multi-enterprise-farming in an integrated manner with respondents' having main occupations which is the prime thrust of their economic activities.

The pond size showed that the majority are small holder fish farmers. Pond size is a determinant of the yield, income and profit of the fish farmers and it limits their production thus it a factor that affects the level of output. Nigeria agriculture is characterized by small farm holdings invariably leading to small output. This is the observation of Amao *et al.* (2009), Omitoyin and Sanda (2013) and Iruo *et al.* (2018) who found poverty to be negatively associated with pond size i.e. farmers with larger pond size are less likely to be poor.

The variable cost per production cycle is in line with the works of Ugwumba and Chukwuji, (2010) accounted for 64% of the total cost in the study area while the fixed cost of production accounted for 36% of the total cost. Fish farming in the study area is adjudged profitable. Cost of feeds alone constituted about 53.1% of the total variable cost, corroborating the findings of Adeniyi *et al.* (2010) and Onyekuru, *et al* (2019) that cost of catfish feeds accounted for over 60% of the total cost of production, thus catfish feed stands as the major ingredient required for catfish farming. This finding is also similar to the observation of El-Naggar *et al.,* (2008) who concluded that cost of feed represented 68.9% of the total production costs of fish in Egypt. The outcome is similar to the findings of the studies conducted by Adewuyi *et al.,* (2010) in Ogun State, Njagi *et al* (2013) in Kenya, Dickson, *et al* (2016) in Egypt. All attest to the profitability of fish farming under good management. To improve on the profitability, effective and efficient

utilisation of available resources to reduce the cost of production and increase productivity should be enhanced while expansion of fish production facilities (farm size) to increase production is critical.

This Benefit Cost Ratio is an indication that the enterprise is profitable, thereby supporting the work of Nwaobiala and Ebeniro, (2012), Adebayo, (2013) and Adedeji *et al.* (2016)**.** Also, Return on Investment, Gross Revenue Ratio, Fixed Ratio and Operating Ratio reveals that the business is worthwhile. This conforms also the work of Kudi *et al.,* (2008) that states that fish farming has a high profit margin (Afodu *et al.,* 2017)

The result obtained is supported by Edward *et al.* (2010) and Guo *et al.* (2015) who ascertained that age had a positive correlation with Agricultural Productivity and that middle aged people participate more in fisheries enterprise. By implication, most of the farmers are still in their active age and therefore, tend to be more productive in fish farming in the study area (Olasunkanmi*,* 2012). Dietrich (2010) opined that age of the decision-maker is an important factor influencing change. Oyinbo *et al.* (2016) is of the opinion that years of experience can contribute invariably to inefficiencies in catfish production; however, Oluwasola and Ige, (2015) posited that fish farming experience was a significant determinant of net income in catfish production.

There is a positive and significant relationship between the female gender and total fish production. According to Olufayo (2012) and Agbebi, *et a*l., (2016), women play a vital role in aquaculture production around the world as labourers and managers of the production process however their roles are very much restricted and often ignored. Unlike men, women combine both productive and reproductive roles simultaneously thus, gender could be a possible factor for inefficiency according to Edward *et al.* (2010). Etuk *et al.* (2015) found a higher incidence of poverty in female-headed households than in male-headed households because gender affects poverty and favours male farmers more than their female counterparts, probably because male farmers own production resources, and are more involved in more livelihood activities than their female counterparts. Also, Garcia, (2012) and Botreau and Cohen (2019) reported that even though women were not major players in agricultural production, women are key players in Africa's agricultural sector and their participation is critical to achieving food security and economic wellbeing. Quentin and Yvonne (2010) also observed that females allocate substantial time to domestic chores which limits their economic opportunities.

Even though education at all levels was not significant in this study, higher levels of education is believed to enhance innovation as well as enhance proper documentation in farm business (Olasunkanmi*,* 2012). The level of education plays an important role in influencing productivity and profitability. According to Staff (2012), median earnings increase with each level of education. Inoni *et al.* (2017) found that formal education had a positive and significant influence on the decision of farmers that led to higher productivity and profitability. Operators who spent more years in school acquiring formal education are more likely to be more

productive in catfish farming than their less educated counterparts.

The production of the respondents is below the maximum technical efficiency frontier (89%). A similar result was obtained by Singh *et al.* (2009) who obtained a technical efficiency range of between 0.21 and 0.96 with a mean of 0.66 in fresh water aquaculture in India. Baruwa and Omodara, (2019) obtained a technical efficiency of between 0.41 and 0.90 with mean of 0.74 among catfish farmers in Oyo State. Omitoyin and Fawehinmi, (2016) in Technical efficiency of fish farmers in Osun State also obtained a lower production frontier than that of potential production frontier. According to Onoja and Achike, (2011), fish production system in Nigeria is faced with low technical efficiency. This efficiency is determined by factors including variable input use (Goksel, 2008).

Conclusion

The study revealed that aquaculture, as practiced in the study area, is profitable. The performance can however be improved upon. Aquaculture is sustainable if the total farm operations ensure reasonable economic gains with least detrimental impacts on the environment. Reduction in cost of feed, proper feeding technique to reduce feed wastage and ensure its utilization (Food Conversion Ratio) by the fish for good flesh quality and weight gain should be the priority. Even though credit availability and access were not flagged it is a critical resource for future fish farm expansion. The economic sustainability of a fish farm depends on how it is efficiently and effectively managed following the code of good practices.

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