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Full Length Research

PRODUCTIVITY OF CATFISH PRODUCTION IN OSUN STATE, NIGERIA

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The decline and shortage in animal protein among households in Nigeria has led to unbalanced food consumption and malnutrition among rural households. Therefore, this study examined the Productivity of catfish production in Egbedore and Ede North Local Government Areas of Osun State. A multi-stage sampling; purposive and random sampling technique were used to select 131 catfish farmers with structured questionnaires used to collect data in the study areas. Descriptive statistics, Profitability analysis, Total Factor Productivity (TFP) and a multiple regression model were used to analyze data. Results showed that majority (87.79%) of the catfish farmers were males and married with a mean age of 49 years and more than three-quarter (89.31%) had tertiary education. The average gross margin of ₦788,823.54 and average profit of ₦413,012.27 per production season (5–6 months) and Benefit-Cost Ratio of 1.06 indicate that catfish farming is profitable, feasible and worth venturing into. TFP was found to be 11.32. The high ratio indicates the more the amount of variable input used the more the output. Regression result indicates that years of farming experience, quantity of feed used and cost of hired labour were positively significant at 10%, 1% and 1% respectively with output of catfish sold in naira. This means as more money is expended on the quantity of feed used, cost of hired labour and increased years of farming experience in the catfish business, the output in catfish production increases and thereby brings about increase in total revenue. Stocking density, pond size, cost of fingerlings, type of water use, and cost of transportation have negative relationships with output of catfish production though significant at different levels except pond size that is not significant at any level. The major constraints identified are poor access to credit facility, high cost of feed and unorganized market for producer and marketer relationship. Therefore, it is recommended that farm inputs most especially feed should be subsidized by governments to encourage effective use of inputs to increase catfish production and subsequently, the productivity of farmers. Also, government should also assist farmers in giving out soft loan in order to boost their scales of operation and their economic potentials.

Key words: Total Factor Productivity, Gross Margin, Benefit-Cost Ratio (BCR), Profitability, Regression.

INTRODUCTION

Fishery, a production of aquatic fish either captured or cultured for human utilization. All over the world, the oldest way of fish production is the utilization of existing water bodies which includes the seas, oceans, lakes, and reservoir and streams though the yield is low. The term capture fisheries refer to the artisanal and industrial component of the fisheries sectors. The artisanal sub-sector accounts for 88.13% of total domestic fish production, which is far more than half of the Nigeria's total domestic fish production (Adepegba, 2007). The industrial component which requires high capital outlay and advanced technology application with about ₦50 billion ($321million) invested by the private sector in fishing vessels, onshore processing and handling facilities has a contribution of about 5.88% to domestic fish production in 2002 (Adepegba, 2007) On the other hand, culture fisheries, known as aquaculture, accounts for 25,000 (mt) which is currently about 6% of domestic fish production though it has the potential estimated at about 2.50 (mmt) annually. The projected national fish demand stands at 2.1 mmt while the current local supply is 1.192 mmt according to 2007 estimates (Akintunde, 2009).

Fish is an important source of animal protein for many households. According to FAO (2007), fish contributes more than 60% of the world supply of protein, especially in the developing countries. The Federal Government of Nigeria (FGN, 2011) disclosed the information that about 10 million Nigerians are actively engaged in both the upstream and downstream areas of fisheries operations. According to figures provided by the National Bureau of Statistics in 2013 the fisheries sector contributed 1.31% of total GDP in 2012, and this rose to 1.38% at the end of the third quarter of 2013 (NBS 2013). These figures represent 3.3% and 3.5% of agricultural GDP respectively. The Federal Ministry of Agriculture and Rural Development projected in 2011 that the per capita consumption of fish would be 13.5 kg from 2010 to 2015, while the projected demand would increase from 1,430,000 tons in 2000 to 2,175,000 tons in 2015 with supply gap deficit of 1,444,752 tons. Fisheries occupy a unique position in the agricultural sector of the Nigerian economy (FMARD, 2011). The contribution of the fishery sub-sector to GDP rose from N76.76 billion to N162.61 billion in 2005 (CBN, 2005). Thus, the Nigerian government has recognized the importance of the fishery sub-sector and it has made several attempts over the years to increase their productivity through institutional reforms and the various economic measures. Some of these measures provided subsidy for inputs and exemption from tax for fishermen. (Dada, 2004). Catfish production has continued to increase in Nigeria as a result of high growth rate and ability of resistance with stress. Catfish has become more popular for two reasons: It provides a source of income through rapid growth and more efficient in feed conversion and it can be incorporated to local aquacultures system to diversify the production base. As a result, more flexible integrated culture systems, catfish are being adopted in many regions. Hussain and Zuandi (2002) reported that out of the 15,489 tonnes of fish produced in Nigeria by 2001, catfish production accounted for about 4,627 mt and out of this, the private sector was responsible for the production of about 3,284 mt. The contribution of private enterprise to catfish production in Nigeria reduced the fish price of captured fisheries considerably. The protein content of most fish and shell fish is 17-20 percent, while cooked portion may have as much as 38 percent protein (FAO, 2003). Fish is a rich source of lysine and Sulphur amino-acids and is therefore suitable for complementing high carbohydrate diets.

Fish is also a good source of thiamin, riboflavin, vitamins A and D, phosphorus, calcium, iron and high in poly-unsaturated fatty acids which are important in lowering blood cholesterol level (Tobor, 1994). Consumption of fish especially seafood products was reported to amount to approximately 14 kg per capita in developing countries in 2001 (Christopher et al., 2003). The more considerable and substantial contribution of fisheries worldwide is the supply of highly nutritious animal protein for human consumption and the employment and income generation in often remote coastal areas (Christopher et al., 2003). Fish is also a good source of sulphur and essential amino acids such as lysine, leucine, valine and arginine. It is therefore suitable for supplementing diets of high carbohydrates contents. It has high content of Polyunsaturated (Omega III) fatty acids, which are important in lowering blood cholesterol level and high blood pressure. It has also been implicated to have decreased the risk of bowel cancer and reduces insulin resistance in skeletal muscles (Kudi et al., 2008).

Fish is a source of high-quality protein that can be

produced more cheaply than any other animal protein for human consumption. It is also medically recommended for pregnant women, children and adults because of its high-level protein, digestibility and lack of cholesterols, preventive recipe for heart attack or failure and stroke (Ajao et al., 2004). As the population grows and puts more pressure on natural resources, more people will probably become food insecure, lacking access to sufficient amount of safe and nutritious food for normal growth, development and an active healthy life. It is thus, pertinent to provide the poor and hungry with a low cost and readily available strategy to increase food production using less land per caput, and less water without further damage to the environment (Pretty et al., 2003).

The country has a high potential to develop fish farming through cat fish production due to adequacy of natural water endowments. What is however needed is a more dynamic approach to implement the available knowledge of economic efficiency with a view to ameliorating the performance of the fish industry. Thus, the major challenge for the fisheries sector is meeting the current level of consumption in Nigeria (Banjo et al*.,* 2009). Despite the efforts of government over the years, there is still a deficit in the supply and demand for fish. This might not be unconnected to the population growth rate of Nigeria (Dada, 2004). Similarly, despite these considerably high potentials in Nigeria, the gap between fish demand and fish supply was reported to be very wide (Tobor and Ajayi, 1992).

Also, Nigerian diet is full of carbohydrate and little protein. Therefore, there is need for a thorough research, especially on the productivity of the catfish production with a view to improving the life of the generality of the poor masses. A sure means of solving the demand- supply gap is by embarking on widespread investment in fish production (Williams et al*.,* 2007).

PROBLEM STATEMENT

Nigeria is largely a protein deficient country. FAO, 2003 revealed that West African Countries, of which Nigeria is inclusive, obtain most of their animal protein needs from fish. Fish roles in improving diets is undisputed as sources of high quality protein in child nutrition and children diet as it increases their growth and prevent spread of disease.

There exists a demand supply gap of 908,000 mt. However, according to Aquaculture and Inland Fisheries Project (AIFP) Technical Reports 2005 that the shortfall in fish supply has led to low annual per capital fish consumption of 36.6 gmday^{-1} a level below the recommended requirement by World Health Organisation (WHO)/(FAO).

The production of this fish as an economic resource is undertaken by a large number of people especially the small-scale farmers in Nigeria (Oladejo 2010). Presently, Nigeria produces 1.7 mmt of fish annually (Abba, 2012). Regrettably, Nigeria has been one of the largest importers of fish in the developing world, importing some 600,000 metric ton annually to solve the country's high demand for fish (Olagunju et al., 2007).

Therefore, increasing fish production in Nigeria requires embarking on pond fish farming. This has prompted the Federal Government of Nigeria to package the Presidential Initiative on fisheries and aquaculture development in 2003 to provide financial and technical assistance to government programmes and projects encouraging fish production (Ugwumba and Chukwuji, 2010). Regardless these efforts of Government, fish production has remained low in Nigeria (Ugwumba and Chukwuji, 2010).

This has been attributed to inadequate supplies from the local fish farmers due to the use of poor quality fish seeds, inadequate information, high cost of feeds, traditional techniques, small size of holdings, inefficiency in resource use, poor infrastructural facilities, lack of credit, high cost of industrial feed, lack of extension agents, lack of veterinary doctors and lack of fish production equipment and low capital investment (Adeogun et al., 2007; Inoni, 2007; Ugwumba and Nnabuife, 2008; Ugwumba and Chukwuji, 2010; Adinya et al., 2011; Madubuike, 2012).

This as consequently necessitated for urgent attention to development of aquaculture in order to become self-sufficient in fish protein production in Nigeria. The characteristics feature of the current phase of aquaculture development in Nigeria is the emergence of investment from the private sector as the driving force. This is also complemented with the government policy of transferring its farms to private sector.

JUSTIFICATIONS

Catfish production has been seen as a viable

investment by the investors apart from the fact that it provides cheap and quality protein, create employment opportunity, as well as constitute an important element in the social stability and progress of the people in Nigeria. All these indicate that catfish production can go a long way in the attainment of the millennium development goals (Adelakun et al., 2015).

Currently, about 90% of farmed fish in Nigeria is catfish; during the last four years almost all hatchery infrastructure and table fish production systems have exclusively targeted towards catfish production (FDF, 2007). The emergence of high volume producers who have invested in intensive recirculation and flow-through fish production systems have been largely responsible for the phenomenal increase in the volume of production of both fingerlings and table fish.

Population increase and large numbers of undernourished or starving people, especially in the developing countries, made the need for food production a worldwide concern (Olasunkanmi, 2012). According to Olasunkanmi (2012), the most reliable source of protein for many people in the developing economies is fish. Recent knowledge shows that the world's natural stocks of fish and shell fish, though renewable, have finite production limits, which cannot be exceeded even under the best management regimes (Okechi, 2004).

Nigeria is one of the countries in sub-Saharan Africa with a great potential to attain the sustainable fish production via aquaculture considering the extensive mangrove ecosystem available in the country (FAO, 2005). With an annual fish demand in the country of about 2.66 mt, and a paltry domestic production of about 780,000 tonnes, the demand-supply gap stands at staggering 1.8 mt (Oyinbo and Rekwot, 2013).

With importation of more than 750,000 mt of fish, more than USD 600 million is spent in foreign currency and thousands of jobs are exported (USAID, 2010), thereby leading to a negative trade balance in the country.

The shortfall of fish supply in the country has led to a low annual per capita fish consumption rate of only 7.5 kg as against 15 kg per annum as recommended by the FAO (FGN, 2011). Domestic production needs to be increased in order to meet the shortfall between demand and supply, and to diversify the country's resources. According to Mwangi (2007), aquaculture production involves more than the biological processes of fish growth. It also includes paying a critical attention to the financial aspects of production. Efficient financial management of aquaculture can determine the extent of profit maximization. Greater improvements in catfish production can be achieved with a proper analysis of productivity in catfish farming which is the basis of this study. The research study objectives are to-

(i) describe the socio-economic characteristics of the catfish farmers in the study area.
(ii) identify the sources of water for catfish production.
(iii) determine the factors affecting catfish production and productivity
(iv) determine profitability of catfish production
(v) identify problems faced by the catfish farmers.
(vi) make recommendations base on the result of the study.

RESEARCH METHODOLOGY

The study areas are Egbedore and Ede Local Government areas of Osun State. The study was undertaken precisely in Ido-Osun, Ofatedo and Owode-ede townships where we have larger percentage of catfish farmers in the state according to the information from Ministry of Agriculture, Fisheries and Aquacultures Department Osun State.

Osun state has a total landmass of 9,125 Km². It lies between latitude 7^0 & 8^0 N and is bounded in the North by Kwara state, in the north-east by Kogi state, in the east by Ondo state and bounded in the south by Ogun state. The rainfall pattern of Osun state is wide and diverse ranging from 125 mm (minimum in the dry season). Thus, there are two rainfall peaks.

The average rainfall ranges from 1125 mm in derived savannah to 1475 mm in the rain forest belt. The mean annual temperature ranges from 27.2°C in the month of June to 39.0°C in December. The soil types are varied but most contain a high proportion of clay and sand, and are mainly dominated by laterite. Osun state is well drained with some rivers which the indigenes of the area used for domestic purpose and fish cultivation. The area is an agrarian community that engaged in crop, fishery and poultry productions. Osun state has the highest proportion of fish farmers compared with other states in South-western Nigeria. Out of the total 906 fish farmers in the Southwest, Osun State

had the highest fish farmers of 300 followed by Oyo with a total of 234 fish farmers (Amao et al., 2009). Administratively, Osun state is divided into 30 local government plus 1 area office with an estimated population according to 2006 census of 3423,535. But going by the Osun state Agricultural Development Programme (ADP) method of administration, the state is divided into three zones: Iwo, Oshogbo and Ilesha zones.

Ido-Osun and Ofatedo towns are located in Egbedore Local Government while Owode-Ede is in Ede North Local Government of Osun State. These three towns fall in Iwo zones.

SOURCE OF DATA AND SAMPLING TECHNIQUE

Primary data was used for this study. The data was collected on 2017 catfish production activities using a well-structured questionnaire in a multi-stage sampling technique.

The first stage was purposive selection of Ido-Osun, Ofatedo, (Egbedore Local Government Area) and Owode-Ede (Ede-North Local Government Area) because catfish farming is one of the main livelihood activities the residents are engaged in. The Second Stage was to obtain the list of catfish farmers in the selected locations from the Fisheries Department of Osun State Ministry of Agriculture, Osogbo and Blossom Vine Catfish Farmers Cooperative Society.

Finally, a total of 131 catfish farmers were randomly selected using proportionality factor adopted by Adebayo and Daramola 2013.

S=p/PxQ/1…….…….. (i)
Where;
S =Total number of respondents sampled
p = Number of catfish farmers in each location
P = Total population of catfish farmers
Q = Total number of questionnaires administered.

ANALYTICAL TECHNIQUES

Descriptive statistics was used to describe socio economic characteristics of the catfish farmers, and to identify the sources of water use for catfish production.

Multiple regression analysis of Cobb Douglas function was used to identify factors affecting the catfish production in the study area.

Multiple Regression Analysis

This was used to determine the factors affecting catfish production, the production was measured by the output of quantity of catfish sold in Naira. The relationship between the output of quantity of catfish sold (Y) in Naira and the explanatory variables is stated implicitly as:

$Y = f(X_1, X_2, \ldots, X_{10})$……..……(ii)
The lead equation was the double log which is expressed explicitly below:

$$\log Y = b_o + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + b_8 \log X_8 + b_9 \log X_9 + b_{10} \log X_{10} + U_i$$

Where;
Y = output of quantity of catfish sold (₦),
X_1= Level of education (No of years spent in school);
X_2= Years of experience in catfish farming (Number)
X_3= Transportation cost (₦)
X_4= Vaccination and drugs (₦)
X_5=Quantity of Feed used (Number)
X_6=Type of Water use (Dummy);
X_7=Cost of Hired Labour (₦)
X_8= Cost of fingerlings (₦);
X_9= Stocking density (No of fish in/m^2);
X_{10}=Pond size (m^2)

TOTAL FACTOR PRODUCTIVITY

The Total Factor Productivity was used to estimate the productivity of catfish farmers in the study area. Total Factor Productivity (TFP) is a method of calculating agricultural productivity by comparing an index of agricultural inputs to an index of outputs (Jean-Paul, 2009).

Following Key and McBride (2005), this can be computed as the ratio of outputs to the total variable cost (TVC) of production. This translates of the inverse of the average variable cost (AVC) of production.

$$TFP = \frac{Y}{TVC} = \frac{Y}{\Sigma P_i X_i} \quad \text{.....(iii)}$$

Where;
Y = Monetary value of output, TVC = Total Variable Cost, P_i = unit price of i^{th} variable input, and X_i = quantity of the i^{th} variable input. The above equation can be rewritten as:
TFP = Y/AVC……..(iv)

Gross Margin Analysis

Gross margin analysis is given by equation
GM = TR–TVC……(v)
Where:
GM – Gross Margin (₦)
TR – Total Revenue (₦), TVC – Total Variable Cost (₦).

Benefit-Cost Analysis

The Benefit-cost ratio analysis will be measured using:
BCR = TR/TC……..(vi)
Where:
BCR – Benefit-Cost Ratio
TR – Total Revenue (total fish output (kg) x unit price (₦))
TC – Total Cost (summation of total variable cost and total fixed cost (₦)).
BCR must be greater than 1 for an investment in catfish farming to be worthwhile.

For objective 5, Likert scale (Giroh et.al 2013; Osuala, 1993) was used to measure the production constraints of the catfish farmers.

The Likert scale was adopted with score of the items of constraints as very serious (3), serious (2) and not serious (1).

The mean score, which forms the benchmark on which the constraints was judged and observed by the formula:
X = ∑Xi/N……(vii)
Where;
i = 1, 2, 3; X assigned constraint (i.e. 3 very serious, 2 serious and 1 not serious);
N = number of occurrence.
∑= summation sign.

The bench mark on which the significance of the constraints on production efficiency was judged by summing up assigned values and dividing by the number of occurrence;
3 +2+1 = 6 and divided by 3 = 2.
The decision score = 2 was considered significant constraint.

RESULTS AND DISCUSSION

Table 1, shows the summary of the socio-economic characteristics of the catfish farmers. Descriptive analyses of the socioeconomic characteristics show that majority (87.97%) of the catfish farmers were male, married (87.97.2%) which shows that catfish farming is more dominated by male with a mean household size of 4 persons, and at the economically active age of 31–50 years (58.78%) with mean age of 49 years. A similar result by Alawode et al., 2016, indicates the mean age of catfish farmers in the Oyo state to be 44years. Adebayo et al., 2013, identified that most catfish farmers were in the active age of 31-49 years. The high proportion of age group of less than 51 years shows that they are in their active age; hence, more productivity of fish farming is expected because of the strength and physical ability to manage the fish pond (Williams et al., 2012).

The catfish farmers attained one level of formal education or another. The majority (89.31%) of the catfish them were graduates of higher institutions. This explains why the mean period of experience in catfish farming was relatively low as 7 years. It also implies that most catfish farmers go into the business probably after being unable to secure white collar jobs upon graduation or because of the need for an extra source of income. There were also adults who made fish farming a reliable source of income after their retirement (Alawode and Jinad, 2014).

About fifty three percent (53.44%) of the catfish farmer has capacity of 1000-6000 stocking density while 20.61% stocked less than or equal to 500 fingerlings per production period of 4-6 months with the highest pond size of 41.99% ranges from 1000 m^2 to 5000 m^2. (Note: A sentence never starts with a number).

Most of the catfish farmers of 73.29% incurred a low cost of water supply for the fish pond ranges from 2500 naira to 8500 naira while 26.71% incurred as high as 15000naira to 55000 naira per year depending on the source of water used.

Table 2 shows the source of water used by the fish farmers in their production. Some of the catfish farmers (45.80%) used streams as a source of water supply to the fish pond in the study area. Those that have money to sink borehole for their fish production were few (7.63%) as this could increase cost of production while 27.48% settled for public water supply. This is connected to the cost of water used. Catfish farmers that relied on rainfall (8.40%), Well water (4.58%) and Rivers (6.11%) would not be able to produce catfish all year round and so have low fish production or go off during the dry season due to very low water supply during the period and thereby less income during summer

Table 1. Socio-economic Characteristics.

Variables	Frequency	Percentage	Mean
Sex			
Male	115	87.79	
Female	16	12.21	
Total	131	100	
Age			
31-40	32	24.43	49
41-50	45	34.35	
51-60	30	22.90	
61-70	16	12.21	
71-80	8	6.11	
Total	131	100	
Marital Status			
Single	16	12.21	
Married	115	87.79	
Total	131	100	
Household size			
1-5	100	76.33	4
6-10	31	23.67	
Total	131	100	
Farming Experience			
1-5	68	51.91	7
6-10	47	35.87	
11-15	16	12.22	
Total	131	100	
Level of Education			
Primary	0	0	
Secondary	14	10.69	
Tertiary	117	89.31	3
Total	131	100	
Stocking Density			
≤ 500	27	20.61	6323
1000-6000	70	53.44	
10000-30000	34	25.95	
Pond size (m^2)			
≤ 900	42	32.06	
1000-5000	55	41.99	3193
6000-10000	18	13.74	
12000 and above	16	12.21	
Total	131	100	
Cost of Water used			
2500-8500	96	73.29	
15000	1	0.76	
35000	9	6.87	16880
50000	9	6.87	
55000	16	12.21	
Total	131	100	

Source: Data Analysis 2017.

time. Table 3 shows the factors identified by catfish farmers as constraints or problems to their production activities in the study area. From the results in Table, most of the problems faced by catfish farmers were severe because most of the farmers identified each one as a major constraint. Poor access to credit was recognized by the respondents (87.80%) as the most serious constraints to catfish production in the study area and was ranked first. Poor access to credit could cause inadequate finance as personal savings, borrowing from friends or relatives alone could not solve all the financial challenges because catfish production is capital intensive and thus requires big capital investment for reasonable profit to be made (Adebayo et al., 2013). Sikiru et al., (2009) identified inadequate finance as a serious problem in catfish production. Poor access to credit may also be due to collateral demanded by banks (Alawode et al., 2016).

The second constraint identified by 85.50% of the catfish farmers was high cost of feed as the major input used and this is due to the lack of government's intervention to subsidize the needed inputs, especially the feed which is quite expensive (FAO, 2001; Alawode et al., 2016). Most of the feeds used are imported feeds which possess floating and high protein content and this could be the reason why high price of feed as some of the local feeds available are of poor quality. This result is also in consonance with the records of Ocmer (2006). Ugwumba and Nnabuife (2008) also identified high cost of feed as very serious draw back to profits realizable from catfish farming.

An inadequate market was considered by 83.96% of the farmers and was ranked third as a serious constraint because the fish marketers purchased the catfish from the farm gate at low prices and sold them at very high prices in the market. As a result, the marketers gained more than the farmers who labored so much in producing the fish. There was no organized market as to fix a price for a table size catfish. Each farmer sells at his or her own will or as occasion demands when he or she is in desperate need of money to satisfy pressing needs. 82.44% of the catfish farmers identified technological problems such as improved feed, machineries, and modified re-circulating system as the fourth constraints. Other constraints identified include pests and diseases (72.52%), inadequate security as theft was experienced by (74.81%) of the farmers, infrastructural problem (69.47%) such as power failure, lack of good roads and storage facilities (to preserve the fish during harvesting if not sold instead of taking back to the ponds), water scarcity (45.80%), scarcity of fingerlings (41.22%) and high

Table 2. Source of Water.

Source of water	Frequency	Percent
Rainfall	11	8.40
Well	6	4.58
Borehole	10	7.63
Streams	60	45.80
Tap/Public water	36	27.48
Rivers	8	6.11
Total	131	100

Source: Data Analysis 2017.

cost of skilled labour (38.93%) and was ranked fifth, sixth, seventh, eighth, ninth and tenth respectively.

Profitability Analysis

(a) Gross Margin

$GM = TR - TVC$ Where GM= Gross Margin, TR= Total Revenue and TVC= Total Variable Cost

TR= ₦885, 428, 000

TVC= ₦782, 091, 16.3

G M =₦ (885,428,000- 782, 091, 16.3)

Gross Margin =₦103, 335, 883.7

$$\text{Average Gross Margin} = \frac{\text{Gross Margin}}{\text{Number of Observation}}$$

$$= ₦\frac{103, 335, 883.7}{131} = ₦788,823.54$$

(b) Profit

$\pi = TR - TC, \pi = \text{profit}, TR = \text{Total Revenue and } TC = \text{Total Cost}$

TC= ₦ 831,323,392

TFC= ₦49231276

TC = TFC + TVC Where TFC = Total Fixed Cost and TC = Total Cost

Profit = ₦ (885, 428, 000 - 831,323,392)

= ₦54,104,608

$$\text{Average Profit} = \frac{\text{Profit}}{\text{Number of Observation}} = \frac{₦54,104,608}{131} = ₦413,012.27$$

(c) Benefit-Cost Ratio

$$BCR = \frac{TR}{TC} = \frac{885428000}{831323392} = 1.06$$

The result of Gross Margin and Profit show that catfish production is profitable because the values of the gross margin and profit are high. Catfish farmers with higher gross margins or profit will have more money left over to spend on other important things, especially food, to improve their welfare (Alawode et al., 2016). The value of Benefit-cost ratio calculated is 1.06. This indicates that catfish business is feasible, profitable and worth venturing into because the value of BCR is greater than one. The value of BCR 1.06 simply means that every ₦1 invested into the enterprise will yield ₦1.06. This result agrees with (Oladejo 2010; Adebayo et.al, 2013; Alawode et.al, 2016) who also found catfish production feasible and profitable with 1.65, 1.62 and 2.2 respectively.

Total Factor Productivity

The Total Factor Productivity was used to estimate the productivity of catfish farmers in the study area. Total Factor Productivity (TFP) is a method of calculating agricultural productivity by comparing an index of agricultural inputs to an index of outputs (Jean-Paul, 2009). Following Key and McBride (2005), this can be computed as the ratio of outputs to the total variable cost (TVC) of production. This translates of the inverse of the average variable cost (AVC) of production.

$$TFP = \frac{Y}{TVC} = \frac{Y}{\Sigma P_i X_i} \quad \text{.....(ix)}$$

Where;

Y = Monetary value of output, TVC = Total Variable Cost, P_i = unit price of i^{th} variable input, and X_i = quantity of the i^{th} variable input. The above equation can be rewritten as:

$TFP = Y/AVC$.....(x)

$$TFP = \frac{₦88542800}{78209116.3}$$

$TFP = 11.32$

Table 4 showed the result of the multiple regression analysis. From the results, the output of quantity of catfish sold (Y) in Naira has positive relationship with years of experience (X_2) in the catfish business, quantity of feed used (X_5) and cost of hired labour (X_7) significant at 10%, 1% and 1% respectively. It also has positive relationship with cost of vaccination and drugs (X_4) but not at any significant level. This means as more money is expended on the quantity of feed used (X_5) and cost of hired labour (X_7) and increase in years of experience (X_2)

Table 3. Constraints faced or challenges encountered in Catfish Production.

	Frequency	Percentage	Rank
a. Poor access to credit/inadequate capital	115	87.80	1
High cost of feed or high input price	112	85.50	2
b. Unorganized market/market price	110	83.96	3
c. Technological problem	108	82.44	4
d. Pests, Diseases and Infections	98	74.81	5
e. Inadequate security	95	72.52	6
f. Infrastructural problem	91	69.47	7
Water Scarcity	60	45.80	8
g. Scarcity of fingerlings	54	41.22	9
h. High cost of labour	51	38.93	10

Source: Data Analysis 2017.

in the catfish business, the output in catfish production increases and thereby brings about increase in total revenue. (Adebayo et al., 2013; Mohammed et al., 2015; Alawode et al., 2016). Stocking density (X_9), pond size (X_{10}), cost of fingerlings (X_8), type of water use (X_6), and cost of transportation(X_3), have negative relationships with output of catfish production though significant at different levels except pond size that is not significant at any level. For stocking density, cost of fingerlings, and pond size, the number of fishes stocked does not necessarily indicate the output you get unless the fishes are fed properly and adequately to have a good output result and that was why quantity of feed is positive and significant at 1%. The quality fish feed is necessary for the growth of catfish which gives high yield at the end of the production season. Increased yield implies increased profit (Alawode et al., 2016). Mortality also affects output and so cost of vaccination and drugs have positive relationship with the output. Therefore, if quality and quantity feeding is not done the higher the quantity of fingerlings stocked in a sizeable pond the lower might be the yield and so also the output due to overcrowding, cannibalism and high mortality rate which result into more losses and so less income to the farmers.

CONCLUSION AND RECOMMENDATIONS

Catfish farming is a profitable enterprise (with high gross margin and average profit) especially when there is proper management of inputs especially feed. Catfish production does not disturb the peace of other people in the community because fish is noiseless and require little space. Most catfish farmers prefer to use earthen pond in swampy areas not only because it is less expensive to construct and maintain but also to raise a large number of grow out type of fish. Majority of the catfish farmers buy imported feeds and use less of local feeds because of high protein content and floating quality of the imported feeds that are lacked or inadequate in local feeds. Some buy and sell imported feeds as other source of income. Only very few of the farmers have functioning hatcheries because of technological know-how that is lacking in the study areas. The quantity of output of catfish harvested/sold depends largely on proper management of quality feeds input. Farming experience also contributes to how much income a farmer gets from the catfish enterprise. The major challenges of catfish farmers are inadequate funding, high cost of imported feeds due to high exchange rate and unstable market. Catfish production is capital intensive. Therefore, it is recommended that:

(i) Government should subsidize inputs used in catfish production especially feed input as this will encourage the farmers to increase their productions and subsequently increase in total revenue.

(ii) Farmers should form a strong cooperative society that would give members access to soft loans, inputs availability at subsidized rate and controlled market price of catfish in their areas.

Collaborated efforts (of government and catfish farmers associations) should be made to build capacity for technology and innovation adoptions through trainings, seminars and workshops to enhance increased production and

Table 4. Multiple Regression Result.

Variables	Coefficient	t values	p>/t/
Constant	-15789.47	-0.20	0.840
Level of education	-5054.514	-0.30	0.763
Farming experience	6568.654	1.33	0.187
Transportation cost (₦)	-9.532421	-4.46	0.000***
Vaccination and drugs (₦)	4.790472	0.83	0.408
Quantity of Feed(kg)	929.3082	166.05	0.000***
Type of water used	-28.80164	-3.48	0.001***
Cost of hired labour (₦)	8.386188	11.56	0.000***
Cost of fingerlings (₦)	-0.4637239	-2.23	0.025**
Stocking density(m^2)	-377.306	-23.56	0.000***
Pond size (m^2)	-48.74873	-1.61	0.109*
No of Observation	130		
R- Squared	0.9998		
Adjusted R Squared	0.9997		
Pro F Statistic	48253		

Source: Data analysis, 2017. ***, **and * Sig. at 1%, 5% and 10% respectively.

better income for farmers.

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