ECONOMIC ANALYSIS OF CATFISH PRODUCTION IN KUJE AREA COUNCIL OF THE FEDERAL CAPITAL TERRITORY, ABUJA, NIGERIA

By

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DECLARATION

I hereby declare that this thesis titled **"Economic Analysis of Catfish Farming in Kuje Area Council of the Federal Capital Territory, Abuja, Nigeria"** has been written by me and it is a record of my research work. No part of this work has been presented in any previous application for another degree or diploma at any institution. All borrowed ideas have been acknowledged in the text and a list of references provided.

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CERTIFICATION

This thesis, titled **"Economic Analysis of Catfish Farming in Kuje Area Council of the Federal Capital Territory, Abuja, Nigeria"** by Martina Onyema **OGENYI**, meets the regulations governing the award of degree of Master of Science (M.Sc) in Agricultural Economics of Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This research is dedicated to The Almighty GOD and to my beloved Husband, Mr. Ogenyi, Benedict Ogbe.

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ABSTRACT

This study examined the profitability and efficiency of catfish production in Kuje Area Council of the Federal Capital Territory, Abuja, Nigeria. Purposive random sampling technique was used to sample 60 catfish farmers from whom the primary data used were collected with the aid of structured questionnaire. The data were analysed using descriptive statistics, net farm income and stochastic frontier production function. The study revealed that the mean age, household size and fish farming experience of the respondents were 42 years, 11 and 6 years respectively. Most (86.7%) of the respondents were male (86.7%). Catfish farming was found to be profitable with net farm income of ₦1,772,195.00. The mean technical, allocative and economic efficiencies were 73%, 59% and 43% respectively. The study also showed that economic efficiency of catfish farmers in the study area can be improved substantially(57%) with more improvement in cost allocation. Major constraints encountered by catfish farmers were high cost of feed, water inadequacy, capital insufficiency and rodent attack. The study recommended that local feed research that would help reduce cost of feed should be encouraged.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The increase in human population coupled with large numbers of undernourished people, especially in developing countries, have made the need for food production a major worldwide issue of concern (Okechi, 2004). Studies have showed that there is a limit to 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. Hence, the maximum sustainable fishing limit in natural waters has been exceeded (FAO, 2000). Therefore, fish production will depend on aquaculture to bridge the demand-supply gap of fish.

According to (FAO 2006) production in capture fisheries is stagnating and aquaculture output is expanding faster than any other animal-based food sector worldwide, particularly in developing countries. It contributes nearly a third of the world's supply of fish products and China and other Asian countries are by far the largest producers. Unlike terrestrial farming, where the bulk of the production is based on a limited number of species, aquaculture produces more than 220 species; of these species, catfish, carps, tilapia and related fish form the largest group in terms of quantity while other groups include aquatic plants and mollusc (FAO 2006).

Out of 35 grams of animal protein per day per person recommended by the Food and Agriculture Organisation (FAO), less than 7 grams is consumed on the average. Many Nigerians suffer from protein deficiency due to low animal protein uptake (Emmanuel and Omotoriogun, 2010). According to Ojo (2008), a small amount of fish is an important dietary supplement for people who cannot easily afford other sources of animal protein. Fish is therefore considered a good source of dietary protein for most Nigerians. Anoop *et al*, (2009), also stated that catfish

provides food for the populace allows for improved protein nutrition because it has a high biological value in terms of high protein retention in the body, higher protein assimilation as compared to other protein sources, low cholesterol content and one of the safest sources of animal protein. Although, fish provides far less animal protein for global nutrition than livestock, people in major areas of Africa and Asia are highly dependent on fish as part of their daily diet. In 18 countries in Africa and Asia, nine on each continent, fish provide at least 40% of dietary animal protein. It also provides highly digestible energy, and is a rich source of fat and water soluble vitamins, minerals and fatty acids.

Kehinde *et al* (2009) also showed that aquaculture production in Nigeria has been steadily increasing since the beginning of the 21st century as shown in Table 1.

Table 1: Nigeria fish supply by sector and percentage contribution of each sub sector to domestic fish supply (Metric Tons)

Sector/ Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Artisanal	Output	418,069.4	433,537	450,965	446,203	434,830	513,537	513,537	504,227
	%	89.5	89.1	88.1	87.4	85.4	84.7	81.4	81.9
Aquaculture	Output	25,720	24,398	30,664	30,677	43,950	56,335	84.533	85,087
	%	5.5	5.0	6.0	8.6	6.0	9.7	13.3	13.8
Industrial (Commercial Trawler)	Output	23,308.3	28,378	30,091	33,882	30,421	32,595	33,778	28,193
	%	5.0	5.8	5.9	6.6	6.0	5.6	5.3	4.3
Distant Water (External Source)	Output	557,884	648,197	681,152	663,180	648,033	611,521	646,484	739,666

While other sources of fish production are now very unpredictable due mainly to technological, environmental and climatic constraints which are beyond the control of fish farmers in Nigeria; fish supply from aquaculture is more predictable. To meet the country's high demand for fish, Nigeria must therefore turn to her under-utilized in-land water for improved fish production and aquaculture. The Federal Department of Fisheries (2007) estimated the total available land for aquaculture development to be 1.7million hectares of which only *60,000* hectare have been utilized and of the estimated aquaculture production potential of 2.5million tons only 85,087 is being produced per hectare (Kehinde, *et al.*, 2009).

1.2 Problem Statement

In spite of the ever increasing growth being witnessed by other major sources of animal protein such as livestock and poultry industries, the problem of protein deficiency has continued unabated due to the current level of production in the country. Fish constitutes about 41% of the total animal protein intake by the average Nigerian, hence there is a great demand for fish in the country (Federal Ministry of Agriculture & Rural Development, 2011).

F.A.O (2002) stated that fisheries products represented a major source of export revenue for developing countries amounting to over US$ 20 billion per annum in late 1990s. Fish is also important as food, fish oil, fish skin and leather, fish meal and fish manure, medicine and disease control. The contribution of fishing to the Gross Domestic Product (GDP) of the Nigerian economy increased from ₦108.2B in 2003 to ₦486.7B in 2013 (CBN, 2014). Catfish production is important to the Nigerian economy as it serves as a source of income, reduces the rate of unemployment. In Nigeria, catfish fetches a higher price than tilapia. It also requires less space, time, money and has a higher feed conserving rate. As identified by

Osawe (2004), catfish is hardy, survives in different culture systems and diverse environments, grows very fast, has higher fecundity, improved survival of the fry and adaptation to supplemental feed.

Although statistics indicate that Nigeria is the largest African aquaculture producer with production output of over 154,890 tonnes per annum which grew to 800,000 tonnes per annum in 2008 (Fison, 2008), this has been unable to meet the market demand in Nigeria which according to Inside Nigeria Fish report (2006) increased from over 1 million tonnes per annum in 2006 to 2.66 million tonnes per annum in 2009. Consequently the country has become a major importer of fishery products given its ever increasing consumption and insufficient internal sources, leading to considerable imports which accounted for more than 800,000 tonnes (valued at $900 million) in 2009 (Rondom and Nzeka, 2010). This is a source of concern owing to the various efforts that the government has put in place so as to make Nigeria self- sufficient in fish production.

To meet up the shortfall in fish demand, the government especially at the Federal and State levels in 2008 placed premium on growing local fish farm and catfish was the choice on account of its nativity to the country (Fison,2008). Also, in May 2009, the Federal government deployed a simple but proven technology in the 36 states as well as the Federal Capital Territory (FCT) to encourage private fish farmers master the art of fingerling production and hatchery in the bid to boost local fish production.

The gap could be attributed to several factors. One of these could be low returns on investment as profit plays a vital role in the success of any business. Low returns on investment could be attributed to use of poor quality fingerlings, high cost of feed, inadequate finance as catfish farming is capital intensive, inadequate information, traditional techniques, poor infrastructural facilities, small size of holdings and low capital investment as identified by Ugwumba and Nnabuife, (2008). Olagunju *et al.,* (2007) also

identified water pollution, inadequate supply of fingerlings, inadequate information and feed supply as constraints to catfish farming.

The increasing demand for fish highlights the need for sustainable management of aquatic resources and the need to measure the efficiency of catfish farmers to meet up the increasing demand. Even though a number of researches may have been undertaken to assess economic analysis of catfish production, no one has been done in the FCT and hence the need for this study. Without a critical assessment of the catfish business, it might be difficult to ascertain the profitability of the business. Given this background, it therefore becomes imperative to carry out this research with a view to producing answers to the following research questions:

i. What are the socio-economic characteristics of catfish farmers in Kuje Area Council of FCT - Abuja?
ii. Is there any relationship between inputs and outputs of catfish farming?
iii. What is the profitability status of catfish farming in Kuje Area Council?
iv. What is the technical, allocative and economic efficiency of catfish farmers?
v. What are the determinants of technical, allocative and economic efficiency in catfish production?
vi. What are the constraints to catfish farming in Kuje Area Council?

1.3 Objectives of the Study

The main objective of the study is to undertake economic analysis of catfish farming in Kuje Area Council of FCT – Abuja while the specific objectives are to:

i. describe the socio-economic characteristics of catfish farmers in Kuje Area Council of FCT – Abuja;

ii. estimate the relationship between inputs and outputs of catfish farming;

iii. determine the profitability of catfish farming in Kuje Area Council;

iv. estimate the technical, allocative and economic efficiency in catfish production;

v. identify the determinants of technical, allocative and economic efficiency in catfish production; and

vi. identify the constraints to catfish farming in Kuje Area Council.

1.4 Justification of Study

The demand for fish is expected to keep rising but the current domestic supply cannot meet up with the demand. Fish farming is the only way to increase the domestic fish supply. Nigeria has a high potential to develop fish farming to make up for a substantial fraction of its fish product deficit (Sikiru *et al., 2009*). What is needed is a more dynamic approach to increase the current level of production.

FAO (2000) reports that the most commonly cultured fish species include catfish (*Clarias gariepinus),* tilapia (*Clarias lazera)* and Carp (*Heterobrachus spp).*But many fish farms focus on catfish as they can have a market value of 2 to 3 times that of tilapia and are also the most successfully cultured fish species in Nigeria. If the fish production and consumption nexus would be fully exploited, it implies that encouraging fish production from aquaculture would also mean encouraging its domestic consumption. It thus becomes important to embark on the economic analysis of catfish farming in Nigeria with exclusive emphasis on Kuje Area Council of the FCT – Abuja.

This economic analysis of catfish farming is important as fish farming generates employment directly and indirectly in terms of people employed in the production of fishing output and other allied business. In turn, these jobs provide the wealth to support secondary activities in the communities such as schools, retail services and medical care. It also generates income for all categories of people involved in fish farming and thus contributes to the National income. Fish farming also allows for large species of fish to be farmed according to demand as catching fish from the wild may not yield enough products to meet consumer demand and simultaneously keep the natural ecosystem in balance.

Finally, the findings of this research will provide empirical evidence on resource use in catfish farming in the study area and will contribute to the existing literature as well, useful for policy making and formulation and the recommendations will assist catfish farmers to increase their output.

1.5 Research Hypotheses

Given the objectives of the study, the following hypotheses were formulated:

i. there is no significant relationship between input and output of catfish farming in Kuje Area Council of the FCT – Abuja.

ii. catfish farming is not profitable in Kuje Area Council of the FCT – Abuja.

iii. catfish farmers in Kuje Area Council of the FCT are technically not efficient.

CHAPTER TWO

LITERATURE REVIEWAND CONCEPTUAL FRAMEWORK

This chapter is concerned with issues relating to catfish farming and as such it is divided into conceptual framework, theoretical framework, and empirical literature.

2.1 Conceptualization of Catfish Farming

Catfish farming is simply the farming of catfish stocked in rice fields, cages, bays, and ponds through land-based and water-based systems. Land-based systems are commonly integrated with agriculture by stocking catfish in rice fields and ponds while water-based systems involve stocking catfish directly in enclosures or attaching them to substrates in water bodies such as rivers, lakes, reservoirs or bays. Hence, water-based systems may provide an entry point for landless people and poor fishers to start fish farming.

Catfish farming can be done either on a mall-scale or large-scale. Small-scale catfish farming is a low cost option that can deal directly with the consumers and the farmers receive less income per pond while commercial catfish farming often deals with processing unit which requires about 80 to 100 acres of pond, and by extension the farmers receive more income per acre of pond.

'Rural catfish farming' would therefore imply low-cost production with extensive and semi-intensive technologies most appropriate for the limited resource base of small-scale households. It is based on natural food for fish such as plankton, which is occasionally fertilised and/or supplemented by other feed. Fertiliser and feed may be derived from on-farm by-products, at least in the initial stage of intensification, although even here formulated and pelleted feed from agro-industry are increasingly used. By contrast, intensive systems invariably depend on relatively high-cost, nutritionally complete diets.

2.2 Catfish Management and Management Systems

According to Taiwo (2002), the major determinant of excellent result in fish farming venture is nature and culture. Nature is related to ability to obtain good fingerlings while maintaining fish in good environment with excellent feeding, water quality and temperature is the issue of nurture. He thus

stated 5-variable model for realizable objectives to be quality of fish, diet, environment, health, and management. The management of these variables determine the optimal performance of catfish farming venture at a minimum cost. A successful catfish farm takes time and careful planning to develop. Although, it is similar to other feedlot operations: cattle, swine, or poultry in that complete feeding and avoidance of unnecessary stress are imperative; the major difference is that catfish lives in water, a water environment which serve as their source of oxygen as well as their waste dumping ground which requires intensive water management for the good health of the fishes.

2.3 Cobb Douglas Production Function (CDPF)

In evaluating the economic analysis of catfish farming in Kuje Area Council, Cobb Douglas production function will be used as the basis upon which feeding, labour hour employed with other factors will indicate the required combination to attain maximum catfish output.

The choice of the theory is pre-informed by the argument of neoclassical economists that the class of growth models that include relevant (both economic and non-economic) resources can account for mass balance and thermodynamic constraints with the “essentiality condition”." Essential in this case means that given positive non-resource inputs, output is only zero when the resource input is zero, and strictly positive otherwise. The Cobb-Douglas production function thus has the essentiality condition. Economists argue that this at least accounts for the fact that some amount of inputs are required to produce the needed catfish output.

The economics perspective of this scenario can be illustrated by examining a production function for the overall catfish production:

$$Q = f(K, L, Fd, Ch)$$

Where Q is output of catfish, K is capital, L is labour employed, Fd is feeding, and Ch is chemical used for treatment.

The normal economic conditions for production, which mean a positive marginal product for each input is expected from the derivatives of the above production function.

$$\frac{\partial Q}{\partial K} > 0; \frac{\partial Q}{\partial L} > 0; \frac{\partial Q}{\partial Fd} > 0 \text{ and } \frac{\partial Q}{\partial Ch} >$$

For each input, output increases with its use, as is shown by the positive first derivative above.

Normal economic conditions for national growth (GNP) also mean a diminishing marginal product for each input:

$$\frac{\partial^2 Q}{K^2} < 0; \frac{\partial^2 Q}{L^2} < 0; \frac{\partial^2 Q}{Fd^2} < 0 \text{ and } \frac{\partial^2 Q}{Ch^2} < 0$$

For each input, output increases at a decreasing rate with increased use of the input, as is shown by the negative second derivative.

The basic assumption of the application of this theory is that the social objective of the Kuje community is to maximize catfish output from good management outcome γ through right combination of fish farming inputs at an appropriate formula (C) of usage as used in the conceptual framework in Cohen and Dupas (2008,). The structural relationship between management outcome (γ), appropriate formula (*C*) and prices of inputs (P) is given by:

$$\gamma = f\{C(P)\}$$

The first derivative of this function with respect to C (greater than zero) implies that the application of C enhances greater catfish output and since P is to be incurred, the higher the effective application of C, the greater will be the output of catfish.

Given that inputs are used to produce output (Q) according to the Cobb-Douglas production function, the factor prices then correspond to the marginal products of the factors. In such an environment, availability and accessibility dynamics become very important in shaping production output.

2.4 Review of Empirical Studies on Catfish Farming

Fish has become very important in the life of humans as it provided more than 2.6 billion people with at least 20 percent of their average per capita intake of animal protein in 2001 (FAO 2004), equivalent to almost 16 percent of the total world animal protein supply. The worldwide average per capita supply from aquaculture has increased from 0.7 kilograms (kg) in 1970 to 6.7 kg in 2003 (an average annual growth rate of 7.2 percent), reflecting an increase in food fish production by more than 500 percent since the early 1980s, compared with an increase of less than 60 percent for meat (excluding milk products) in the same period. This has attracted numerous academic and non-academic interest resulting to a range of empirical investigation of the role fish (catfish) can play in the 21st century global economy and mostly the developing economy (World Bank, 2006).

On this background, Emmanuel and Omotoriogun (2010) investigated the socio-economic viability of catfish, *Clarias gariepinus* culture in some sampled farms in Lagos State between October, 2006 and

March, 2007 using ratio analysis and observed that two of the farms operated earthen ponds while other used concrete ponds. The study found that the market price of fish (N400 – N1, 200) signalled fish business being more viable for fish mongers than the growers (farmers). The debt/asset ratio of the farms of less than one indicated a solvent business while the net worth of the farms indicated that the farms were growing but the equity/asset ratio of the farms was equal to 1. The financial outcome of the farm ranged between N48, 210 (USD 401.75) and N1, 841,002 (USD 15,341.68) depending on the size of the farm. The larger the farm, the higher the profit and they concluded that the catfish culture is economically viable in Lagos State.

Sikiru, *et* al (2009) undertook socio-economic analysis of the productivity of Clarias (Catfish) through a random selection of 50 catfish farmers in Ijebu-Ode, Ogun State during 2005/2006 production season by using two-stage least square regression model, descriptive statistics, Friedman chi-square and Analysis of Variance (ANOVA). The study discovered stocking capacity and rate of water change to be the significant factors of high productivity. High cost of inorganic fertilizer and unavailability of credit facilities were found to be main problems associating with catfish production and the study therefore recommended that farmers should embark on practices like formation of cooperatives that would enhance procurement of credit facilities and inorganic fertilizers and other essential inputs.

Emokaro, Ekunwe, and Achille (2010) analyzed the economics of catfish farming in Lokoja and Adavi Local Government Areas of Kogi State, as a way of determining the profitability and viability of commercial catfish production in the study area. The simple random sampling technique was used in selecting 40 catfish farmers that provided the primary data used in the study collected with the aid of well-structured sets of questionnaire, administered through personal interviews and observations and Benefit-Cost Ratio (BCR) and Cost and Return Analysis (CRA) were used for data analysis. The result of

the study showed that an estimated average initial capital of $2,283 was used in setting up each of the 0.5 hectare catfish farm business studied, at a prevailing interest rate of 17.5% per annum. The result also showed an estimated average annual gross revenue of $5,723 and an average net profit of $2,576, a mean gross margin of $2945.16 and a net profit margin of 51.46%, which shows that catfish farming is a profitable business in the study area. Also the benefit cost ratio was estimated as 1.82, indicating that the catfish farms in the study area are viable enterprises.

Ekunwe and Emokaro (2009) examined the technical efficiency of catfish farmers in Kaduna metropolis in Kaduna State of Nigeria using the stochastic frontier production function analysis. Primary data for the analysis were obtained through the use of well structured questionnaire in a simple random sample of 60 farmers drawn from the list of Agricultural Development Programme (ADP) contact farmers in four Local Governments Areas (Chikun, Igabi, Kaduna North and Kaduna South) that make up the study area and descriptive statistics were used to analyze the socioeconomic characteristics of catfish farmers while the stochastic frontier production function analysis was used to determine the technical efficiency of the farmers. The empirical result showed that the estimated farm level technical efficiency ranged from 47.0 % to 97.1 % while majority of the farmers (90%) had technical efficiency exceeding 0.71. The study also found fingerling, labour and pond size being efficiently allocated while gender, household size and education were found to be negatively related to technical efficiency; and experience and age were found to be positively related to technical efficiency. The empirical result also indicated farmers operating in stage II of catfish production in the study area.

From these reviews of related studies, it is found that lots of studies have been done but not specifically on Kuje Area Council of the FCT – Abuja which this study intends to fill by carrying out an economic analysis of catfish farming in the Area Council.

CHAPTER THREE

METHODOLOGY

3.1 Study Area

The study was conducted in Kuje Area Council which is one of the 6 Area Councils in the Federal Capital Territory (FCT) – Abuja, Nigeria. The FCT with 8000sq.km of land is located between latitudes $8^0\ 25^1$N and $9^0\ 20^1$N and longitudes $6^0\ 45^1$E and $7^0\ 39^1$E. Kuje Area Council is about 40 km south west of the FCT. It has an area of 1,644 km² and a projected population of 118,632 in 2014 based on the 2006 national population census result (NPC, 2006) using a population growth rate of 2.5%. FCT is characterised by a park savannah climate with distinct wet and dry season. The wet season falls between the months of April to October while dry season is between November and March.

Kuje is also one of the agricultural areas in the FCT earmarked to supply the city with agricultural produce with a large percentage of land in the area council allocated to farm land for various agricultural activities. The area council also has a busy market. The major occupation of the inhabitants is farming but also characterised by modern agricultural activities prominent among which is fish farming. The major ethnic groups are the Gbagyi and Gwandara who are mostly farmers engaged in root crop farming. Cat fish farming is carried out mostly by other tribes other than the Gbagyi and Gwandaras who have come to settle there, but due to urbanisation as a result of the Federal capital territory, people from different ethnic groups have come to settle there. Most importantly, Kuje is undergoing a rapid expansion in house building because of its proximity to the city centre.

3.2 Sampling Technique

The sample frame was purposively selected with a random sample size. The concept of purposive sampling was as a result of selected farmers who specialised in cat fish farming in Kuje Area Council of Abuja for the survey of the study. This was based on the peculiarity of cat fish production in Kuje Area council compared to the other 5 Area councils of the FCT. Random sampling technique was used to select 60 catfish farmers out of the list of registered catfish farmers that was obtained from the Agriculture Department in the Area Council. The names were shuffled together and 60 catfish farmers (70%) were randomly selected through balloting.

3.3 Method of Data Collection

Data were collected from primary sources through the use of structured questionnaire with the help of trained enumerators. The questionnaires were distributed to the selected catfish farmers in Kuje Area Council of the FCT – Abuja. Data collected include socio-economic characteristics of the respondents (age, sex, family size, educational qualification, access to credit, educational attainment, marital status, experience, major occupation, access to extension agent and membership of cooperative), the inputs used (fingerlings, pond size, feed, fertilizer, labour) as well as production output (quantity of catfish in Kg) and constraints (sources of fingerlings, feed, access to credit, market,) faced by the farmers. The data for the study were collected between October and December, 2012.

3.4 Analytical Techniques

Three analytical techniques were used to analyze the data collected for the study. They include descriptive statistics, net farm income, and the stochastic frontier production model.

3.4.1 Descriptive statistics

The relevant instruments under this statistics include percentages and frequency distribution. This was used to achieve objectives i and vi of the study.

3.4.2 Net farm income

To determine the profitability of catfish farming in Kuje Area Council of the FCT, net farm income (NFI) analysis was used. The tool was used to estimate the gross revenue and total cost in the production period. The difference between the gross revenue and the total cost of production was the profit or the net farm income. The total revenue represents the total number of fish produced multiplied by the unit price.

The total cost comprises of the variable cost and the fixed cost of establishing and running the pond. This was used to achieve objective iii of the study.

The equation for net farm income is given as:

NFI = TR – (TVC + TFC)……1

Where: NFI = Net Farm Income (₦)

TR = Total Revenue (₦)

TVC = Total Variable Cost (₦)

TFC = Total Fixed Cost (₦)

The fixed inputs are not normally used up in a production cycle. They were depreciated using the straight line method given by

$$D = \frac{P-S}{N} \quad \text{.....2}$$

Where D= depreciation (₦)

P= purchase value (₦)

S = salvage value (₦)

N = life span of asset (₦)

This was used for objective iii.

3.4.3 The stochastic frontier production function

The stochastic frontier production function was used to determine the relationship that exists between input and output used in the production of catfish. The Cob-Douglas functional form of the stochastic production frontier was also used to estimate the technical, allocative and economic efficiencies and identify the determinants of technical and allocative efficiencies of catfish farmers in the study area. The Stochastic frontier analysis estimates the production function which serves as a benchmark to estimate the efficiency level of each producer and also identifies the determinants of efficiency by incorporation of exogenous variables which are neither inputs to the production process nor output.

The Cob- Douglas stochastic frontier model is specified in its explicit form as:

$I_nY_1 = \beta_0 + \beta_1 I_nX_1 + \beta_2 I_nX_2 + \beta_3 I_nX_3 + \beta_4 I_nX_4 + \beta_5 I_nX_5 + Vi - Ui$----------(3)

Where:

$I_{n=}$ Natural logarithm

Y_1 = Quantity of catfish (Kg)

X_1 = Stocking capacity (Number of Fingerlings)

X_2 = Pond size (meter square)

X_3 = Feed (Kg)

X_4 = Labour (Man-hours)

X_5 = Drugs (mg)

Ui = Error term which are non-negative random variables which are assumed to account for technical inefficiency in production (one sided component, which captures deviation from frontier as a result of inefficiency of the firm).

Vi= Error term which are random variables which captures the effect of factors outside the control of the farmers, observation and measurement error and other stochastic (noise) term.

β_0 = Intercept

$\beta_1 - \beta_6$ = Regression Coefficient

The determinant of technical efficiency, U_i was modelled in terms of the factors that are assumed to affect the efficiency of production of the farmers. Such factors are related to the socioeconomic

variables of the farmers. These variables are assumed to influence technical efficiency of the farmers.

The determinant of technical efficiency, U_i is defined by:

$$U_i = \beta_0 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + e_i \quad \text{.....(4)}$$

Where,

X_7 = Age (years)

X_8 = Gender

X_9 = Household size (no)

X_{10} = Education

X_{11} =Farming experience (years)

X_{12} = Access to credit

β_0 = Constant

β_{8-} β_{13} = Parameters to be estimated

e_i = Error term

This model was used to achieve objective ii, iv and v .

From the frontier production function, technical efficiency can be estimated as follows

$$TE = \frac{Y_i}{Y_j} = \frac{f(Xi)e^{V} * e^{-u}}{f(Xi)e^{V}} \quad \text{----------5}$$

$$TE = e_j^{-u} \quad \text{----------6}$$

The allocative efficiency is calculated using the Cobb-Douglas stochastic frontier cost function stated as follows:

$$\ln C_i = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + V_i + U_i \quad ----- 7$$

Where:

C_i = Total cost of production (Naira)

X_1 = Cost of Fingerlings (Naira)

X_2 = Cost of Pond construction (Naira)

X_3 = Cost of Feed (Naira)

X_4 = Cost of Labour (Naira)

X_5 = Cost of Drugs (Naira)

β = vector of the coefficients for the associated independent variables in the production function

U_{it} = one sided component, which captures deviation from frontier as a result of inefficiency of the firm

V_{it} = effect of random stocks outside the catfish farmers control, observation and measurement error and other stochastic (noise) error term.

Economic efficiency, EE, is defined as the capacity of a firm to produce a predetermined quantity of output at minimum cost. It is equal to the product of technical efficiency and allocative efficiency, expressed as:

$$EE = TE * AE \quad ---------- 8$$

3.4.4 T- test statistics

To test the hypothesis on profitability of catfish farming, the t-test statistics was employed. For this study, the t- test was used with respect to the cost and returns of each catfish farmer. This was represented by the formula as follows:

$$t = \frac{NFI}{SE} \quad \text{---------- 9}$$

$$SE = \frac{SD}{n}$$

Where:

NFI = Net Farm Income

SE = Standard error

SD = Standard deviation

n = no of respondents

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of the Catfish Farmers

Socio-economic characteristics of the catfish farmers were considered in this section of the study to identify those characteristics that may explain catfish farming activities in the in the study area. They include age, gender, educational level, membership of cooperative organisations, farming experience, main occupation, access to credit, and access to extension contact and household size.

4.1.1 Age

Age is very important in agricultural production as it determines the physical strength of the individual, and young people tend to withstand stress, put more time in various agricultural operations which can result to increased output (Adeola, 2010). The results presented in Table 2 shows that the farmers age ranged from 18 - 65 years. 95% of the farmers are below 55 years old with 5% of catfish farmers above the age of 55 years. Majority (86%) of the catfish farmers fall within the age of 36 -55 years. The mean value of age indicated that the average age of the farmers was 42 years. This supports the study done by Ekunwe and Emokaro (2009) with a mean age of 44 years. This means that the farmers are within active productive age bracket of 30-50 as observed by Onugongu and Nnadozie (2005). This could be attributed to the location of the study site being an urban area. It also shows that there is no age restriction for catfish farming.

Table 2: Distribution of respondents according to Age

Age		Frequency	Percentage
16 – 25		5	8.3
26 – 35		15	25
36 – 45		16	26.7
46 – 55		21	35
56 – 65		3	5
Total		**60**	**100**
Average	42.15		
Minimum	18		
Maximum	65		

4.1.2 Gender of catfish farmers

Results from the study showed that 86.7% of the respondents are males while only 13.3% are females. This can be attributed to the technicalities involved in catfish farming and also that less women own land as compared to men. The women are also more engaged in post-harvest activities. This support the result of Olagungu *et al* (2007), which reported that 80% of cat fish farmers in Ibadan metropolis are male.

4.1.3 Educational level

The educational level of farmers also plays an important role in agricultural production. According to Oladejo (2010), education is important in achieving high level of management capabilities. Findings of the study in Table 3 showed that 98.4% of the farmers had formal education. 40% of the respondents

had secondary education while 56.7% had acquired tertiary education. Only 1.7% had no form of formal education.

This result could also be attributed to the urban nature of the study area as the farmers that engaged in catfish production have acquired some form of formal education. This may also be related to the large migrant of farming population to urban centres. This result supports the study of Oladejo, 2010 in Ido Local Government of Oyo state which revealed that about 33% of the respondents claimed to have acquired tertiary education.

Table 3: Distribution of respondents according to Educational level

Educational level	Frequency	Percentage
No formal education	1	1.7
Primary	1	1.7
Secondary	24	40.0
Tertiary	34	56.7
Total	**60**	**100.0**

4.1.4 Membership of cooperative organisations

Membership of cooperative provides means of interaction and association among farmers which can enhance innovation diffusion easily among members. Although only 14 respondents are members of cooperatives as shown in Table 4, the mean number of years spent as members of cooperatives was 10.9 years with the maximum number of years as 25 years. This results indicated that most (76.7%) of the respondents are not members of any cooperative. This implies that most catfish farmers would have less access to micro credit and dissemination of innovation among farmers would be low as lending agencies would prefer to give credit to cooperatives rather than individuals as group lending increases is

known to have a high repayment rate. Membership of association was found to be a strong determinant of adoption of cassava technologies in Benue State (Oboh *et al.,* 2011).

Table 4: Distribution of respondents according to Membership of Cooperative

Membership of Cooperative (Years)		**Frequency**	**Percentage**
1-6		3	21.4
7-12		7	50
13-18		1	7.1
19-24		2	14.2
25-30		1	7.1
Total		**14**	**100**
Mean	10.9		
Maximum	25		
Minimum	1		

4.1.5 Farming experience

It is of general opinion that experienced farmers would be more efficient, have a better knowledge of climatic conditions and market situations and are thus expected to run a more efficient and profitable enterprise (Oluwatayo *et al,* 2008). Table 5 shows that catfish farmers had between 1 to 34 years of experience. Most of the farmers (75%) had between 1 to 6 years of experience in catfish farming. This indicates that catfish production is relatively a new enterprise and most people were just in the process of learning the art of catfish production.

Table 5: Distribution of respondents according to Farming Experience

Farming experience		Frequency	Percentage
1-6		45	75
7-12		10	16.7
13-18		0	0
19-24		3	5
25-30		1	1.7
31-36		1	1.7
Total		60	100
Average	6.25		
Maximum	34		
Minimum	1		

This supports the study by Olagunju *et al* (2007) in Oyo state which stated that 63.3% of catfish farmers in Oyo metropolis had 1 to 5 years of experience which is an indication that catfish production has not been practiced for too long in the state.

4.1.6 Main occupation of catfish farmers

Most of the migrants from the rural area to urban areas go in search of white collar jobs. In cases where such jobs are not available or do not provide enough income, some urban dwellers may engage in other

agricultural activities to supplement their income. The result from the study showed 75% of catfish farmers in the study area combined fish farming with other income generating activities.

This means that farmers may not devote much time to the fish farming. Hence specialisation in catfish production may be low as the farmers may tend to channel their time to other more profit yielding activities.

4.1.7 Access to Credit of Catfish Farmers

Access to credit is important for the development of small and medium enterprise in the economy. Credit is required by farmers for the purchase of input and financing other range of activities required by the enterprise adding value to agricultural output. According to Nosiru, (2010), lack of access to financial services is a critical constraint to the establishment or expansion of viable agricultural enterprises. Table 6 indicates that 90% of the respondents do not have access to credit facilities as only 6 respondents had access to credit facilities hence, they resort to personal savings.

Only one respondent had access to a credit facility of N500, 000.00 which is the maximum amount availed the respondents with the minimum amount being N150, 000.00. The average credit availed the farmers was at N25, 000.00. The low access to credit could be attributed to high interest rate charged by lending institutions which discourages the borrowers. Also the respondents' low membership of cooperatives could also contribute to the low access credit.

Table 6: Distribution of respondents according to Access to Credit

Access to Credit(₦)	**Frequency**	**Percentage**
1000-100000	0	0
100001-200000	4	66.7
200001-300000	1	16.7
300001-400000	0	0
400001-500000	1	16.7
Total	**6**	**100**
Average	25000	
Maximum	500000	
Minimum	150000	

4.1.8 Access to Extension Contact by Catfish farmers

Extension agents provide technical assistant to farmers, disseminate new technologies to them and also act as a link between the research institution and farmers. This is achieved via extension programs or other forms of non-formal education which improves managerial skills of farmers to keep them abreast of recent development and eventually increase output. The result of the study revealed that 51.7% 0f catfish farmers in the study area have access to extension agents while 48.3% of the respondents do not have access to extension agents.

This shows that more than half of the farmers in the study area have access to extension agents. This could be related to the urban nature of the study area as the respondents are likely to be exposed to formal forms of communication through the media. Also the low level of contact with extension agents could be attributed to the low level of membership of association of the respondents as this makes it difficult for them to form study groups for extension agent. This is likely to make the farmers difficult to reach for coordination of extension programme activities.

4.1.9 Household size of catfish farmers

Family members are also a source of labour on the farms. Greater family size would mean that the cost of paid labour provided by hired labour would be less. Oluwatayo *et al* (2008) observed that most maize farmers in Ekiti state usually have more than one wife with a large family for the purpose of having more access to family labour. They also stated that younger farmers keep lesser wife or just one. The result presented in Table 7 shows that 50% of the respondents have a family size of between 1-6 persons while 35% of them have a household size of 7 – 12 persons.

The average household size of the respondents was 10.5 with a minimum family size of 4 members. This supports the result of Oladejo (2010), which reported that 83% of the small scale catfish farmers in Ido LGA of Oyo state claimed between 1 – 6 members within their households. Therefore, the farmers would be forced to hire labour and pay for hired labour as they are enlightened enough to send their wards to school. This shows that a lot of hired labour will be needed to supplement the insufficient family labour they have which will result in increased cost of production.

Table 7: Distribution of respondents according to family size

Family size	Frequency	Percentage
1 – 6	30	50
7 – 12	21	35
13 – 18	5	8.3
19 – 24	2	3.3
25 – 30	1	1.7
31 -36	1	1.7
Total	**60**	**100**
Average	10.5	
Maximum	35	
Minimum	4	

4.2 Profitability Analysis of Catfish Farming

The viability of a business is indicated by the amount of profit realized per period of time. Profit is the difference between the monetary value of goods produced and the cost of the resources used in their production. The amount of revenue realized and operating cost of a business venture determines how much gain or loss the enterprise can achieve within a certain period. Profitability ratio is a class of financial metrics that helps investors assess a business's opportunities to generate earnings compared with its expenses and other relevant costs incurred during a specific period. The profitability analysis which was used to achieve objective iii is shown in Table 8.

4.2.1 Cost and returns from catfish farming

One of the main goals of calculating cost-returns on investment was to better organize data by the basic cost elements and relate it with returns. Costs are the expenditures incurred for production of fish from fingerlings to table size; these include: total variable cost and total fixed cost. On the other hand, returns are all revenues generated from sale of matured fish after cropping by the catfish farmers. Average cost of cost incurred and output data generated by each of the respondent in a season was used.

Table 8: Cost and Returns for Catfish farming in Naira (₦) per farm (Average Stocking density of 7,304 fingerlings)

Cost and Return	**Mean**	**Percentage**
Variable Cost (₦)		
Cost of fingerling	182,604.8	12.45
Cost of fertilizer	33,866.67	2.30
Cost of feed	936,840.4	63.90
Cost of drugs	4,505.63	0.30
Cost of labour	114,890.5	7.83
Total variable Cost (₦)	1,272,708	86.77
Total Fixed Cost (₦)	164,066.7	13.23
Total Cost (₦)	666,347	100
Output		
Quantity of fish cropped (Kg)	4,271	
Price/Kg (₦/Kg**)**	570.83	
Revenue	2,438,543	
Average Variable Cost	1,272,708	
Average Fixed Cost	194,066	
Average Cost	1,466,774	
Average Revenue	2,438,543	
Net Farm Income		
(AR- (AVC+ AFC)	**971,769.00**	

4.2.1.1 Total variable cost (TVC) of catfish farming

Total variable are expenses that change in proportion to the activity of a business. It can also be considered as normal cost. It is the overall expense associated with the production of catfish from fingerlings to maturity that change in direct proportion to the quantity of fish produced. Total variable cost is the operating cost of the catfish farmers. These costs are the day-day cost incurred in the growing catfish for the production period under study. They include cost of fingerlings, feed, Labour, drugs and fertilizer. The study revealed a stocking density which ranged from 200 to 16,000 with an average stocking density of 7,304 fingerlings per farm. The cost and Return analysis in Table 8 shows that cost of feed accounted for the largest proportion (63.9%).This agrees with the findings of Ugwumba & Chukwuji (2010) that cost of catfish feed accounted for 73.56% of the total cost of production. This shows that large amount of money was spent by fish farmers in the area of study for purchase of feed. This can be attributed to the high cost of imported feed used by the farmers. It is required to feed the fishes 2 – 3 times daily. From the study, it was also observed that the average cost of feed per farm was ₦939,840.4 for an average of 4,271.9Kg of harvested fish. This supports the study by Ugwumba & Okoh (2010) that cost of feed was very high in catfish production. Labour was sourced from both family and hired. Family labour was evaluated using the principle of opportunity cost and it was assumed that family labour served as a perfect substitute for hired labour. Consequently, the imputed cost of labour used for family labour equals the prevailing wage rate of hired labour. The study revealed that the average rate of labour cost per farm in a season was ₦114,890.50 which constituted 7.83% of the total cost. Fingerlings serve as one of the most important input in catfish production. Farmers should ensure that fingerlings are purchased from reliable sources. From the study, it was observed that the average cost of fingerlings per farm in a season was ₦182,604.80 which accounts for 12.45% of the Average Total Cost. The Average cost of fertilizer used in the ponds was ₦33, 866.67k which represents 2.30% of the average total cost of production. This can be attributed to the quantity of fertilizer required and also availability

of organic fertilizer (poultry waste and cow dung) in the study area which can serve as a substitute for inorganic fertilizer. Cost of drugs accounted for 0.30% of the average total cost amounting to ₦ 4,505.63k as only few farms had the need to treat diseases.

4.2.1.2 Total fixed cost of catfish farming

Total fixed cost refers to cost of production that does not change with changes in the quantity of output produced by an enterprise in the short run. In this study, total fixed cost comprised of cost of land, pond construction, wheel barrow and pond equipment such as net, water heater and vibrators. Depreciation cost on the items was calculated due to wear and tear of the assets which renders the items inefficient over a period of time. This accounted for 13.23% of the average total cost of production which was ₦194, 066.70 . This can be ascribed to the high cost of land acquisition in the study area as well as high cost of materials used for pond construction. This shows that catfish production is capital intensive venture.

4.2.1.3 Total cost of catfish farming

The total costs are costs associated with production of catfish from fingerlings to table size. It is the sum of all total variable cost and total fixed cost. The average total cost of production of catfish incurred per respondent in the cropping season was ₦1,466,774.00. The total variable cost accounted for about 86.77% of the total expenses of catfish production. This is in line with the findings of Ugwumba & Chukwuji (2010) where total variable cost accounted for98.06% of the total cost of catfish production.

4.2.1.4 Gross output of catfish farming

Harvested/cropped fish serve as the output or product obtained from catfish farming. From Table 8, the average quantity of output per respondent sampled in a cropping season was found to be 4,271.9kg as shown in Table 8. This means that each farm harvested an average of 4,271.9kg in a cropping season.

4.2.1.5 Net farm income of catfish farming

Income is realized by catfish farmers from the sale of cropped fish at the end of a cropping season. Average selling price of cropped catfish was found to be ₦570.83/kg. Average revenue generated from sale of cropped catfish at for each cropping season as shown in Table 8 was ₦2,439,543.00 per respondent sampled in the study area.

The Net Farm Income which measures the profitability of catfish production was found to be ₦971,769.00. This shows that catfish production is profitable in the study area.

4.2.2 Hypothesis testing

The test for hypothesis which states that catfish farming is not profitable in the study is shown in Table 9. The hypothesis was tested using the t- test statistics. The net farm income of catfish farmers was observed to be significant at 1% level of probability. Therefore, the null hypothesis was rejected and the alternative accepted.

Table 9: Test of hypothesis on profitability of catfish farming

Variable	Mean	Variance	t-value
Revenue	2,438,543	9.56^{+12}	3.86***
Cost	666,347	1.02^{+12}	

***Significant at 1% Level of Probability

The null hypothesis which states that catfish farmers in the study area are not technically efficient was also rejected and the alternative accepted. Technical Efficiency of 76% suggests that the catfish farmers are technically efficient but are yet to attain the frontier due to the presence of inefficiency factors in production.

4.3 Efficiency Measurement of Catfish Production using Stochastic Frontier function

4.3.1 Technical efficiency

The variances of the model presented in Table 10 indicates conformity to the expectation of the model as sigma-square (δ^2) and gamma (γ) were both positive and significant at 1% levels of probability. This indicates a good fit and the correctness of the specified distribution assumption of the composite error term. Based on this, estimation using the Ordinary Least Square is inadequate for the data set. Therefore, the stochastic frontier function estimated by using the Maximum Likelihood Estimation procedure is adequate for the data. Hence, the hypothesis, which states that the inefficiency effects are not stochastic, is rejected. The magnitude of the variance ratio (gamma statistics) of 0.7586 shows that 76% in output changes is due to the presence of the inefficiency factors in the model; implying that 76% of the systematic influences that are unexplained by the production function are the dominant sources of random errors. In other words, it means that inefficiency effects are highly significant in the analysis of the value of output of farmers. Therefore, technical inefficiency effects were present in the production of fish in the area; thereby leading to the rejection of the hypothesis that the parameter estimate $\gamma = 0$. The negative of the parameters in the inefficient function means that the associated variables have a positive effect on the technical efficiency. The mean technical efficiency for fish farmers in the area was 0.7249, implying 72% overall technical efficiency for the farmers. This implies that the

farmers have 28% range for improving their production efficiency using the existing inputs. Therefore, there is need to increase production by utilizing the available resources to attain the frontier level (100%).

The estimated technical efficiency of fish farmers in the study area indicates variation in the variables in the model. Fingerlings are known to be one of the most critical inputs in fish production because output depends on the type and quality of the fingerlings stocked. The result revealed that Fingerlings (β_1) was positive and significant at 1% level of probability; confirming the expected positive relationship between output of fish production and the variable. This means that as fingerlings stocked increases, the quantity of fish cropped (yield) would increase. The significant level of fingerlings shows that it is an important factor in explaining changes in output of fish farmers. Similar result of positive effect of fingerlings on output was obtained by Olayiwola (2013) and Inoni (2007).

The pond is one critical variable upon which output in fish farming depends. Pond size (β_2) was observed to be positive, indicating that increasing the size of the pond used for fish production would bring about increase in the quantity of fish produced in the area. This conforms to the *a priori* expectation that large size of pond could result to larger number of fish stocked in the pond leading to higher output in terms of number of fish cropped. In the same vein, large pond size could result to decongestion of the pond leading to higher output of fish. Therefore, if other inputs are available to expand production, the farmer will have to expand the size of his ponds if existing ponds are stocked to their optimum capacity. Though, the variable, pond size, was found to be insignificant in the production of fish in the area; this is against expectation, as fish cultivation cannot be done without pond. This insignificance of the pond size in the result disagrees with the work of Inoni (2007), where it was stated that pond size has positive and significant effect on fish yield.

The coefficient of feed (β_3) used by the respondents was negatively signed (-0.2254). This indicates that, output will decrease as the quantity of feed used for fish production is increased by a unit. This is against the expectation. Ogundari and Akinbogun (2010) recorded that feed is the most significant contribution to fish production; and was found to be risk-increasing input; indicating that feed increased production variability. The implication of the negative effect of feed on output may suggest that optimum levels of feed utilization under the current scale of fish production in the area have been exceeded. Therefore, further additions to the variable will exert a depressing effect on fish yield. The inverse relationship between feed and fish output found in the study may be attributed to this situations of inadequate and untimely supply of feed during production. The probability of the variables' significance was at 10% level. The significance of the variable indicates that feed is relevant in the production of fish.

Labour is needed in all the state of fishing operations. Nevertheless, the type and level used varies from farmer to farmer and depends on farming operation involved and how large the farm; mostly hired labour is used to supplement family labour in agriculture as production in Nigeria is labour intensive. The positive sign of the estimated coefficient for labour (β_4) was found to conform to *a priori* expectation. The positive relationship of labour with output indicates that if the amount of person used for labour increase by a unit, the quantity of output will rise by the coefficient (0.1309). Efficient usage of labour could result to positive relationship with output. Labour was also found to be significant in the production of fish in the area at 5% level of probability. This result was not in conformity with the report of Olayiwola (2013) who stated that labour has a negative co-efficient and not statistically significant showing that it is not important in explaining the changes in output of fish production.

The estimated coefficient for drug (β_5) was negatively signed and significant at 5% level of probability. The negative coefficient implies that an increase in the quantity of drugs used by the farmers would result to a reduction in quantity of output. This is against expectation as drugs and output were supposed to relate positively. This may stem from the inappropriate usage of the production resources in the farm. The negatively significance of the variable at 5% level of probability signifies that drug is pertinent in the production of fish in the area. Therefore, if appropriate management is given to the resources used in the farm by the respondents, output would improve.

Table 10: Estimates of the Stochastic Frontier model for fish Farmers

Variable	Coefficient	Standard error	t-ratio
Constant (β_0)	1.7426**	0.7246	2.4046
Fingerlings (β_1)	0.9476***	0.1361	6.9607
Pond size (β_2)	0.0063	0.0608	0.1036^{NS}
Feed (β_3)	-0.2254*	0.1334	-1.6899
Labour (β_4)	0.1309**	0.0670	1.9520
Drug (β_5)	-0.0477**	0.0194	-2.4498
Estimated determinants of technical inefficiency			
Constant	11.4651**	5.0116	2.2876
Age (δ_1)	-0.2258**	0.1056	-2.1363
Household size (δ_2)	-0.0955	0.0606	-1.5754
Education (δ_3)	0.2678	0.4028	0.6648
Fishing experience (δ_4)	-0.0206*	0.1134	-1.8183
Extension contact (δ_5)	0.0784	0.0506	1.5071
Cooperative society membership (δ_6)	-0.1169**	0.0468	2.3540
Sigma-squared (δ^2)	0.9559***	0.2354	4.0603
Gamma (γ)	0.7586***	0.5522	13.7369
Mean efficiency = 0.7249			
Log likelihood function = -54.9717			

* = P<0.10, ** = P<0.05 and *** = P<0.01

4.3.2 Determinants of technical inefficiency in catfish farming

The inefficiency model presented revealed that Age (δ_1) has an inverse relationship with technical inefficiency, conforming to the *a priori* expectations that as age of respondents increases, technical inefficiency would decrease resulting to increase in technical efficiency. This rise in technical efficiency could be as a result of accumulated experiences gained by the respondents involved in the enterprise. Hence, older respondents tend to be more technically efficient than younger respondents. The result is against the assertion that young people tend to withstand stress, put more time in various agricultural

operations which can result to increased output (Adeola, 2010). Age was found to be significant at 1% level of probability; therefore, it is very relevant in the production of fish in the area.

Estimated coefficient for household size (δ_2) was negatively signed (-0.0955). This implies that respondents with larger household sizes tend to be more technically efficient than respondents with fewer household sizes. This result agrees with the expectation that larger household sizes could result to higher technical efficiency based on thoroughness in operation and substitution of hired labour with family labour. Household size was found to be significant at 5% level of probability. This indicates that household size can contribute to higher output in farming operations.

Education plays an important role in agricultural operations since it facilitates the adoption of innovations that will improve output. The coefficient for Education (δ_3) was positively signed; implying that, more educated respondents are less technically efficient than their less educated counterparts. This is against the popular opinion that educational advancement brings about better technical efficiency in farming as a result of easy understanding of farming technologies and adoption of new innovations. It can also be implied that most educated people farm by proxy rather than doing it themselves

Fishing experience (δ_4) result was observed to be inversely related to the technical inefficiency of fish farmers in the area; implying a positive effect on technical efficiency of the farmers. Though, the variable fishing experience was found to be significant in the production of fish; showing that accumulation of fishing experience contributes to the output realized by farmers. This could be that as a farmer's number of farming years increases, the farmer tend to be more familiar with production risk in

terms of technologies, season and prices of input and output, hence could venture into taking risk and predict the market situation easily.

Extension contact (δ_5) was found to be positive and not significant; therefore, when the number of extension contacts increases, technical inefficiency would increase, thereby, leading to a decline in technical efficiency. This is inconsistent with several other studies that have found a positive connection between farm level efficiency and availability of extension services (Bifarin *et al*., 2010). Therefore, it is against the opinion that public investment geared to improve the provision of managerial support and dissemination of information to agrarian society via extension programs, or other forms of non-formal education, is likely to lead to higher levels of output and efficiency. The variable was not significant.

Membership of cooperative societies provides means of interaction among farmers which can enhance innovation diffusion easily among members. The technical inefficiency variable, cooperative society membership (δ_6) was found to be negative and significant at 5% level of probability. This agrees with the expected result that belonging to cooperative society will reduce technical inefficiency and increase technical efficiency. Therefore, it implies that respondents who belong to cooperative societies tend be more technically efficient than those who do not belong. This may be attributed to flow of information among members in form of production techniques, input prices and skills. The 5% significant level indicates that cooperative society membership is pertinent in fish production in the area.

4.3.3 Allocative efficiency

The parameter estimates of the stochastic frontier cost function for catfish farmers in the study area are presented in Table 11. The variance parameter estimates for sigma squared (σ^2) was 0.47, and was

statistically significant at 1% probability level. This indicates that there exists a one-sided component error, v_i in the model. Gamma (γ) coefficients was 0.24, and statistically significant at 1% level of probability. The values were significantly different from zero. This means that cost inefficiency effects do make significant contributions to the cost of catfish farming in the study area**.**

The estimated gamma (γ) parameter of 0.24 indicates that about 24 percent of the variations in the total cost of catfish farming in the study area were due to differences in their cost efficiencies. Therefore, the hypothesis that the parameter estimate of γ=0 is rejected. The analysis shows that allocative inefficiency effects were present in catfish farming. A negative sign on a parameter indicates a positive impact on efficiency.

Table 11: Maximum likelihood estimate (MLE) of Cobb-Douglas frontier cost function for catfish farmers in the study area.

Variables	Coefficient	Standard Error	t-ratio
General model			
Constant(β_0)	2.6292***	0.9750	2.6967
Fingerling (β_1)	0.7371***	0.1778	4.1462
Pond construction (β_2)	1.1524	0.0952	0.1211
Feed (β_3)	-0.1872	0.1809	-1.0348
Labour (β_4)	0.1237	0.1080	1.1451
Drug (β_5)	-0.0819**	0.0342	-2.3973
Inefficiency model			
Constant(Z_0)	0.4484***	0.0069	3.71
Age(δ_1)	-0.0078	0.029	-0.27
Household size(δ_2)	-0.0002	0.0440	0.01
Education(δ_3)	0.0427	0.0393	1.09
Farming experience(δ_4)	-0.0151***	0.0060	-2.50
Access to credit(δ_5)	-0.0830***	0.0306	-2.72
Extension contact(δ_6)	0.0039	0.0043	0.372
Membership of association(δ_7)	-0.0264	0.0069	-3.82
Variances			
Sigma-squared (δ^2)	0.4707***	0.1368	3.44
Gama (γ)	0.2432***	0.0588	4.13
Log likelihood function	-18.07***		
LR test	82.06		

** = P<0.05 and *** = P<0.01

Fingerlings cost (X_1):- This shows estimated coefficient of 0.73 with positive sign showing direct effect on cost allocation. The positive relationship of fingerlings cost and cost allocation indicates that an increase in fingerlings cost will result to an increase in total cost of production. This is in line with the *a priori* expectation. It shows that a 1% increase in the cost of fingerlings will increase the total cost of

production by 0.73%. This is in accordance with the fact that cost of fingerlings accounts for 13% the total cost of production in Table 11. Cost of fingerlings was statistically significant at 1% level of probability which indicates that the cost of purchasing fingerlings is very important in catfish farming.

Pond size (X_2):- The result indicates the estimated coefficient of 1.15 for pond size with positive signs which shows direct effect on cost allocation. The positive relationship of pond size and cost allocation indicates that an increase in pond size will result to an increase in total cost of production. This is in line with the *a priori* expectation. It shows that a 1% increase in the pond size will increase the total cost of production by 1.15%. Although pond size was found to be statistically insignificant, this could be attributed to the type of ponds used by most of the catfish farmers as most of them use earthen ponds for farming which cost less to construct as compared with concrete ponds.

Feed cost (X_3):- The result showed an estimated coefficient of -0.18 for feed cost which shows an indirect effect on cost allocation. The result indicated that an increase in feed cost will result to a decrease in total cost of catfish farming. It shows that a 1% increase in cost of feed will result to 0.18% decrease in cost of catfish production. This is against *a priori* expectation as feed serves as an important input in catfish farming. The negative relationship could be attributed to availability of locally produced feed which are less expensive and can serve as substitute for imported feed. The negative relationship could also be attributed to the type of pond used by farmers. Catfish farmed in earthen pond require less feed as they have been found to be able to scavenge for food from their environment, hence they are not feed regularly which can reduce cost of production. Also, cost of feed/kg reduces with bigger sizes of feed.

Labour cost (X_4):- The result revealed the estimated coefficient of labour cost to be 0.12. This shows that labour cost had positive effect on allocative efficiency of catfish farmers in the study area. The implies

that total cost of fish farming is increased as more labour is put into use as a 1% increase in labour cost will increase total cost of fish farming by 0.12%. This is in agreement with Table 8 which shows that labour cost accounts for about 7.83% of the total cost of catfish production. Although labour cost was statistically insignificant, the result can be attributed to availability of family labour which can be used to supplement paid labour as 75% of the farmers were married with an average household size of 11 persons.

Drugs cost (X_5):- Cost of drugs had an estimated coefficient of -0.08 with a negative sign showing indirect effect on cost allocation. The negative relationship of drug cost and cost allocation indicates that an increase in cost of drugs purchased will result to a decrease in total cost of production. It shows that a 1% increase in the cost of drugs will result to a decrease in total cost of production by 0.08%. This result was found to be significant at 5% level of probability. This could be attributed to the low use of drugs by catfish farmers as ponds are properly maintained to avoid contamination and disease outbreak.

4.3.4 Allocative inefficiency

Age (Z_1):- The estimated coefficient for age of catfish farmers was -0.0078. This negative sign implies that as catfish farmers' age increases, allocative inefficiency reduces and the catfish farmers become more cost efficient. That shows that, as catfish farmers age increases, their cost inefficiency decreases. Age of catfish farmers was found to be statistically insignificant.

Household size (Z_2):- The value of the estimated coefficient for household size of catfish farmers was -0.0002. This negative sign implies that as the household size of catfish farmers increases, allocative efficiency increases and the farmers become more cost efficient. Household size of catfish farmers was found to be statistically insignificant.

Education (Z_3):- Education estimated coefficients were directly related to allocative inefficiency of catfish farmers in the study area indicating that the higher the level of education of the farmers, the higher their cost inefficiency. This implies that, increased level of education reduces cost efficiency of the farmers which makes them inefficient in input cost allocation. The findings are not in line with the expectation that educational level affects financial planning which invariably affects cost efficiency. This could mean that most catfish farmers leave cost allocation to hired labour as they are engaged in other businesses and have less time for their farming activities. The coefficient was found to be statistically insignificant.

Farming experience (Z_4):- The estimated coefficient for farming experience was negatively signed. This implies that as farmers' years of farming catfish increases, the more cost efficient the farmers becomes. That shows that increase in farming experience leads to improvement in allocative efficiency in fish farming. As farming experience of catfish farmers increases, cost inefficiency decreases. Farming experience was significantly different from zero at 1% level of probability. This is in conformity with the assumption that farmers' allocative efficiency is affected by experience since farmers' different levels of experience affect ability to obtain and process information on input cost. This is in agreement with the findings of Oguoma *et al*. (2010) where they found out in their study that experience affects allocative efficiency positively.

Access to Credit (Z_5):- The estimated coefficient for access to credit was negatively signed. This indicates that the higher the access to credit, the more cost efficient the farmers become. This is in line with *a priori* expectation as production credit is required by farmers to purchase required inputs on time and allocate resources more efficiently. Access to credit was significant at 1% level of probability.

Extension contact (Z_6):- The estimated coefficient for extension contact of catfish farmers in the study area was 0.039. The positive sign indicates that catfish farmers with access to extension agents tend to be less cost effective than those who do not have access. This suggests that the more extension contact the farmers have, the more cost inefficient they are. It could be implied that because most of the catfish farmers had some level of formal education, they can source for information from various media sources. Extension contact was found to be statistically significant.

Membership of Association (Z_7):- estimated coefficient of membership of association was negatively signed (-0.0264). This indicates that it has a positive effect on allocative efficiency of catfish farmers implying that those who have stayed longer in the association maximum tend to allocate cost more efficiently than those who have fewer years or do not belong to any association. Members of association usually share information on prices of inputs and also tend to enjoy other benefits such as credit which are granted based on duration of membership. Membership of association was significant at 1% probability level.

4.4 Distribution of Efficiencies

The general distribution of catfish farmers efficiency presented in Table 12 shows that most of the catfish farmers (68.34%) were operating at technical efficiency levels between 71 and 90% with a minimum of 12% and maximum of 94%. About 10% of the farmers were operating below 50% technical efficiency level. This result implies that the farmers in the study area have wide differences in their technical efficiency operations.

The mean technical efficiency was found to be 73%, indicating that the farmers have 27% range for improving their technical efficiency by utilizing the available resources to increase output and attain the frontier level.

The allocative efficiency of catfish farmers in the study area as shown in Table 11 reveals that 73.33% of the farmers allocate their cost efficiency at 50% and above with about 53.33% of them between 50 and 70% allocative efficiency levels. The result also shows that only about 26.67% of the catfish farmers have allocative efficiency below 50%. The allocative efficiency distribution of the farmers ranged from 29 to 98% with a mean of 59%. This shows a wide distribution of allocative efficiency among the farmers in the study area. Although none of the respondents had 100% allocative efficiency index, 5 (8.33%) of the farmers fell between 91 and 100% allocative efficiency level thus implying that resources could be allocated to their best alternative uses and prices could as well be allowed to perform their functions in the use of inputs.

The economic efficiency result indicates that catfish farmers in the study area have different economic efficiency spread from each other. Although about 55% of the sampled farmers had economic efficiency level above 50%, 45% of them had economic efficiency level below 50%. As a result of the combined effect of technical and allocative factors, the average economic efficiency of the farmers was 43% with a minimum of 8% and maximum of 88%. This shows that the farmers still had room with the available resources to allocate cost efficiently in order to reach the frontier level. This result indicates that if the average farmer sampled was to reach the economic efficiency level of its most efficient counterpart, then the average farmer could experience a cost saving of 51% [1-(43/88)] while the most economic inefficient farmer can gain economic efficiency of 91% [1-(8/88)] to attain the same economic level with the most economic efficient farmer.

It is evident from the result that economic efficiency of catfish farmers in the study area can be improved substantially with more improvement in cost allocation as the mean allocative efficiency of the farmers was found to be lower (59%) than the mean technical efficiency level of 73%.

Table 12: Distribution of Efficiencies for Catfish farmers in the study area

	Technical Efficiency		Allocative Efficiency		Economic Efficiency	
Class	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
0.01-0.10	-	-	-	-	3	5
0.10-0.20	3	5	-	-	1	1.67
0.21-0.30	1	1.67	2	3.33	6	10.0
0.31-0.40	1	1.67	7	11.67	17	28.33
0.41-0.50	1	1.67	7	11.67	18	30.0
0.51-0.60	3	5	20	33.33	9	15.0
0.61-0.70	8	13.33	12	20.0	1	1.67
0.71-0.80	13	21.67	5	8.33	2	3.33
0.81-0.90	28	46.67	2	3.33	3	5
0.91-1.0	2	3.33	5	8.33	-	-
Total	**60**	**100**	**60**	**100**	**60**	**100**
Maximum		0.94		0.98		0.88
Minimum		0.12		0.29		0.08
Mean		0.72		0.59		0.43

4.5 Constraints to Catfish farming

Agricultural production activities experience constraints which eventually affects output levels. Fish farming has continued to contend with myriad of problems leading to unprofitable venture. Various constraints are faced by catfish farmers in the country which results in inability of the farmers to meet the demand for fish which results in reliance on import of fish and fish products.

The respondents highlighted some constraints they face in catfish production in the study area. These are presented in Table 13 and are discussed according to their ranking.

4.5.1 High cost of Feed

A ranking of the constraints of catfish farming in the study area revealed that high cost of feed was rated highest. 35.4% of the respondents identified this as a problem. Feed forms a major input in catfish production and also very expensive and sometimes not readily available. This may not be unconnected with high cost of foreign feed as feed used for catfish production are imported. As a result of the over dependence on imported feed, cost of purchase of fish feed is usually high. This supports the result of Ohen and Abang (2009), which reported that 90% of respondents identified feed as a major constraint to catfish farming in Rivers State.

4.5.2 Water inadequacy

Water inadequacy was ranked 2nd as one of the constraints encountered by the farmers. This was identified by 18.3% of the farmers. Water is one of the most important inputs required in catfish farming. Fish farming requires enough supply of quality water which should meet the water flow requirement of the pond. Water supply should also be suitable for catfish farming. It has been observed that the best water for catfish farming is borehole water. The high cost of water for ponds could be attributed to cost of drilling borehole by the farmers and/or cost of pumping water from boreholes to the ponds.

4.5.3 Capital insufficiency

Capital insufficiency was ranked 3rd by the catfish farmers. Capital is required for pond construction, construction of boreholes or wells for water supply as well as frequent purchase of feed. This makes catfish farming a capital intensive enterprise as much capital is required for start up. Lack of capital was also identified by Kudi *et al.,* (2006) and Ugwumba & Chukwuji (2010) as one of the major constraints to catfish farming in Anambra State. It could be inferred that insufficient capital would make the farmers

less productive as capital sunk into construction of ponds and source of water supply would affect availability of capital for other inputs required in the production process.

4.5.4 Weed and rodent attack

Among the constraints encountered by catfish farmers, weed and rodent attack was ranked 4th which was identified by 9.8% of the respondents. Some harmful weeds grow in the pond which can result to death of fish. Also, rodents also attack and feed on them resulting to loss in number of fish stocked for production. This result in decreased number of fish cropped at the end of the production period and consequently decrease in income generated.

4.5.5 Expensive labour

Expensive labour was ranked 5th among the constraints encountered by the farmers with those who identified it consisting 8.5% of the respondents. This can be related to the semi-urban nature of the study area which makes labour more expensive compared to the rural areas where labour is cheaper and more readily available. Also about 50% of respondents have family size of between 1 – 6 persons which shows that the farms would have less supply of family labour as most of the children are expected to be in school and will not be readily available to help out on the farms. This can also be related to the result that fish farming is a major occupation of about 25% of the catfish farming. About 75% of the catfish farmers have to employ paid labour required for farm operations. Fish farming activities also requires some skills for weeding, water filing, draining of water hence such specialised services would have to be paid for. The semi-urban nature of the study area makes labour expensive.

4.5.6 Financial problem

About 4.9% of the sampled respondents ranked financial problem 6th as one of the constraints. This explains why only 6 of the sampled farmers have access to credit facilities. Credit facility is required for the day to day running of the farm such as purchase of feed, drugs, and other inputs required. Also only 14 of the sampled respondents are members of cooperatives hence they do not have access to financial assistance from cooperatives or self help groups and have to depend on their personal savings.

4.5.7 Market unavailability

The sampled catfish farmers identified market unavailability as a constraint and was ranked 7th by 2.4% of the farmers. This may not be unconnected to the un-availability of fish market in the area. Most hotels, eateries, relaxation points and schools which serve as the market for catfish are located in the Federal capital city. As a result, farmers incur high transportation cost, transporting cropped catfish to the city centre after harvest as well as selling at give away prices as just some of the harvested fish are sold on-farm.

4.5.8 Bad road

Bad road was also ranked 7th as one of the factors affecting production by 2.4% of the sampled respondents. Most of the farms are located in areas which are linked by un-tarred roads. This could be attributed to the fact that government was still working on various road projects in the Area Council to make them accessible. As a result of the bad roads, most of the roads are inaccessible during rainy season. The farmers have to resort to the use of motorcycles. This result to high cost of transportation in the area with an attendant production cost.

4.5.9 Poor disease management

One (1) of the farmers representing 1.2% of the sampled respondents agreed that poor disease management was a constraint which was ranked as the 9th constraint. Lack of knowledge of efficient

health management of catfish can lead to poor disease management especially when an outbreak of disease occurs on the farm. Disease management practices can be discussed during cooperative or association meetings but only 14 of the sampled respondents are members of cooperative associations.

Table 13: Constraints encountered by Catfish farmers

Constraint	**Frequency**	**Percentage**	**Rank**
High cost of feed	29	35.4	1st
Water inadequacy	15	18.3	2nd
Capital insufficiency	14	17.1	3rd
Weed and rodent attack	8	9.8	4th
Expensive labour	7	8.5	5th
Financial problem	4	4.9	6th
Bad roads	2	2.4	7th
Unavailability of market	2	2.4	8th
Poor disease management	1	1.2	9th
Total	**82***	**100**	

*The frequency was more than 60 due to multiple responses from the catfish farmers

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This research was conducted to determine the economics of catfish production in the study area for the year 2012.

Data were collected from 60 respondents through structured questionnaires which was analysed with the use of descriptive statistics, net farm income and the stochastic frontier model.

The study revealed that the average ages of catfish farmer were 42 years with 86% of them within the age group of 36 – 55 years. Catfish farming was dominated by males (86.7%). About 98% of the respondent had formal education. The study also showed that 75% of the farmers had an average of 6 years of experience. About, 75% of the catfish farmers combined fish farming with other business activities. Most of the respondents were not members of any cooperative (76.7%). The farmers had an average family size of 10 persons. About 52% of the catfish farmers had access to extension contact.

Profitability analysis showed an average cost of ₦666,347.00 per farmer. Average output per farmer was 4,271Kg sold at an average price of ₦570/Kg. The farmers earned an average revenue of ₦2,438,543.00 with an average Net Farm Income of ₦1,772,195.00.

The Cobb-Douglas stochastic frontier was used to estimate technical efficiency of the farmers. The individual technical efficiency of the farmers ranged between 12 and 93.5 percent with a mean technical efficiency of 72 percent. The result of the parameter estimates showed that fingerlings, labour and pond size affected technical efficiency of the farmers although pond size was found to be insignificant.

An analysis of the inefficiency model showed that age, household size, years of experience and membership of cooperatives are socio-economic variables that were significant determinants of technical efficiency in the study area. This means that as these variables increases, catfish farmers technical efficiency increases. Educational level and Extension contact was not significant in the inefficiency model. All the socio-economic variables included in the model were significant at 5 and 10 percent level of probability.

The analysis of the frontier revealed average levels of technical, allocative and economic efficiency of 73%, 59% and 43% respectively. The result of the parameter estimates revealed that fingerlings, pond size and labour affected technical efficiency of catfish farmers positively. Fingerlings and labour was statistically significant while pond size was found to be insignificant.

Age, household size, fishing experience and membership of cooperative were socio economic variables which were found to have negative effect on technical inefficiency. This means that as these variables increases, catfish farmers technical efficiency increases. Household size was found to be insignificant. Although education and extension contact was found to have a positive relationship with technical inefficiency, they were not statistically significant.

The estimated cost function for catfish farmers revealed that cost of fingerlings, pond size and labour had direct effect on allocative efficiency. This means that a 1% increase in cost of any of the variables will lead to an increase in total cost of catfish farming by the coefficient of the variable. Costs of labour and pond construction were found to be insignificant. Cost of feed and drugs were found to have an inverse relationship with allocative efficiency which indicates that an increase in these variables will

result to a decrease in allocative inefficiency. Feed cost was found to be insignificant while cost of drug was significant at 5%.

The technical efficiency indices of the sampled catfish farmers revealed that most of the farmers (90%) were operating at technical efficiency of above 51% while about 73% catfish farmers were operating at an allocative efficiency level of 51% and above.

Economic efficiency of the farmers did not exceed 90% as the result shows that an average economic efficiency of 43% with about 75% operating below 50% economic efficiency level.

Constraints faced by the farmers in the study area include high cost of feed, water inadequacy, capital insufficiency, weed and rodent attack. Others include expensive labour, bad roads, unavailability of market and poor disease management.

5.2 Conclusion

Catfish farming was found to be a profitable business in the study area as the farmers recorded a significant net farm income of ₦1,772,195.00 fish cropped despite constraints faced by the farmer notable which is high cost of feed. The study established that farmers with large household size and more years of experience are more technically efficient in catfish production.

The efficiencies computed shows that the respondents in the study area have not attained the frontiers. Also efficiency level of the most efficient catfish farmer can be attained by other farmers with the current prices of input. The allocative efficiency off 59% and technical efficiency of 73% implies that

there is a significant potential for the catfish farmers to increase output and income using the available inputs at current prices.

5.3 Recommendations

Based on the findings of this study, the following recommendations are made:

1. Catfish farmers should focus more on allocation of resources which will result in higher economic yield.
2. Local feed research that would help to reduce cost of fish feed should be encouraged by research institutions since cost of feed was identified as the most expensive input in catfish production.
3. Inadequate capital was found to be one of the constraints faced by the catfish farmers. Effort should be made by extension agents to encourage catfish farmers to form themselves into cooperative groups. This could enhance link of catfish farmers to financial institutions to access credit facilities. These financial institutions can also provide technical assistance to the farmers to ensure prudent management of such facilities.
4. Farmers should have more access to extension services in order to increase their knowledge of farm management. They should be encouraged to give more time by extension agents to supervision of farm activities to increase their experience in managing fish farms which would also increase output.

5. The mean technical efficiency of 72% shows that the catfish farmers can still improve their production efficiency so as to reach the frontier level. This can be achieved by

encouraging association of catfish farmers to organise trainings, workshops and seminars for members where they would acquire knowledge on improved methods and technologies of catfish farming.

6. Various tiers of government should provide adequate rural infrastructure such as markets, water supply, feeder roads and other social amenities to facilitate storage and transportation of harvested fish from the farms to the market.

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APPENDIX: FARMERS' RESEARCH QUESTIONNAIRE

ECONOMIC ANALYSIS OF CATFISH FARMING IN KUJE AREA COUNCIL OF ABUJA, NIGERIA.

Dear respondent,

This questionnaire will be used by a student of the Agricultural Economics Department, Ahmadu Bello University, Zaria. Please fill and tick where necessary. All information will be treated with utmost confidentiality and will be used strictly for the purpose of research.

A. SOCIO-ECONOMIC CHARACTERISTICS

1. Name …… Village……

2. Sex: Male ( ) Female ( )

3. Marital status: Single ( ) Married ( ) Divorced ( ) Widow ( ) Widower ( )

4. Age (Years)……

5. Family Size (What is the number of people in your household?)……..

6. What is the highest level of education attained?

(i) No formal education ( ) (ii) Primary education ( )

(iii) Secondary education ( ) (iv) Tertiary education ( )

7. How many years of experience do you have in catfish farming? .....

8. Do you have access to credit (whether formal or informal) Yes ( ) No ( )

If yes, specify the amount and source of formal or informal credit

Amount Source

…… ……

…… …….

9. (a) Do you belong to any Agricultural Cooperative? Yes ( ) No ( )

(b) If yes, how long? ……

10. (a) Do you have contacts with extension agents? Yes ( ) No ( )

(b) If yes, how many times a year?.....

11. Is fish farming your major occupation? Yes ( ) No ( )

12. If no, which other activity/activities do you engage in? (i)……
(ii)…… (iii)……..

13. Do you have formal training in catfish production? Yes ( ) No ( )

14. If yes, how long?.....

15. What kind of training did you have? (i)……
(ii)……
(iii)……

B. INPUTS USED

(i)Pond size

Pond No	**Pond Size(m2)**	**Cost of Construction or acquisition**
1		
2		
3		
4		
5		

(ii) Fingerlings (No)

Pond No	**Quantity of Fingerlings(No)**	**Cost of purchase**
1		
2		
3		
4		
5		

(iii) Feed

Pond No	Quantity of feed to maturity(Kg)	Cost of purchase
1		
2		
3		
4		
5		

Unit: Kg, Bags

(iv) Fertilizer

Pond No	Quantity of fertilizer(Kg)	Cost of purchase
1		
2		
3		
4		
5		

Unit: Kg, Bags, Mudu

(v) Drugs

Pond No	Type of drugs	Cost of purchase
1		
2		
3		
4		
5		

(vi) Labour

(a) Pond Construction

	FAMILY LABOUR					**HIRED LABOUR**				
Pond No	No of men	Days spent	Hours/day	Cost/day	Total Cost	No of men	Days spent	Hours/day	Cost/day	Total Cost
1										
2										
3										
4										
5										

(b) Filling / Draining of Water

	FAMILY LABOUR					**HIRED LABOUR**				
Pond No	No of men	Days spent	Hours/day	Cost/day	Total Cost	No of men	Days spent	Hours/day	Cost/day	Total Cost
1										
2										
3										
4										
5										

(c) Fertilizer application

	FAMILY LABOUR					**HIRED LABOUR**				
Pond No	No of men	Days spent	Hours/day	Cost/day	Total Cost	No of men	Days spent	Hours/day	Cost/day	Total Cost
1										
2										
3										

4										
5										

(d) Stocking of fingerlings

	FAMILY LABOUR					**HIRED LABOUR**				
Pond No	No of men	Days spent	Hours/day	Cost/day	Total Cost	No of men	Days spent	Hours/day	Cost/day	Total Cost
1										
2										
3										
4										
5										

(e) Cropping

	FAMILY LABOUR					**HIRED LABOUR**				
Pond No	No of men	Days spent	Hours/day	Cost/day	Total Cost	No of men	Days spent	Hours/day	Cost/day	Total Cost
1										
2										
3										
4										
5										

(f) Weeding

	FAMILY LABOUR	**HIRED LABOUR**

Pond No	No of men	Days spent	Hours/day	Cost/day	Total Cost	No of men	Days spent	Hours/day	Cost/day	Total Cost
1										
2										
3										
4										
5										

Estimate the total amount you spent on catfish farming last season (N)……

(C). DEPRECIATION

S/No	**Type of Pond**	**Years of construction or Purchase**	**Construction or purchase price(N)**	**Years of Utilisation**	**Resale value(N)**
1					
2					
3					
4					
5					

(D) MARKETING INFORMATION

(i) How much did you sell per Kg of catfish? (N)

(ii) Did you sell all the fish cropped immediately after cropping? Yes ( ) No ( )

(iii) If No, what quantity did you sell immediately after cropping?.....Kg

(iv)How do you sell your catfish? Market ( ) On farm ( ) or both ( )

(v) If market, how far is the market from you?..... Km

(vi) If market, how much did you pay for transportation? N.....

(E) OUTPUT

Pond No	Quantity Cropped/Harvested	Price per Kg	Value(N)
1			
2			
3			
4			
5			

Estimate the total sales or revenue you generated from catfish farming (N)…….

Did your family members consume any of the cropped fish? Yes ( ) No( )

If yes, what quantity did the family members consume?.....Kg

(F) CONSTARAINTS

(i) What are the constraints you face in catfish farming? List them

……
……
……
……
……
……
……

(ii) What do you think are the possible suggestions for the constraints mentioned above?

……
……
……