ANALYSIS OF CATFISH VALUE CHAIN IN IMO STATE, NIGERIA

BY

IGWENAGU MANFRED OBINWANNE
(B.Agric.Tech. FUTO)
REG. NO: 20154949528

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CERTIFICATION

This is to certify that this work "**Analysis of Catfish Value Chain in Imo state Nigeria**" was carried out by **IGWENAGU MANFRED OBINWANNE, (Reg. No:20154949528)** in partial fulfilment for the award of the degree of Master of Science (M.Sc.) in Farm Management and Production Economics in the Department of Agricultural Economics, Federal University of Technology, Owerri, Imo state.

.....
Prof. D. O. Ohajianya
(Principal Supervisor)

18/05/2021
.....
Date

.....
Dr. I.U.O Nwaiwu
(Co-supervisor)

18/5/2021
.....
Date

.....
Prof. S.U.O. Onyeagocha
(Head, Department of Agricultural Economics)

18-05-2021
.....
Date

.....
Prof. P.C. Obasi
(Dean, School of Agriculture and Agricultural Technology)

02-06-2021
.....
Date

.....
Prof. C.C. Eze
(Dean, Post Graduate School)

.....
Date

.....
Prof. A.C. Iheanacho
(External Examiner)

18/05/2021
.....
Date

DEDICATION

This research work is dedicated to Almighty God who saw me through the completion of this work.

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TABLE CONTENTS

LIST OF TABLES

Tables

LIST OF FIGURES

Figures

ABSTRACT

The study analyzed the Catfish Value Chain in Imo State, Nigeria. Multi-stage sampling technique was employed in the selection of 217 actors comprising 37 input suppliers, 50 catfish producers, 50 catfish processors, 50 catfish marketers and 30 consumers for the study. However, 36 input suppliers, 47 catfish producers, 50 catfish processors, 47 catfish marketers and 29 consumers returned well filled questionnaire and used for the data analysis. Data were analyzed using descriptive statistical tools such as percentages, means, charts and frequency distribution and functional analytical tools such as value chain map and multiple regression technique, costs and returns analysis, gross margin analysis, net income model and Z-statistics. The Hypotheses were tested using z-values from the results of multinomial logit regression model, Analysis of Variance (ANOVA) and t-values from the multiple regression analyses. The results indicated that the actors along the entire value chain carry out both primary and support activities and can be categorized as actors in inputs suppliers, producers, processors, marketers, consumers research, finance and legislation. The total value added in the catfish value chain system was ₦2,944.5/kg with value added share of 0.41%, 15.54%, 24.83% and 59.22% for input suppliers, producers, processors and marketers respectively with statistically significance at 5% indicating that marketers possessed the highest value added share as they occupied a pivotal position to harness the preference, place, price and product information from the final consumers who were at the epicentre of the value chain system.The result of the multinomial logistic model showed the significant quasi–elasticities for input supplier were age (-1.2946; $p<0.01$), household size (0.8215; $p<0.01$), membership of association (0.1866; $p<0.01$), net value added (0.4130; $p<0.01$) and year of formal education (0.7124; $p<0.01$); Household size (0.4328; $p<0.05$) and net value added (-0.2614, $p<0.05$) were significant quasi–elasticities in the producers' category; age (0.9596; $p<0.01$), gender (-0.1828; $p<0.05$), household size (-0.9344; $p<0.01$), membership of association (-0.1897; $p<0.01$), net value added (0.3315; $p<0.01$) and year of formal education (-0.6469; $p<0.01$) were significant quasi–elasticities effects in the processors' category and only gender (0.2774; $p<0.05$), net value added (-5.8477; $p<0.01$) and year of formal education (-0.6755; $p<0.05$) were significant quasi–elasticities effects in the marketers' category. Major determinants of net value added were age, years in school, household size, experience, quantity of fish and age, depreciation of fixed assets, marital status, years in school, amount of credit, operating costs and cost of marketing. High cost of activity, high mortality of catfish (fingerlings) after purchase, inadequate finance, high cost of labour, high cost of transport, high mortality of catfish after purchase, high cost of activity, inadequate finance and poor infrastructure, low patronage, low pricing of price and poor infrastructure and high cost of marketing activity were major constraints faced in Catfish value chain in the study area. It was recommended that catfish farmers should source for locally formulated feeds, which are often cheaper. This will reduce the overall cost of production and consequently improve the net farm income. It is very pertinent for primary actors to form well-coordinated co-operative societies as to enable them pool their resources together for effective collaboration with support actors such as input suppliers, government, insurance companies and other necessary organization for better performance of the catfish value chain. Government and all relevant stakeholders should provide adequate infrastructure to and adequate rural road network for quick evacuation of inputs and output, power for processing and storage including cold chain to increase value addition and improve shelf life of catfish products.

Keywords: Catfish value chain, Value chain map, Net value added, Quasi-elasticities

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Nigeria is proudly the most resourceful and vibrant African nation in the aquaculture industry and currently the leading producer of catfish in Africa [Federal Ministry of Agriculture and Rural Development (FMARD), 2013]. In spite of this, Nigeria is still far behind in her efforts at reaching optimality (i.e. tapping the highest potentials from every resource use and production pattern) in fish farming, thereby leading to artificial glut, and low value of non–exportable aquaculture products (FMARD, 2011). Due to these facts, value chain has gained more recognition and importance as a way of fighting poverty and achieving food security for fish farmers.

Catfish Value Chain according to Hempel (2010) is defined as every step, a fisheries business goes through from raw materials to the eventual end user. Catfish value chain is thus a chain of activities; products pass through all activities of the chain in sequence and at each activity the product gains some value (Alam, *et al.*, 2012). The chain of activities gives the products more added value than the sum of added values of all activities [Food and Agriculture Organization (FAO, 2011)]. Catfish value chain therefore, describes a high-level model of how fishery businesses receive raw materials as input (land, water, labour and capital), add value to the raw materials through various processes and sell finished products to customers (Alam *et al.*, 2012).

The nature of value chain activities differs greatly in accordance with the types of fish production the farmer is involved in (Ardjosoediro and Neven, 2008). Value chains for pisciculture differ between fish types as well as fish management and frequently within and outside various regions (De Silva, 2011). The goal is to deliver maximum value at the least possible total cost (FAO, 2011). The value chain framework shows that the value chain of a farmer or producer may be useful in identifying and understanding crucial aspects to achieving competitive strengths and core competencies in the marketplace (Dubay *et al.*, 2010). Value chains have various strategies that focus on those activities that would enable the farmer to attain sustainable competitive advantage and are also tied together to ultimately create value for the consumer (Alam *et al.*, 2012). Value chain offers the customer a level of value that exceeds the cost of the activities, thereby resulting in a profit margin (De Silva *et al.*, 2006). Cost advantage can be pursued by reconfiguring the value

chains. Reconfiguration or structural changes of value chain refers to activities such as new production processes, new distribution channels or a different sales approach (United Nations Environment Programme (UNEP), 2009). Moreover, differentiation of value chains stems from uniqueness. Differentiation advantage may be achieved either by changing individual value chain activities to increase uniqueness in the final product or reconfiguring the value chain (Wilkinson, 2006). Value chain analysis can help fish export of developing countries to be competitive in the international market (United States Agency for International Development (USAID), 2008).

In addition, the Value Chain approach can be a useful tool in the management of natural resources such as fisheries and aquaculture. It provides an analytical framework for crafting cohesive and inclusive strategies to guide the orderly development of the industry such that it benefits the environment and local business development. A value chain is a chain of activities and services required to bring a product or service from its conception to final customers, and final disposal after use (Kaplinsky and Morris, 2000). Value chains include input suppliers, producers, processors and buyers. They are supported by a range of technical, business and financial service providers. Value chain analysis (VCA) has been proved to be a useful means to assess performance in different systems including: distributional issues, pro-poor and gender equitable growth (Mayoux and Mackie, 2008; Rubin *et al.*, 2009; USAID, 2011; Macfadyen *et al.*, 2012).

Fish farming is the sub-set of aquaculture that focuses on rearing of fish under controlled or semi-controlled conditions for economic and social benefits (Folayan and Folayan, 2017). The African Catfish is a specie of catfish of the family Clariidae and its scientific name is Clarias gariepinus which was named by Burchell in 1822. The story of aquaculture in Nigeria is essentially the story of catfish culture and the hope of fish supply in Nigeria hangs on its development and culture. Folayan and Folayan, (2017), made a statement that fisheries products represented a major source of export revenue for developing countries, amounting to over US $20 billion per annum in late 1990s. This exceeded the values obtained from the exports of meat, dairy, cereals, vegetables, fruit, sugar, coffee, tobacco and oilseeds in 1997 from developing countries (International Trade Centre, 2002).

However, Food and Agriculture Organization (F.A.O) (2007), estimated that Nigeria imports about 560,000 tonnes of fish valued at about $400 million annually while annual domestic fish supply in Nigeria stands at about 400,000 tonnes. Catfish production is important to the Nigerian economy.

It serves as a source of income, reduces the rate of unemployment in the economy and increases the Gross Domestic Product (GDP). In most countries it fetches a higher price than tilapia. It can be sold live at the market as they have a market value two to three times that of tilapia (Emokaro, 2010). According to Olagunju, *et al.*, (2007), it requires less space, time, money and has a higher feed conserving rate. The importance of catfish itself cannot be overemphasized. According to Anoop *et al.*, (2009), it 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. Many species of fish are farm produced all over the world, but Catfish is taking the lead because of its uniqueness.

The demand for Catfish in Nigeria is unprecedented so much so that no matter the quantity supplied into the market, it would be consumed by ready buyers. This is so because of its low caloric value, low carbohydrate content, high in protein, low in fat, it is quick and easy to prepare and above all, it tastes great (Adebayo and Daramola, 2013).

Nath et al (2000) stated that there is still a great need for practical scientific knowledge, economic and profitability studies and knowledge of potential areas for site selection, development and expansion. In this respect, reliable analytical tools for use in decision making are key need in planning expansion. Thus, greater improvement in catfish input supply, production, processing, marketing and consumption can be achieved with a proper analysis that will lead to knowledge of the level of profitability of catfish farming and constraints to catfish input supply, production, processing, marketing and consumption. This constitutes the basis for this study.

1.2 Statement of the Problem

Animal protein consumption in Nigeria is less than 8 g per person per day, which is far lower than the FAO minimum recommendation (Omodele *et al.*, 2014). Although, fish and fish products provide more than 60% of the total protein intakes in adults, the supply of fish has been on the decline (Adekoya and Miller, 2004). It is due to consistent declines from the country's major source of fish (Ugwumba and Chukwuji, 2010). Domestic fish production is put at 551,700 metric tonnes as against the present National demand of about 1.5 million metric tonnes estimated for 2007 (Osawe, 2007). It was reported by Nigeria Bureau of Statistics that in spite of the country's

(Nigeria) capacity to produce enough fish, local fish production has failed to meet the country's domestic demand (Chilaka *et al.* 2014). This has led to the existence of a demand-supply gap of at least 0.7 million metric tonnes in Nigeria. Increased catfish production in the country, according to Chilaka *et al.* (2014), can help reduce this worrisome demand-supply fish gap, as the shortfall is said to be abridged by the importation (Odukwe, 2007). A number of factors had been identified to pose unnecessary limitations to sufficiency in fish production in Nigeria. The socioeconomic characteristics of catfish value chain participants leave a lot to be desired. They are mainly women, with considerable marketing experience but above a certain age, are not well trained, and lack the requisite skills and equipment to conduct an effective marketing system (Abah et al., 2013; Adebo and Toluwase, 2014). Freshly captured fish must be properly preserved, which necessitates the use of special equipment. Fish spoilage is on the rise in areas where preservation facilities are lacking, such as most developing countries. The lack of appropriate fish handling, preservation, and processing methods contributes significantly to the low supply of fish to people, especially the poor rural dwellers who make up three-quarters of the population in developing countries (Ikeme, 2006).

In a meeting of the African Regional Nutrition Strategy in 1993, Nigeria was included as one of the countries having the lowest daily per capita supplies of between 70-90 percent of nutrition requirements (Amao *et al.*, 2006). Therefore, increasing fish production in Nigeria requires embarking on pond fish farming. This has prompted the Federal Government of Nigeria to package the Presidential Initiative on fisheries and aquaculture development in 2003 to provide financial and technical assistance to government programmes and projects encouraging fish production (Ugwumba and Chukwuji, 2010). Similarly, the Imo State government created a fisheries component in their Agricultural Development Programme with many technologies to support fish farmers in order to compliment the Federal Government effort. Regardless of these efforts of Government, fish production has remained low in Nigeria (Ugwumba and Chukwuji, 2010). This has been attributed to inadequate supplies from the local fish farmers due to the use of poor quality fish seeds, inadequate information, high cost of feeds, traditional techniques, small size of holdings, inefficiency in resource use, poor infrastructural facilities, lack of credit, high cost of industrial feed, lack of extension agents, lack of veterinary doctors and lack of fish production equipment and low capital investment (Adeogun *et al.*, 2007; Inoni, 2007; Ugwumba and

Nnabuife, 2008; Adinya and Ikpi, 2008; Ugwumba and Chukwuji, 2010; Adinya *et al.*, 2011; Madubuike, 2012).

Increased fish production without commensurate effort to improve efficiencies of processing and marketing would still amount to widening demand – supply gap because agricultural production is never in isolation of these critical components: processing, marketing and distribution. Therefore, any inefficiency experienced in the fish marketing structure could jeopardize efforts towards increased production and reducing existing demand-supply gap. Lawal and Idega (2004) observed that marketing of fish is not usually on the basis of catfish producers - consumer link thus prices of fish change as it passes through middlemen such that by the time it reaches consumers it becomes expensive and out of reach of low-income household.

Most of the catfish value chain actors encountered marketing and processing challenges as a result of lack of storage facilities, hence they could not sell their fish fresh at appropriate prices, the issue of value addition as marketers have no access to modern smoking kilns which could increase their ability to sell catfish either in fresh or smoked form also posed a significant challenge (Adebo and Toluwase, 2014). According to Obasi and Onyeagocha (2014), factors such as low pricing of their product as a result of economic status of the consumers, availability of substitutes and competition for sales, access to credit, awareness, unavailability of water, lack of access road and high transportation cost, lack of storage facilities and high labour cost contributed to inefficient market of catfish as a consequence, widening the demand-supply gap of fish consumption leading to poor protein intake, malnutrition, food insecurity and hunger among people.

Greater improvement in fish production can be achieved with a proper analysis that will lead to knowledge of the effect of productive inputs on output of pond fish farming and constraints to pond fish production which constitute the basis for this study.

1.3 Objectives of the study

The broad objective of this study was to analyze catfish value chain in Imo state, Nigeria.

The specific objectives were to:

i. map the catfish value chain actors and their roles;

ii. describe the socio-economic characteristics of catfish input suppliers, producers, processors, marketers and consumers;

iii. estimate and compare the costs and returns along the catfish value chain;

iv. identify the factors that influence the choice of catfish enterprise of value chain actors;

v. isolate the determinants of the net value added of the actors in the catfish value chain;

vi. examine the constraints militating against value addition among input suppliers, catfish producers, processors and marketers.

1.4 Hypotheses of the Study

The null hypotheses to be tested states that:

Ho_1: There is no significant difference in the net farm incomes earned by the various actors in catfish value chain in the three agricultural zones of Imo State.

Ho_2: Factors such as level of education, gender, marital status, age, household size, experience, membership to association and net value added do not have significant influence on catfish value chain actors' choice of catfish enterprise in Imo state.

Ho_3: Socio-economic characteristics of the Catfish Value Chain actors do not have significant influence on the Value addition in the study area.

1.5 Justification of the Study

The findings of the study are useful for potential and practicing fish farmers, policy makers, researchers, extension agents and the general public at large. It will aids potential fish farmers in their enterprise selection and production pattern decisions. The fish farmers currently involved in this venture will in addition to the aforementioned information be able to utilize the findings of this study to realize vast opportunities unexploited in their enterprise. The policy makers will use these findings to plan effectively for fishery programme, since the finding will expose the inherent and peculiar socioeconomic characteristics of fish farmers and how these characteristics influence their technical efficiency. Researchers who intend to further studies on fish farming will find this work useful as a reference material. The findings will provide the extension agents good background information about the fishing community and systematic approach in carrying out the extension programs. The general public at large can also benefit from this study as it would provide information on profitability of catfish value chain in the study area.

1.6 Organization of the Study

The report of the study is organized into five chapters, followed by references and appendices. The first chapter is the introduction to the Catfish value chain in Imo State and contains the background information, statement of the problems, the research objectives and the justification for the study. Information on limitations and delimitations of the study is also catered for in this chapter. Organization of the study as a sub-topic closes the entire chapter.

The second chapter is titled literature review and looks into concepts, theories, research findings and publications relevant to the research topic and the literatures on the analytical tools that will be employed in the research. It is followed by Chapter Three which outlines the methods that were used for the study. It describes the research design type used, population and the sample for the

study; instruments used and procedures for data collection; and ends with the methods used for analyzing collected data.

Chapter Four is titled as results and discussions and comes after chapter three. It covers the results or findings of the study together with their corresponding discussions. It offers medium for inferences to be made by virtue of responses gathered from the participants of the research. This chapter is immediately followed by Chapter Five which contains the summary, conclusions and recommendations of the study. References and appendices are provided at the back of the report and that close the entire document.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Literature

2.1.1 Concept of Catfish

Catfish is an endemic species of fish having a ubiquitous distribution in rivers, streams, dams and lakes in the country. All the Clarias species reported in Nigeria (Greenwood, 1966) inhabit wetlands or wetland open interface. These groups of fish (siluriformes) are widely consumed in East Africa. Successful culture/captive breeding of this species has been done in the country and fingerlings raised (Macharia *et al.*, 2002).

In the culture of this species artificial reproduction ensures a year-round supply of fish seed. The African catfish is relatively insensitive to disease and does not have high water quality requirements. It tolerates high concentrations in the water of ammonia (NH_3) and nitrite (NO_2). Low oxygen concentrations are tolerated because the fish utilizes atmospheric as well as dissolved oxygen, (well-developed air breathing organs). It grows fast and feeds on a large variety of agriculture by products (De Graaf and Janssen, 1996). It can be raised in high densities resulting in high yields (6– 16 tons ha-1 year-1); and fetches a higher price than tilapia as it can be sold live at the market. The optimum temperature for growth is 250^0C (Hogendoorn, 1979).

Figure 2.1: A Sample of Catfish.

Source: Okechi, (2004).

2.1.2 Concept of Production Costs

Cost can be defined as the money spent in the course of producing inputs. Costs include value of inputs used in production. Cost is also one of the major price determinants in all market situations of the economy and in all economic models which could explain the behavior of the firm (Reddy *et al.*, 2009).

Cost of production can be classified into the following categories;

2.1.2.1 Explicit Costs

These are costs of acquiring capital and include interests paid on bank loans and bonds or money allocated to cover the depreciation of capital goods. In other words, it includes the costs incurred on repairing broken down parts of machines, repainting factories and decorating offices.

2.1.2.2 Implicit costs

These are sometimes called opportunity costs. They are the costs that capital and labour resources owned by the firm and employed in its production process could have earned in some alternative employment. In other words, it is the amount of other goods and services that must be sacrificed to obtain more of any good.

2.1.2.3 Cost Components

The various cost components of production costs include fixed, variable and total costs.

2.1.2.3.1 Fixed Cost (Total Fixed Cost or TFC)

Those costs which tend to remain constant in total amount regardless of their volume of production. They refer to the cost of physical assets such as tractors, buildings, lands, plants and equipment, etc.

2.1.2.3.2 Average Fixed Cost (AFC)

This is derived by dividing the total cost of producing any single commodity with total quantity (output) of goods produced. That is;

$$AFC = \frac{TFC}{Q} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2.1)$$

(Ebele and Nneamaka, 2018)

Where Q=Total output

AFC and TFC are as earlier defined above.

2.1.2.3.3 Variable Costs (Total Variable Costs or TVC)

These include those costs that vary with the level of production. In other words, they are input of factors of production whose costs usually vary as output changes at a given scale.

2.1.2.3.4 Average Variable Cost (AVC)

This is gotten by dividing the total variable cost with the total quantity of goods produced (output), that is;

$AVC = \frac{TVC}{Q}$. . . . . .(2.2) (Ebele and Nneamaka, 2018)

2.1.2.3.5 Total Costs (TC)

This is the total cost of producing any given level of output. It is determined by the addition of the total fixed cost and the total variable cost, that is;

TC= TFC+TVC or TC= FC+VC . . . . .(2.3) (Ebele and Nneamaka, 2018)

2.1.2.3.6 Average Total Cost (ATC)

At any given level of output, it is obtained by adding total average cost (AFC) and average variable cost (AVC), that is;

ATC =AFC+AVC . . . . . .(2.4) (Ebele and Nneamaka, 2018)

Alternatively, Average Cost (AC) = $\frac{TC}{Q}$. .. . . (2.5)

Where; TC and Q are as defined earlier.

2.1.2.3.7 Marginal Cost (MC)

This is the addition of total cost (TC) of producing one or more unit of output. Mathematically, it is gotten by dividing change in total cost (ΔTC) with change in total output (ΔQ), that is;

MC = $\Delta TC\ \Delta Q$. . . . . .(2.6) (Ebele and Nneamaka, 2018)

Alternatively, $MC = \frac{\Delta FC}{\Delta Q} + \frac{\Delta VC}{\Delta Q}$. . . . . (2.7)

2.1.3 Concept of Revenue

Revenue refers to the amount of money realized from or earned over the sale of a particular good or service rendered to as income. According to Raj (2005), revenue is seen as the total gross earnings of a firm before subtracting costs. The following include the components of farm revenue:

2.1.3.1 Total Revenue (TR)

This refers to the amount of money generated from the sale of some goods and services. Mathematically, it is given by;

TR = P.Q . . . . . (2.8)

Where TR = Total Revenue

P = Unit Price of that commodity (current market price)

Q = Total output or quantity produced of that commodity.

2.1.3.2 Average Revenue (AR)

This refers to the revenue per unit output. It is determined by dividing the total quantity of units or output by the total quantity of units or output produced.

That is; $R = \frac{TR}{Q}$. . . . . (2.9)

2.1.3.3 Marginal Revenue (MR)

This refers to the addition of the total revenue (TR) of selling one or more unit of output. It is stated thus;

$MR = \frac{\Delta TR}{\Delta Q}$ . . . . . (2.10)

Where MR = Marginal Revenue

ΔTR = Change in total revenue

ΔQ = Change in total output

2.1.3.4 Profit (π) or Net Revenue (NR)

Profit or net income can be defined as the amount by which the value of the output produced in the farm during the accounting period exceeds the value of the total resources used in the production process.

It is given by; π = TR – TC . . . . . (2.11)

Where π = Profit or Net Revenue (NR)

TR = Total revenue

TC = Total cost

The revenue function used by (Ohajianya, 2006) is written as TR = PxX

Where TR = Total revenue

Px= Price per unit of fuel woods sold

X = Quality of fuel woods sold

2.1.4 The Concept of Value Chain

Value chains provide the framework for designing and implementing many development programs and projects. Given a multitude of different arenas of application, geographical locations, commodity types, target groups and desired outcomes, a variety of closely related conceptualizations of value chains has emerged (Kaplinsky and Morris, 2001).

A value chain is "the full range of activities and services required to bring a product or service from its conception to sale in its final markets" (Microlinks, 2010). A value chain encompasses the entire network of actors involved in input supply, production, processing, marketing and consumption, these value chain actors operate within an institutional environment which can either facilitate or hinder its performance (Kaplinsky and Morris, 2001). Value chain therefore consist of a range of activities that are required to bring a product from its conception, through its design, sourcing of raw materials and intermediate inputs, its production, marketing and distribution to the final consumer (Humphrey and Schmitz, 2001).

According to USAID (2010) the Value Chain Analysis (VCA) characterizes the incremental value of a resultant product produced from processing of a product. For agricultural products, value addition can also take place through differentiation of a product based on food safety and food functionality. Price of the resultant product shows its incremental value. Hence, Kaplinsky and Morris (2001) defines VCA as the study of the "full range of activities which are required to bring a product or service from conception through the different phases of production (involving a combination of physical transformation and the input of various producer services) delivery to final consumers and final disposal after use". The study of value chain comprises of two important concept value and chain.

The term value is synonymous with value added in the incremental value of a resultant product produced from the processing of a product (USAID, 2010). The term chain refers to a supply chain indicating the process and the actors involved in the cycle (from inception to disposal) of a product (Hawkes and Ruel, 2011). Sanogo (2010) in addition to the movement of a product from one stage to another and identification of the actors, firms and their services also adds analysis of the institutional support to production at various stages to VCA. At production level of an agricultural produce, value addition will involve enhancements or additions to a product that result in higher returns to the commodity seller, who is often the farmer (Roduner, 2007). For instance,

technological enhancements, labour-saving steps, or any other innovation that allows the producer to offer more of a commodity is a form of "input value-added" enhancements that reduce costs of production thus returning value to the farmer. However, if the farmer grows specialty crops, engage in strategic marketing of commodities or he/she sells the product for a premium, this constitutes "output value-added" enhancements. A value chain can be understood as a set of businesses, activities and relationships engaged in creating a final product (or service). In this sense the value chain describes how producers, processors, buyers, sellers and consumers separated by time and space-gradually add value to products as they pass from one link in the chain to the next (UNIDO, 2009).

A chain is a number of different actors each specializing in different functions but linked through certain ways of cooperation in a network (Tevelde *et al.,* 2006). Kaplinsky, (2001) in his definition of a value chain emphasized on the added value realized and how it is communicated as the product moves from the producer to the consumer. Most authors succinctly defined a value chain as "a set of value-adding activities through which a product passes from the initial production stage to final delivery to the consumer" (Kanji *et al.,*2005). Kula *et al.,* (2006) define a value chain as a supply chain made up of a series of actors, from input suppliers to producers and processors to exporters and buyers, engaged in the full range of activities required to bring a product from its conception to its end use.

A value chain may be defined as the set of interconnected, value-creating activities undertaken by an enterprise or group of enterprises to develop, produce, deliver and service a product or service (Janssen *et al.*, 2006). Value chains include all of the vertically linked, interdependent processes that generate value for the consumer as well as horizontal linkages to other value chains that provide intermediate goods and services (Webber and Labaste, 2010).

Value Chain Actors: These are actors who deal directly with the products, i.e produce, process, trade and own them. Value chain actors are those who directly deal with the production, processing, packaging, trading etc. of a product. Usually they own the product for some time as it travels along the chain (Osuji, *et al.,* 2016).

2.1.5 Industry Supply and Value Chains

After understanding how the framework of the industry determines competition and profitability, it is possible to predict the future profitability of the industry (Grant, 2005). This involves description of the industry and market structures and relationships within that from both supply and value chains. It is from analysing these that it becomes possible to suggest strategies to adjust the industry framework.

The supply chain denotes a series of activities in which a product or material is transferred from one point to the final point while in the value chain; instead of just transferring the product, value creation and addition is involved (Feller *et al.*, 2006). As an example, suppose the flow of tilapia is from farmers to wholesalers to retailers and finally consumers. If the tilapia just goes through this channel without any grading, sorting or processing then it is a supply chain. If at each stage along the line, we add some value like grading, processing, packaging, cooling and storage, then it becomes a value chain. Value occurs when needs are fulfilled in terms of supply of goods and services in a transaction. Therefore, value flows from the person (or institution) receiving the goods or service i.e. the customer (Feller *et al.,* 2006). This is a key difference between a value chain and a supply chain: They flow in opposite directions (Figure 2.2).

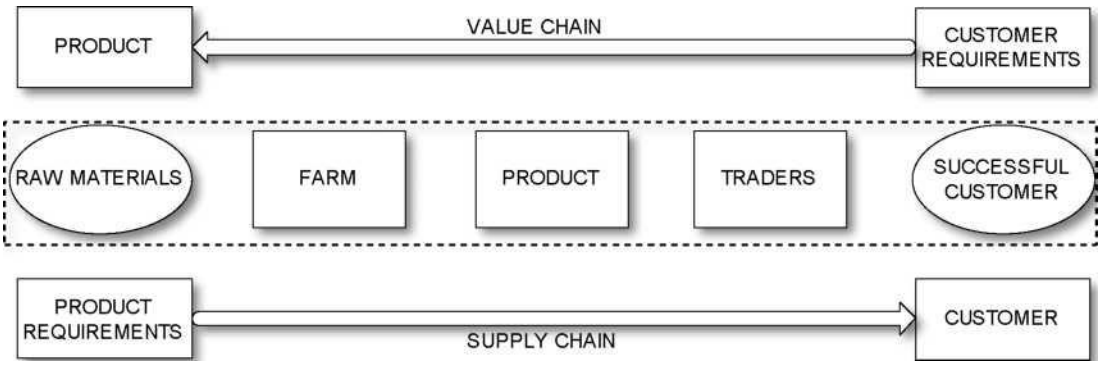

Figure 2.2: The concept of supply and value chain (Feller *et al.,* 2006).

The concept of efficient supply chain management is therefore mostly concerned with the reduction in production costs while value chains take this a step further and look at the effective ways of generating profit. Supply and value chains denote balancing views of the same business process that entail flow of goods and services (demand) in one direction and value (cash flow) in

the other. The producer is the source of the supply and the customer of the source of the value (Porter, 1998). Several studies have covered the issues of supply chain management in the food production industry, for example Folkerts and Koehorst (1998) on beef and Thorpe and Bennett (2004) on Nile perch. Thorpe and Bennett (2004) used the supply chain management model of Folkerts and Koehorst (1998) to study how changes in the market and supply chain of Nile perch may have undesirable outcomes for producers at the start of the chain. However, much as supply chain models have been successful, their use is being challenged with increasing interest in the value chain concept. Several factors now drive attention to a more profitability-oriented value chain analysis (Feller *et al.*, 2006).

- Increasing competition and focus on innovation as an element of strategy. Enormous competition has been caused by globalisation and a shift to value chains as a tool to model survival strategies is preferred by most actors.
- Evolving governance models for the extended enterprise. Interest in the value chain has increased as a primary tool for examining new models for business governance.
- Globalisation in outsourcing and purchasing has levelled the ground for value addition and thus the need for a global value chain model as a model of business in many industries.
- Benefits are already squeezed out of production and the supply chain. In order to improve the operational efficiency of other value addition activities in the business, shifting perspective from the supply chain to the value chain is a must.

Supply chains can generate maximum value only if they synchronize the flows of supply with the flows of value from customers addressing rapidly changing tastes, preferences, and demand. It is important to think of supply chains and value chains as integral.

Value reflects the total earnings at a given point in the chain and a firm makes a profit only after the value exceeds production costs (Grant, 2005). Scholars argue that the value concept rather than cost concept should be used when looking at competitiveness since firms often raise their costs to improve value of a product or item. Such a product would be priced highly but at the same time the customer will have higher value for money (DFID, 2008). The value chain margin is then the difference between total value added and total production cost and sustainable value chains are those with fair distributions of margins amongst actors (Porter, 1998). Each value chain performs

differently from the other depending on the actors, how they relate to each other, how information flows and who is in command of the chain (Sturgeon, 2000).

2.1.6 Value Added

Value added is created at different stages and by different actors throughout the value chain. Value added may be related to quality, costs, delivery times, delivery flexibility, innovativeness etc. The size of value added is decided by the end-customer's willingness to pay (USAID, 2012). Opportunities for a company or cooperative to add value depend on a number of factors, such as market characteristics (size and diversity of markets) and technological capabilities of the actors.

According to Kaplinsky (2000) access to high income yielding activities, with high added value, requires participation in global value chains aiming at market demanding products with high added value. These global value chains are often linked through long-term relationships supported by foreign direct investments. For commodities with low value added, however, the terms of trade with Western countries are in a downwards spiral (Kaplinsky and Morris, 2001). Raw materials are first made homogeneous and are differentiated again in processing and distribution stages (e.g. through packaging), because of the high costs of separating and controlling various materials flow upstream in the chain (Grunert, 2005).

Value addition is a representation of utility or value added to a commodity as it moves from one stage, place or form to another over time. As a commodity move from points of production to points of consumption, value is added to it according to the stages, places, forms or seasons, which the commodity undergoes. The value added attracts costs and margins thus, the price of the commodity from the net return such that return is regarded as a reflection of the value added to the commodity. Therefore, value addition considers the components of cost and returns. An agricultural commodity for instance undergoes different levels of processing after production, move place overtime thereby incurring costs and adding margins (Fakayode *et al.*, 2010).

According to CAPI (2012), the internal dynamics of the value chain process determines the value eventually added to the commodity. The internal dynamics include the costs incurred and the returns recorded while the external dynamics accommodates other factors that can influence the levels of cost and returns in the business such as the demographic characteristics of the participants in the system and environmental factors in form of nature of social infrastructure, government

policies, and inflation. Costs incurred and household demography has massive influence on value added to commodities (Stierwald, 2009).

Dewally *et al.,* (2013) stated that profits which represent value added are determined by price levels, volume of sales, paid taxes and other expenditures. Value added to commodities are in some case determined by the general economic conditions in the economy, market conditions, operating and financing decisions and the interplay of these factors (Mirea and Asalos, 2010). In laying more credence to the above, Jones (2000) stated that profits is the net return to business capital or investment and in addition to the typically included cash income and expense items, true profit calculations need to account for inventory charges, valuation of stock, accounts payables and receivables, depreciation, accrued interest and taxes. Ogundari (2006) noted that efficiency improves value addition or profits as the value of net returns are more likely to increase with enhance efficiency. Generally, value addition is directly influenced by the levels of cost and return. However, other factors that can cause variations in cost and returns equally influence value addition.

2.2 Theoretical Literature

2.2.1 Porter's Competitive Advantage

The term "value chain" was originally introduced in Michael Porter's book "Competitive Advantage - Creating and Sustaining Superior Performance" (Porter, 1985). The value chain analysis is based on Michael Porter's generic value chain model (Porter, 2001), developed in 1985 and used to explore Porter's model of competitive advantages through differentiation or cost leadership strategy. Porter always warns of the danger of being "stuck in the middle" (Porter, 1996). The model of competitive advantages will not be discussed in this study as the discussion would be too broad. It should be noted, however, that other authors like Mathur (1988) see exactly this "stuck in the middle" as a possibility for competitive advantage.

Porter breaks companies' value chains down into single activities. The method allows the firm to understand which parts of its operations create value and which do not (Ketchen and Hult, 2007). The aim is to cut the entire complicated supply chain of a company into smaller units. Hergert and Morris (1989) state that "the fundamental notion in the value chain analysis is that a product gains value as it passes through the vertical stream of production within the firm. When created value exceeds costs a profit is generated". The model was originally introduced for companies in the

manufacturing industry (Ketchen and Hult 2007), which has a significant impact on service firms. As the Figure shows, the value chain is segmented into primary and support activities.

Primary activities are those involved with a product's physical creation, sales and distribution, and after-sales service. In detail, this involves the product interrelations inbound logistic and operations and the market interrelations outbound logistic, marketing, sales and after-sales service (Ireland *et al.*, 2009, Mowen and Hansen 2011). Primary activities are always defined as value-added activities which are "those that customers perceive as adding utility to the goods or services they purchase" (Lanen *et al.*, 2008).

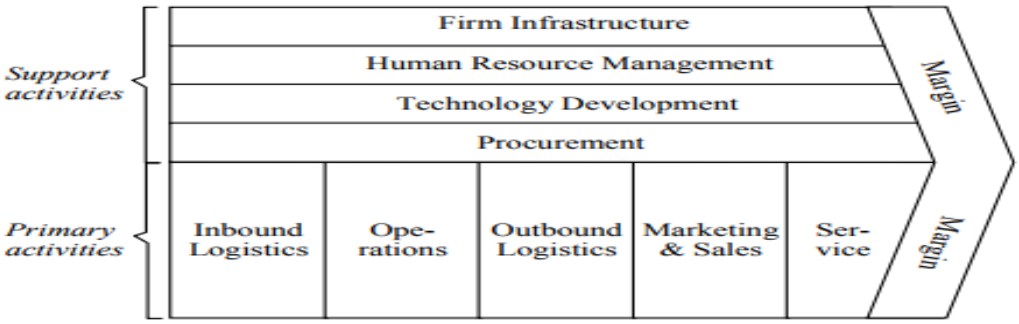

Figure 2.3: Classical value chain: adapted from Porter (2001).

Support activities provide the assistance necessary for primary activities. In detail, this involves the infrastructure interrelations firm's infrastructure and human resource management, technological interrelations (technology development) and procurement interrelations (procurement) (Ireland *et al.*, 2009, Mowen and Hansen 2011). Those activities are not part of the closer value chain they are included in every function of the value chain (Lanen *et al.*, 2008).

Usually most companies do not produce all components by themselves and has, as incoming, a set of already-finished products. In this situation, the company is part of a larger supply chain and needs to consider linkages with external activities (Mowen and Hansen 2011). Porter (1985) also identified the importance of chains or networks which lies outside and controlled by other companies. The upstream-suppliers (preceding company) provide input to a company which adds value (own company), which then downstreams the products to the next company (following company) (Normann and Ramirez 1993).

The target of a well-planned and organized value chain is to maximize value creation while minimizing costs, where all activities of a company link efficiently together (Lynch, 2003). The

result of adding together the total value and the cost of creating value is, according to Porter (1985), the margin. The total value is referred to as the price a customer is willing to pay (Macmilan and Tampoe, 2000). According to Johnson *et al.*, (2008), especially in service organisations, the organisational culture also has an impact on creating value, as culture includes the way people perform the service, which if it successfully enhances competitive advantages and is difficult for competitors to copy.

Accounting data is also essential for the value chain analysis. Therefore, cost accounting is an excellent approach to dedicating cost to single functions and operations (Kinney and Raiborn 2009). According to Lanen *et al.*, (2008), measuring the effects of a value chain is a fundamental service of cost accounting.

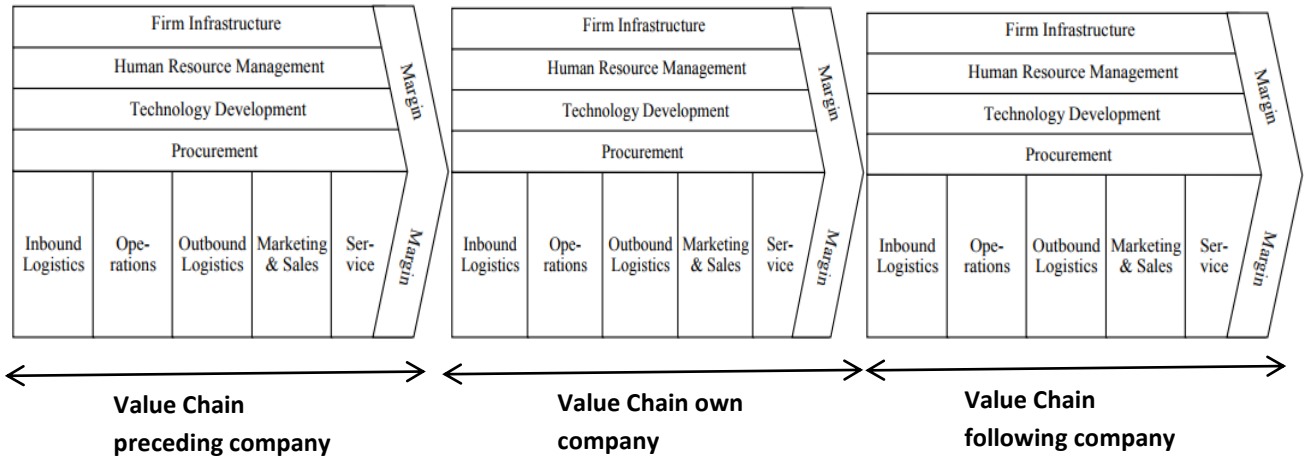

Figure 2.4: Value chain as part of a network of chains: adapted from Porter (2001).

2.2.2 Gereffi's Global Community Chain (GCC)

In the 1990s, Gereffi (1999) developed the global commodity chain (GCC), originally derived from Wallerstein's commodity chain (Bair, 2005). Gereffi established four core elements

(a) input-output structure
(b) territorial (International) structure
(c) institutional framework and
(d) governance structure.

The focus was set on governance referring to institutional mechanisms and inter-firm relationships. The main attention was paid to balance the power embedded in the coordination of globally

fragmented but interlinked production systems. Gereffi concluded that many chains are characterized by some dominant actors who determine the overall character of the chain. These actors become responsible for upgrading possibilities, knowledge transfer, and interaction coordination within the value chain.

2.2.3 Utility theory

Utility is a measure of relative satisfaction. It refers to the total satisfaction derived from the consumption of a good(s) and/or service(s). Utilities are created through production activities which involve the making of goods and services useful and available, and marketing is a major part of the production process. There are various forms of utilities that can be created through the production processes. These include utility of form, utility of place, utility of time and utility of possession (Koutsoyiannis, 1977).

Posner (2011) Form utility is created through the process of transformation of products, goods and services from one form to another. Fish are not normally consumed the way they are produced. Their original forms are changed to forms which can give maximum satisfaction to different classes of consumers. Most times they have to be transported to places where there is effective demand for them. This is made possible through marketing activities.

Furthermore, fish are usually not consumed when they are harvested or produced.

According to Idowu *et al.*, (2012), fish abundance is only experienced in the rainy season; however, their consumption is year-round. Time utility is created in the process of making fish available to consumers all the year. Time utility is created through processing and storage activities. Through marketing activities, fish may be stored and processed by drying, smoking or boiling. This helps to preserve the fish and make it fit for consumption throughout the year. In the same vein, according to (Adebayo and Adeola, 2005) marketing activities help in the creation of possession utility. By so doing, marketing activities assist the consumers in acquiring and taking title to desired products. The processes that bring about these utilities are carried out by middlemen; as such they perform very important roles in marketing activities.

2.2.3.1 Theory of Production

This phase involves growing of the fingerlings/juveniles to table size catfish and it takes place in different water holding systems. These systems are the earthen ponds, concrete ponds, fibre glass tanks, cages, the intensive recirculation systems and any other containers that can hold enough water to keep the catfish alive. The earthen ponds, as the name implies is as a result of earth

movement resulting in a water holding depression. The water could be introduced through rainfall, borehole, and reservoir or through seepage (Olagunju *et al.* 2010). After careful preparation (i.e. liming and fertilizing) the catfish is stocked and fed to table size (1-1.2kg in four months with good feeding) for the market (Federal Department of Fisheries, FDF Data). It has been observed that there is a significant relationship between feed size and the growth in catfish. In line with this, feeding of catfish with feed of smaller sizes make them to feed more and it enables easy digestibility thereby increasing growth (Erik, 2010).

2.2.3.2 Theory of Processing

Processing of catfish changes its form to products that meets consumers preferences. The theory holds that more benefit (value) is achieved in the processing industries when there is an additional improvement in management and efficiency in the processing of catfish. This implies that improved varieties that meets the consumers taste, quantity and quality will enhance the supply of catfish that meets consumer's preference. This theory ensures that consumer's preference is not compromised as the catfish is changing from the form after harvest, to the form the consumer will want to place his demand (either smoked, grilled, fresh, frozen, etc.) (Greenfield, 1970).

2.2.3.3 Theory of Marketing

The next stage in the process is the trade and marketing. The processed products have to be transferred to the places of demand and distribution and sold there. This theory holds that mmarketing can be done directly by the producers or processors, but the higher the amount and quality of the traded goods the higher are the requirements for marketing. In such cases, restaurants, hotels, logistic companies, corporations and supermarket chains are mainly found on this stage (Rahji *et al.* 2010).

2.2.3.4 Theory of Consumption

The last stage is consumption of a good. Even though the consumer neither participate in the production nor add value to the product, he is part of the chain because in most cases the consumer is the driving power of the whole process. Therefore, consumer demand is a determining factor for the kind, amount and quality of a product (UNIDO, 2009).

2.3 Empirical Literature

2.3.1 Socioeconomic characteristics of catfish farmers in Nigeria

The socioeconomic characteristics of fish farmers from empirical findings on catfish farming in different parts of Nigeria reviewed are as follows:

Age: Awoyemi (2011) in a study conducted in Osun State revealed that the catfish farmers whose ages fall between 31 and 40 years constituted the majority and on the whole, 80.0% fall into the economically active group of 20 – 50 years. The result of Ele *et al.*, (2013) shows that the farmers that are actively involved in catfish farming in Cross River State fall within 40 - 50 years and this means that the farmers still have the strength to run the business. Olasunkanmi (2013) revealed that the mean age of catfish farmers was 40 years. Akegbejo-Samsons and Adeoye (2012) revealed that the average age of catfish farmers in South West Nigeria was 43.5 years, with 55.5% between 36 and 45 years age category, and 27.5% in 16-35 years category. According to Henri-Ukoha (2012), majority of the fish farmers in Abia State fell in the age bracket of 41 – 50 years with a mean of 43 years.

Gender: Ele *et al.,* (2013) revealed that the males (81%) were actively involved in fish farming than the females (19%) in Cross River State. In a study carried out in Osun State, only few women (8.3%) were involved in fish farming in the state (Olasunkanmi, 2013). He further reiterated that there was need for extension services that would encourage more women to be involved in fish farming so that similar mistake made in Chibote, Zambia where fish farming was seen as an activity for male youth would not occur in the State.

Marital status: The findings of Awoyemi (2011) showed that majority (67.7%) of the fish farmers were married in Osun State. In a similar study, Olasunkanmi (2013) reported that fish farmers in Osun State Nigeria were mostly married (97.2%). The report of Agbebi (2012) on the marital status of fish farmers in Ekiti State showed that most (78.9%) of the fish farmers were married. This suggests that there may be high demand for food and additional income as the family size increases. Few percentages (15.6%) of the respondents were single and this indicates that they were youths and they still had strength to work on the pond without hiring labour. Those that were widowed were 3.3% and 2.2% were divorced. Okoedo-Okojie and Ovharhe (2012) in a study conducted in Delta State discovered a higher proportion (47.3%) were single. This could be

attributed to the young age of respondents, and implication that marital status was not a bias in fish farming in the study area. Apata (2012) in a study conducted in South-Western Nigeria found that majority (60.0%) of the fish farmers were married.

Household size: According to Akegbejo-Samsons and Adeoye (2012), in a study conducted in South West Nigeria, the mean household size of the fish farmers was 8 persons. Henri-Ukoha (2012) reported that most (63.3%) of the fish farmers had household size of 1 to 5 persons with a mean household size of 5 persons. Olaoye *et al.,* (2011) in a study conducted in Ogun State revealed that most (80%) of the fish farmers had household sizes of 2 to 6 persons. Olaoye *et al.,* (2013) in a study conducted in Oyo State revealed that majority (68%) of the fish farmers had household sizes of 4 to 7 persons with a mean of 6 persons and standard deviation of 0.563.

Education: The findings of Ele *et al.,* (2013) in Cross River State revealed that all the respondents are learned and highly educated as all of them had tertiary education. This means that fish farming is a highly technical enterprise that requires learned farmers. According to Olasunkanmi (2013), fish farmers in Osun State, Nigeria, were well educated (52.8% having tertiary education) and were mostly married (97.2%).

Agbebi (2012) revealed that Majority (83.3%) of the fish farmers in Ekiti State had one form of tertiary education or the other, while 11.1% and 4.4% had secondary and primary education, respectively. Just 1.1% had no formal education. This means that fish farming is dominated by the educated class with tertiary education. This is so because fish farming requires a lot of technical and scientific knowledge. In the work of Agboola (2011), majority (43%) of the fish farmers had tertiary educational qualification while few (13.3%) had primary educational qualification.

Farming experience: In the work of Nwosu and Onyeneke (2013), majority (65.00%) of the farmers had fish farming experience of 4-6 years while the average fish farming experience of the farmers was 5.4 years. The farmers have had an experience about the fish farming which implies that they have knowledge of managing the enterprise for the purpose of maximizing production. Experience of farmers increases their farm production.

Most (60%) of the fish farmers in Abia State as reported by Henri-Ukoha (2012) had 13 and above years of fish farming experience with a mean of 10 years.

Membership of association: According to Olasunkanmi (2013), most of the fish farmers (72.2%) in Osun state did not belong to any fish farmers' association. Agbebi (2012) revealed that majority (58.9%) of the fish farmers in Ekiti State did not belong to any social group while 27.8% subscribed to co-operative societies. Those engaged in monthly contribution constituted 8.9%of the respondents, while 4.4% of them held membership of Fish Farmers Association. Those that did not belong to any social group were many because majority of the farmers in the study area lacked knowledge on the benefits of those social groups.

The findings of Aphunu and Nwabeze (2012) revealed that majority (43.8%) of the fish farmers in Delta State belonged to fish farmers Association for the purpose of credit and accessibility to information. Solomon *et al.* (2013) in a study carried out in Lagos State revealed that majority (86.7%) of the fishers did not belong to any fishery association while 13.3 per cent belonged to a fish association.

Access to credit: According to Henri-Ukoha (2012), majority (63.3%) of the fish farmers in Abia State had no access to credit. The study carried out by Agboola (2011) showed that majority of the farmers did not have access to credit. A good proportion of the respondents (40%) began by using their own savings, sales and gifts or loan from families and relatives as well as friends. This is due to the fact most banks charged high interest rates and most farmers, had no collateral. Because of this poor access to credit, farmers could not expand their scope of business.

Access to extension contact: Adewuyi *et al.,* (2010), in a study carried out in Ogun State, revealed poor extension visits to fish farmers as 78% of the fish farmers had no access to extension in the study area. Solomon *et al.,* (2013) in a study carried out in Lagos State indicated that majority (85%) of the fishers reported that they had no agricultural extension contact in their artisanal fishery operations. Also, 69.5 %of fish farmers claimed they had no agricultural extension contact. All (100%) of those that were visited by extension agents indicated that they were visited once a while. The low contact of agricultural extension agents may be due to poor funding of agricultural extension in the State.

Pond size/number of ponds: According to Adewuyi *et al.,* (2010), the average pond size in Ogun State was 335 m^2. Aphunu and Nwabeze (2012), in a study on small scale fish farmers who engaged in fish farming for the purpose of augmenting household incomes in Delta State, majority (73.8%) of the respondents had between 1 and 5 fish ponds.

Essien *et al.,* (2010) in a study carried out in Akwa Ibom State reported that 70% of the fish farmers had small ponds of 10 x 8m size. Ufuoku *et al.,* (2006), in a study undertaken in Delta State, revealed that most (48%) of the fish farmers had ponds ranging between 100 and 150 m^2 in size, 46.7% between 151 and 200 m^2, 4.0% between 201 and 250 m^2, 1.3% 251–300 m^2 while none had pond above 300 m^2 in size.

2.3.2 Fishery Production in Nigeria

Nigeria has become one of the largest importers of fish in the developing world, importing some 600,000 metric tonnes annually (Olagunju *et al.,* 2007). The awareness on the potential of aquaculture to contribute to domestic fish production has continued to increase in the country (Adewuyi *et al.,* 2010). This stems from the need to meet the much-needed fish for domestic consumption and export. Fish species which are commonly cultured include *Clarias gariepinus, Tilapia spp, Heterobranchus bodorsalis, Mugie spp, Chrysichthys nigrodigitatus.*

The practice of culturing fish in ponds developed because growing fish in ponds is a more useful practice for some purposes, than trying to catch fish from lakes, rivers, or streams (Sharon, 2008).For example, many interested people discover that building afish pond close to home is possible and far more convenient than going to the nearest market or river. It is easier to get fish out of a pond and can be controlled. But it is very difficult to know how many fish can be caught in a river or stream or lake at any one time. Therefore, figure 2.5 below represents a fishery production trend in Nigeria between year 1970 – 2010.

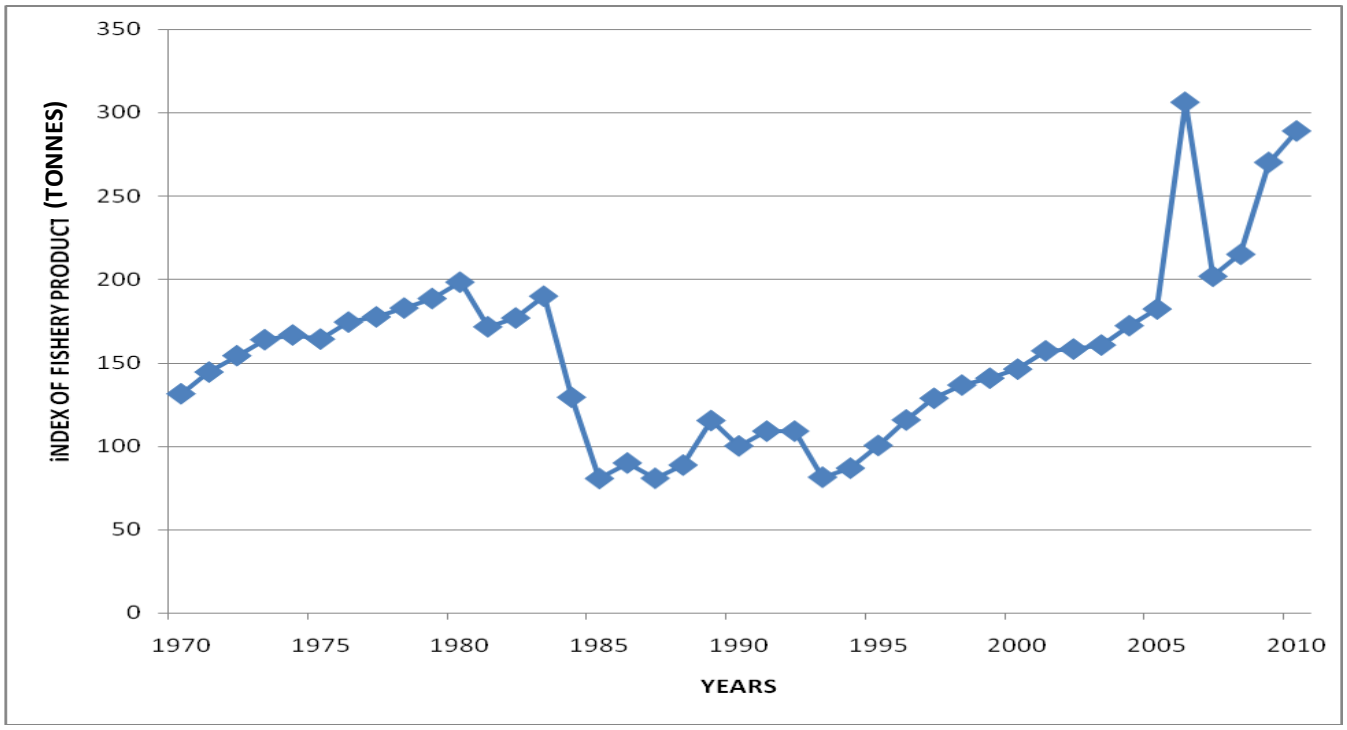

Figure 2.5: Fishery production trend in Nigeria (1970 – 2010).

Source: CBN (2008; 2011)

2.3.3 Economic Importance of Catfish

The importance of catfish itself cannot be overemphasized. According to Anoop *et al.*., (2009), it provides food for the populace, it allows for improved protein nutrition because it has a high biological value in terms 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.

Proteins are the major structural components of all cells of the body and amino acids are the building blocks of protein. Proteins can function as enzymes, membrane-carriers and hormones (Jensen, 1994). Protein contains approximately 22 amino acids, eight of which are essential because the body cannot produce them. Therefore, they must be obtained from our food. The sulphur-containing amino acids: methionine, cystine and cysteine are particularly important for the health of the brain and nervous system (Addo, 2005).

Protein is required for the growth, maintenance and repair of all body tissues. Protein is 90% of the dry weight of blood, 80% constituents of enzymes, hormones and antibodies (Fallon and Eing, 2001). Proteins encompass many important chemicals including immunoglobulin and enzymes. Lack of dietary protein can retard growth in children and in adult, can be a contributing factor in chronic fatigue, depression, slow wound healing and the decreased resistance to infections (Iyangbe and Orewa, 2009).

2.3.4 Catfish Production in Nigeria

Catfish farming is the sub-set of aquaculture that focuses on rearing of fish under controlled or semi controlled conditions for economic and social benefits (Anthonio and Akinwumi, 2002). The African catfish is a species of catfish of the family *Clariidae* and its scientific name is *Clarias gariepinus* which was named by Burchell in 1822. The story of aquaculture in Nigeria is essentially the story of catfish culture and the hope of fish supply in Nigeria hangs on its development and culture. Food and Agriculture Organization (2002), made a statement that fisheries products represented a major source of export revenue for developing countries, amounting to over US $ 20 billion per annum in late 1990s. This exceeded the values obtained from the exports of meat, dairy, cereals, vegetables, fruit, sugar, coffee, tobacco and oilseeds in 1997 from developing countries (International Trade Centre, 2002).

Statistics indicate that Nigeria is the largest African aquaculture producer, with production output of over 15,489 tonnes per annum, this is closely followed by Egypt with output of about 5,645 tonnes. Only five other countries: Zambia, Madagascar, Togo, Kenya and Sudan produce more than 1,000 tonnes each (FAO, 2007).

However, F.A.O (2007), estimated that Nigeria imports about 560,000 tonnes of fish estimated at about $400 million annually while annual domestic fish supply in Nigeria stands at about 400,000 tonnes. This makes Nigeria one of the largest importers of fish in the developing world. Catfish production is important to the Nigerian economy. It serves as a source of income, reduces the rate of unemployment in the economy and increases the Gross Domestic Product (GDP). In most countries it fetches a higher price than tilapia as it can be sold live at the market as they have a market value two to three times that of tilapia (Emokaro, 2010). According to Olagunju, *et al.*, (2007), it requires less space, time, money and has a higher feed conserving rate.

Many species of fish are farm produced all over the world, but Catfish is taking the lead because of its uniqueness. The demand for Catfish in Nigeria is unprecedented so much so that no matter the

quantity supplied into the market, it would be consumed by ready buyers. This is so because of its low caloric value, low carbohydrate content, high in protein, low in fat, it is quick and easy to prepare and above all, it tastes great (Adebayo and Daramola, 2009).

2.3.5 Catfish Processing in Nigeria

Processing of fish helps to make fish attractive to the consumers and also elongates its shelf-life (Akinneye *et al.*, 2007). Okonta and Ekelemu (2003), also reported that processing of fish is very important since fish is highly susceptible to deterioration immediately after harvest, thereby preventing economic losses. When fish is captured or harvested for commercial purposes it needs some processing so they can be delivered to the next stage of the marketing chain in a fresh and undamaged condition. If fish is not sold fresh, some activities are needed to be carried out to prevent bacteria which cause metabolic change that result in the loss of fish quality (Tawari, 2006). As such, the central concern of fish processing and preservation is to prevent fish from deteriorating and this remains an underlying concern during processing operations.

According to Davis (2008), efficient preparation of fish is important when top quality, maximum yield and highest possible profits are to be achieved. In the view of Ajuba and Omeje (2006), processing will enable fish storage operators achieve their primary objective of profit enhancement and waste reduction during times of bumper harvest. The development of fishing machinery and techniques that can be employed for effective fish handling, processing and storage can never be over emphasized especially in the age when aquaculture development is fast gathering momentum in Nigeria (Akinneye *et al.*, 2007). Other methods used to preserve fish and fish products include: control of temperature using ice, refrigeration or freezing, the control of water activity by drying, smoking or freeze drying, physical control of microbial loads via microwave heating or ionizing irradiation and chemical control of microbial loads by adding acids and oxygen deprivation, such as vacuum packing. (Akpabio and Ekanem, 2008).

In a study conducted in South western Nigeria, the predominant fish processing and preservation methods included salting, sun-drying, smoke-drying and frying (Kolawale *et al.*, 2010). A similar study conducted in Niger Republic revealed that salting and smoking of fish were the popular fish preservation and processing techniques (Kassali *et al.*, 2011). Further studies showed that in Liverpool market of Lagos State, smoked fish was the sole processed fish marketed constituting about 65% of all fish marketed both fresh and processed (Ayo-Olalusi, *et al.*, 2010). Kainga and

Adeyemo (2012) reported from their study in Bayelsa State that smoking, refrigeration and salting were major methods of fish processing and preservation. Similar studies also showed that salting, smoking, refrigeration and sun-drying were among the major fish processing measures (Nwabueze and Nwabueze, 2010; Akankali and Jamabo, 2011; Madugu and Edward, 2011).

2.3.6 Fish Demand and Supply in Nigeria

The fisheries sub–sector in Nigeria account for about 40% of animal protein in the diet and it contribute to 4.47% of the Agricultural share of the Nation's GDP in 2003 (Ojo and Fagbenro, 2006). Recently demand for fish product has doubled as other sources of animal protein have become expensive due to pressure by the ever –increasing population and the high population cost of the other animal protein source. Domestic fish demand in 1998 was 1.52 million tonnes while the domestic production was 292,800 tonnes (sufficiency ratio of 19.26%) (Ojo and Fagbenro, 2006).

In marketing, fish passes through various market participant and exchange point before they reach the final consumer. These markets intermediaries are the wholesale and retail. Both play important role in marketing of system, at all stages in the marketing channel, fish has to be packed un-packed to meet consumer's demand (Ojo and Fagbenro, 2006).

To maintain the freshness of fish, the catch must be preserved or processed. However, several fish processing methods include fermentation, drying, frying, canning, Salting and smoking may be done in a variety of ways: pre-drying or salting before smoking; cold-smoking which involves the use of little fuel-wood that produces low heat and the products obtained do not keep long; and Hot-smoking which entails the application of much more heat, through the burning of large quantity of fuel-wood (Emere and Dibal, 2013).

The products from hot-smoking are tastier and have longer shelf-lives. Smoking preserves fish by drying, cooking and depositing natural wood-smoke chemicals like tars, phenols and aldehydes all of which have powerful bactericidal action and prevent the growth of other micro-organisms on the flesh of the fish (Obodai *et al.*, 2009).

The flavour of smoke lies in the quantity of the smoke that the flesh is coated with (Obodai *et al.*, 2009). The smoke determines the colour, which is one of the qualities that attract consumers. The colour is largely dependent on the method as well as the type of fuel wood used in smoking the fish. The colour ranges from black, dark brown, golden brown or light brown to dirty white.

Consumer preference for colour of smoked fish varies from place to place. Preservation by smoking is probably the oldest and most popular method of fish preservation in Nigeria and is carried out mostly by women. Fish may be smoked in many ways but the longer it is smoked, the better it will keep. However, in order to improve smoking techniques, some control must be exercised over temperature, airflow and Smoking density. Traditional open type oven produces non-uniform smoked product, consume high quantity of wood (Obodai *et al.*, 2009).

2.3.7 Costs and Returns of fish farming in Nigeria

According to Awoyemi (2011), an average total cost of ₦ 371, 486.35 was incurred per annum by fish farmers in Osun State while gross revenue of ₦791,242.52 was realized with a gross margin of ₦ 574, 314 and a profit of ₦419, 756.17. The rate of return on investment of 0.58 implies that for every one naira invested in Fish production by farmers, a return of ₦ 1.5 and a profit of 58k were obtained.

In a report on the profitability of fish farming in Abia State, Henri-Ukoha (2012) found that the overall variable cost was $535,055 and the revenue was $810,000, yielding a gross margin of $274, 945 per pond. Meanwhile, the net farm income was ₦263,890. However, the rate of return on the business was 1.48. This implies that for every one naira spent in the fish farming business 48k was returned.

Anyanwu *et al.,* (2009) in a study conducted in Onitsha reported that a gross margin of ₦ 96, 002.29 and net enterprise income of ₦ 63, 192.14 was realized by the fish farmers in a production cycle.

Oguoma *et al.,* (2013) in a study carried out in Imo State reported the profitability of the fish farmers in the three agricultural zones of the State as follows: in Owerri Agricultural Zone, the sum of ₦596, 910/tonne/year was earned per farmer as average total revenue and, with an average total cost of production of ₦ 160, 279.30, the sum of ₦ 436, 630.70 was earned as net return with a return on investment of 2.72; In Okigwe Agricultural zone, average total revenue of ₦ 621,440/tonne/year was earned per farmer with an average total cost of production of ₦186, 414.51, giving a net return of ₦435,025.49 and 2.35 as return on investment; In Orlu Agricultural Zones average total revenue of ₦ 650, 560/tonne/year was earned per farmer with a total cost of

production of ₦188, 155.80 per tonne, giving estimated net revenue of ₦ 462, 404. Although this result shows fish production to be profitable in the state, it suggests that it was most profitable in Orlu Agricultural Zone, followed by Owerri Agricultural Zone, and then Okigwe Agricultural zone.

2.3.8 Constraints of fish farming in Nigeria

Adewumi and Olaleye, (2011) found out that a number of problems confront the production of catfish; being a major specie in Nigeria. Prominent among these are: Poor management skills, inadequate supply of good quality seed, lack of capital, high cost of feed, faulty data collection, lack of environmental impact consideration and marketing of products. If the associated problems of production, especially the twin issue of feed production and fingerling supply are tackled, Nigeria will soon become a world exporter of catfish.

According to Olasunkanmi (2013), the fish farmers in Osun State were confronted with one problem or the other and most of the farmers identified more than one problem and that the most important problem identified in this study is that of cost of feed (66.7%). Kudi *et al.*, (2008) reported that the most important problems encountered in fish production in Kaduna State were capital, marketing and diseases and pests as indicated by as many as 98%, 82% and 57% of the respondents, respectively. Also, 21% faced water supply problem, which, however was not severe.

According to Akegbejo-Samsons and Adeoye (2012), there are many constraints hindering efficient production of fish by the farmers. The two most serious problems in the study area indicated by all the respondents (100%) were high price of fish feeds and high mortality of stocked fish. Ninety five percent of the respondents opined that the acute shortage of fry and fingerlings was a major problem when they wanted to re-stock their ponds after each cycle of production. Eighty five percent of the farmers complained of lack of skilled workers needed for daily production routine and lack of capital needed for expansion of the business.

Olaoye *et al.*, (2013) reported that majority of the fish farmers (94.6% and 96.0%) in Oyo state claimed that poaching/predators and high cost/lack of construction equipment respectively were one of the major challenges facing aquaculture development in the study area. It was also shown that all (100%) of the respondents considered market price fluctuation and high cost of fish feed as a problem facing fish production. Some other factors militating against aquaculture production

included; water shortage during dry season (92.3%), diseases and pest infestation (32.4%) and lack of technical know-how (42.4%).

In the work of Anyanwu *et al.,* (2009) all the fishermen were of the view that cold room and other storage facilities were major problems. These would increase fish spoilage which will reduce their income. Other problems encountered by the fish farmers were lack of credit facilities and poor funding. The credit facilities, which they needed, could aid them to get more of fishing nets, outboard engine and boats. This will improve fishing activities and enable them adopt new technologies.

The findings of Nwosu and Onyeneke (2013) in Owerri, Imo State, revealed that majority (60.00%) of the pond fish farmers reported inadequate finance as a major problem challenging pond fish farming in the area. The second serious problem was the problem of high cost of feed as reported by 52.50% of the farmers. The scarcity of commercial pelleted and floating fish feed mills and problems associated with production and distribution of fish feeds could be the main reasons for the hike in feed prices. Lack of good sources of fingerlings is the third serious problem reported by 50.00% of the pond fish farmers. This could be due to the nearly inexistence of local supplies of pond fish fingerlings in the study area. The fourth serious problem to pond fish production reported by 45.00% of the farmers was high cost of transportation. This is due to the inadequacy of motorable roads in the area.

Olasunkanmi and Yusuf (2014) in a study carried out in Osun State identified the most important factor inhibiting farmers' productivity in the study area as lack of support from extension officers during site selection (22.13%) for construction of pond or any other farm activities, insufficient fund (15.69%), absence of government assistance (10.64%), high cost of feed and other inputs (11.77%), market price fluctuation (10.36%) and flooding during the raining season (5.60%).

Nwaobiala and Ebeniro (2012) in a study conducted in Edo State found that majority of the respondents (70.0%) claimed that unimproved fingerlings is their major problem, while 40.0% identified poor quality feeds as another problem. Thirty-three point three per cent and 26.67% of the catfish farmers indicated that irregular supply of feeds and fingerlings and government policy on fisheries development are their problems respectively. Finally, 16.67% of the respondents identified poor water quality as their problem as a result of water salinity.

2.3.9 Review of studies on catfish farming

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. The study found that the market price of fish (₦400–₦1,200) and debt/asset ratio of less than one. The financial outcome of the farm ranged between ₦48,210 and ₦1,841,002 depending on the size of the farm 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. 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.

Emokaro *et al.*, (2010) analyzed the economics of catfish farming in Lokoja and Adavi Local Government Areas of Kogi state. The simple random sampling technique was used in selecting 40 catfish farmers. The result also showed estimated average annual gross revenue of $5,723 and an average net profit of $2,576, amen 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 at 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. Primary data were obtained in a simple random sample of 60 farmers and descriptive statistics were used to analyze the socio-economic characteristics of catfish farmers while the stochastic production frontier function analysis was used to determine the technical efficiency of the farmers. The empirical result showed that the estimated farm level of 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.

2.3.10 Constraints of Value Addition

2..3.10.1 Capitals

One of the most crucial factors of production known to man is capital. Capital is needed to set up and catfish production and processing farm and capital is needed to sustain productivity. One of the major constraints of the animal industry especially in developing countries like Nigeria is capital. This implies that farmers are not able to afford a lot of infrastructural and other facilities that they need for maximum productivity. To worsen matters loan facilities are hardly available and where they are available there are lots of bottle-necks and constraints to accessing such loans. Many of the farmers involved in animal production have to find other sources of income to better the quality of life of their families (Bamaiyi, 2013).

2.3.10.2 High cost of animal feeds

Nutritious animal feeds are essential for full development and productivity of animals. Animal feeds are not readily available and where they are they are not easily affordable for an average farmer. Since farmers go into animal production for profit they need to obtain feed at a price where they do not only break-even: but also make reasonable profit. Due to the high cost of feeds various research alternatives have been sought for other means of providing animal feeds to ameliorate the effects of cost of feed (Bamaiyi, 2013).

2.3.10.3 Level of education of farmers

It is a well-known fact that most farmers have a low level of education or are even illiterates making it difficult for them to employ modern animal production techniques where traditional techniques have failed or yielded less profit. A study carried out in Osun state has found that education level had significant and positive relationship with average catfish production (Adebayo and Adeola, 2005).

2.3.10.4 The Role of the Government

The failed policies of the government are most of the times inimical to the progress of the catfish industry. Sometimes politicians ban the importation of goods not readily available in the country in an attempt to help home grown industries but without providing viable alternatives. An example is the shortage of feeds and sky-rocketing high prices due to scarcity of raw materials in the country (Adeniyi, 2012). The government has tried loan schemes and policies through mainly banks for decades right from the 1970s (Nwoko, 1981) but this has often met with failure due to many factors bordering on proper implementation over the years (Jabbar *et al.*,2002).

2.3.10.5 Urbanization

There is rapid urbanization in many developing countries which comes at a high price to animal productivity due to neglect of animal farming as a result of mass rural-urban drift for better standards of living and yet increased demand for animal products is the order of the day (Devendra, 2007). A study has shown that from the year 1961 to 2001 there has been a dramatic increase in the consumption of catfish in developing countries due to urbanization and industrialization (Fraser, 2008). Urbanisation also leads to constraints of space due to overcrowding arising from population explosion in the cities (Alirol *et al.*, 2011; Lancet, 2011). This implies that there will be less opportunity for animal production as emphasis shifts to rapid industrialization.

2.3.10.6 Market and storage facilities

Market for animal products is crucial for the sustainability of the industry. The catfish production market is poorly organized and often farmers lose instead of making profit because most catfish products are perishable goods that expire within a short period of time. To encourage maximum animal productivity there should be provision for storage of animal products in deep freezers and other storage facilities that are now been used with technological advancement. Employing modern methods of meat preservation will help Nigeria to grow its animal production to be able to take part in international trade and better the economy of the nation (Bamaiyi, 2013).

2.3.10.7 Inadequate Extension services

Extension workers provide technical advice to farmers on techniques for maximum productivity and advise on market related matters with the ultimate aim of ensuring the farmers succeed in their chosen vocation and contribute meaningfully to the economy of the nation (Davis, 2008). One of the greatest challenges of extension services in Nigeria in spite of the intervention of a World Bank assisted project is the ability to secure the commitment of government and mobilizing local funds to sustain the service (Omotayo *et al.,* 2001). A good number of Nigerian Universities and other institutions offer courses on Agricultural extension services but the number of graduates each year that end up in the actual profession of Agricultural extension are still grossly inadequate compared with the population involved in farming and the locations of those they are supposed to service.

2.3.10.8 Inadequate manpower

There is a short supply of, especially, skilled labour in the catfish production industry in Nigeria for example in some quarters one man does the work of many people leading to inefficiency in productivity. This is a point for major concern because of the potentials of a nation of over 170 million people. There is inadequate labour supply in the country and many times catfish farmers have to hire temporary workers or forfeit it at the detriment of their farms due to costs (Ude and Salau, 1987).

2.3.10.9 Inadequate basic infrastructure

Many African countries have problems with infrastructure for animal production (Van der Zijpp 1999) and Nigeria is not an exception. There is also the perennial problem of electricity supply in Nigeria which is a major setback for the catfish industry. It means fish has to be prepared for consumption immediately after harvest additional costs of utilizing generating plants to store the fish will be incurred. Water supply is also inadequate even though it is very essential to have water always for maximum catfish productivity (Bamaiyi, 2013).

2.3.10.10 Attitude to animal production

People's attitude to catfish husbandry and production is very poor. Some young people in Nigeria think catfish production is only for the elderly or sometimes retired government staff but youths are known to do very well in catfish production when they diligently go into it (Oladeebo and Ambe-Lamidi 2007). Some believe that catfish processing and marketing is for illiterates or the jobless in the society unlike what is obtained in developed economies where the wealthy and educated are leading the way in catfish farming.

2.3.11 Determinants of Value Addition

Kohl (2001) observed that several important factors are impacting the global agri-food industry. These factors include the growing trade of processed foods, changing consumer needs, rising disposable income, improved diets in many areas, industry consolidation, and increasing food demand in developing countries. According to IFPR, meat demand will be strongest in China, Latin America, and developed countries. As a result of economic and population dynamics, value added in global agribusiness will continue to shift towards the end product; traceability will gain more importance in marketing. Food preparation time at home has been reduced from 2.5 hours in 1930s to less than 8 minutes in 2010. He observed that over the next 10 years, food distribution sectors will observe the great debate over farm vs rural policy and domestic vs global policy.

Karantininis *et al.,* (2008) investigated what determines innovation in the agro-food industry. They used the number of products launched (zero inflated Poisson model) and investments in innovation as a percentage of sales (Heckman sample selection model) as proxies for innovation 12 activity of the firm. They noted that number of products launched is a misleading indicator as it is heavily influenced by product proliferation and not innovation. They concluded that organization, stage in the value chain and market power are important to innovation, and that Wholesalers and retailers tend to have a larger number of new products (Model I), whereas manufacturing firms tend to invest more in research and development.

Mitcheels and Gow (2008) used a structural equation model for beef producers to explore the importance of a producer's market orientation on their subjective performance within agricultural commodity markets. They found that market-oriented firms are highly innovative and achieve superior performance.

Punjabi (2007), observed that it has become clear worldwide that the most rapid growth in agriculture has been occurring on the part of post-production activities. This is being driven by growth of middle income consumers even in low income countries and their demands for better quality value added products. Absence of agro-industry and agribusiness resulting in low levels of value addition of agricultural commodities has been one of the main causes of stagnation in rural incomes. A substantial agribusiness sector generating a high outflow of value added commodities is always correlated with high agricultural GDP and high rural incomes.

Mapiye *et al.,* (2007) analyzed the potential for value addition of Nguni cattle products in the communal areas of South Africa. They concluded that development and research programmes aimed at reintroducing the Nguni breed in the rural areas should take a holistic and participatory approach in agro-processing and value-addition of Nguni cattle products. Increased value addition can be achieved by provision of appropriate incentives for the establishment of agro processing industries in the rural areas and promotion of partnerships between communal farmers and agribusiness.

McEachern and Schroeder (2004) observed that superior knowledge of customers' perceptions of value is recognized as a crucial success factor in today's competitive market place. Despite this, the voice of the consumer is often poorly integrated in the value chain. Few studies have assessed

value created for consumers. The study evaluated the main attitudes driving consumer 13 purchases of fresh meat bearing value-based labels. Market potential for further differentiation was also examined.

Ward *et al.* (2008) Found that, across all beef products sampled, the location of the retail outlet significantly influenced variation in product prices. The product name or cut significantly influenced beef retail price. Special and other brands were priced higher than unbranded or generic beef.

2.4 Analytical Framework

In carrying out analysis, several analytical techniques could be used. The choice of which technique to use is a function of the type of analysis to be carried out (Uzoagulu, 2009). Analysis involving mere descriptions is usually undertaken using descriptive statistics tools. Such descriptive tools of statistics that will be used in this study include frequency distribution, means, graphs and charts. However, there are other analytical techniques that will also be used in the study. These other techniques, in the view of Uzoagulu (2009), require more detailed analysis, and are used to achieve particular results. These include multiple regression analysis, cost and returns analysis, gross margin and net farm income.

2.4.1 Mean

The mean is the value arrived at by dividing the sum of observations by the total number of observations. Symbolically, for a sample of n observations

$$x(readas'xbar') = \frac{x1+x2+\cdots+xn}{n} \quad . \quad . \quad . \quad . \quad . \quad (2.11)$$

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2.12)$$

The symbol Σ (read as 'sigma') means sum the individual values x_1, x_2 … of the variable, X. Usually, the limits of the summations are not written, since it is always understood that the summation is over all n values. Hence, we can write

$$\bar{x} = \frac{\Sigma x}{n} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2.13)$$

2.4.2 Gross margin analysis

Gross margin (GM) is the difference between the total revenue and the total variable cost (Emokaro *et al.*, 2010). Gross margin is a very useful tool in situations where fixed capital is a negligible portion of the farming enterprise as in the case of subsistence agriculture. According to Agboola (2011), gross margin of fish farming is the difference between the total value of production (total revenue) and the variable costs of production.

The total revenue refers to the gross income accruing to fish farms from the sales of table-sized fish. This is obtained by multiplying the unit price of average table-sized fish by the quantity sold. The variable costs are those costs that vary with the level of output. Therefore;

GM = TR – TVC. . . . . (2.14)

NI = TR – TC . . . . . (2.15)

NI = TR – (TVC + TFC) . . . . . (2.16)

Where GM = Gross margin (Naira)

TR = Total revenue (Naira)

TVC = Total variable cost (Naira)

TFC = Total fixed costs (Naira)

TC = Total cost (Naira)

NI = Net Income

Empirical studies that utilized gross margin analysis in estimating profitability of fish farming include Olagunju *et al.* (2007) and Kudi *et al.* (2008).

2.4.2.2 Net income analysis

Net income is the difference between the Total revenue and the total cost of production (Olukosiand Erhabor, 1989).The general model for the Net Income is as follows:

NI = TR – TC . . . . . (2.17)

TC = TVC + TFC. . . . . (2.18)

NI = Net income (Naira)

TR = Total revenue (Naira)

TC = Total cost (Naira)

Total cost = Total variable cost (TVC) + Total fixed cost (TFC)

Empirical studies that utilized net farm income in estimating profitability of fish farming are as follows; Agboola (2011) and Kudi *et al.* (2008).

2.4.4 Z – Statistics

The Z-statistic, according to Koutsoyiannis (1977), is based on the standard normal distribution (or Gauss Standard Normal Curve). It is applicable only if the population's variance is known and the sample is large (n > 30). The Z-statistic distribution is usually applied in determining whether variables contained in the model (s) are significant or not. Uzoagulu (2009) stated that, Z- statistic is essentially used to determine whether two mean (X_1 and X_2) are significantly different at a chosen level of significance.

The Z- statistic distribution is specified below:

$$Zcal = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2.19)$$

where,

$\bar{X}_1$ = mean of group 1

$\bar{X}_2$ = mean of group 2

S_1 = standard deviation of group 1

S_2 = standard deviation of group 2

n_1 = sample size of group 1

n_2 = sample size of group 2

2.4.5 Multiple regression

Multiple regression is one of the analytical tools that are used to determine the effect(s) of one or more variables on another. The variables that cause the effects are known as the explanatory or independent variables, whereas the variable that is affected is called the explained or dependent variable. According to Koutsoyiannis (1977), multiple regression analysis allows for the quantification of the effects of the independent variables on the dependent variable. The simplicity

and user-friendly nature of multiple regression analysis makes for its popularity and wide application. The model is generally specified as follows:

$$Y = f(X_i, e) \quad . \quad . \quad . \quad . \quad . \quad . \qquad (2.20)$$

where: Y = dependent variable,

F = functional form of the model which can be linear, semi-log, double log, or exponential

Xi = independent variables, and

e= error term.

The functional forms are stated thus:

i) The Cobb-Douglas function

$$lnY = b_o + b_1 lnX_1 + b_2 lnX_2 + \cdots + b_n lnX_n + e \qquad \ldots\ldots\ldots\ldots \quad (2.21)$$

ii) Semi-log function

$$Y = b_o + b_1 lnX_1 + b_2 lnX_2 + \cdots + b_n lnX_n + e \qquad \ldots\ldots\ldots\ldots \quad (2.22)$$

iii) Exponential function

$$lnY = b_o + b_1 X_1 + b_2 X_2 + \cdots + b_n X_n + e \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2.23)$$

iv) Linear function

$$Y = b_o + b_1 X_1 + b_2 X_2 + \cdots + b_n X_n + e \qquad \ldots\ldots\ldots\ldots \quad (2.24)$$

CHAPTER THREE

METHODOLOGY

3.1 Study Area

This study was carried out in Imo state. Imo state is located in the South - Eastern area of Nigeria and shares boundaries with Anambra, Abia, Delta and Rivers states. It is located between latitudes $5^0$and 6^0 North and longitudes 6^0 and 7^0 East. The state has a total land mass of about 5,100 square kilometers and a population of about 3.9million (NPC, 2006). The people of the state are mostly rural which makes their occupational distribution tilted towards agricultural production. The climate is of two types: the dry and wet seasons with intervening cold and dry harmattan period usually experienced during December and January. The state has an annual rainfall ranges from 2000 to 2500 mm, while maximum average temperature ranges from 30 to 35 degrees centigrade (Imo ADP, 2009).

The Igbos form the major ethnic group in the State, Christianity and traditional religions are the beliefs by the people in the State. The State falls within the tropical rain forests zone with dense forest in the south (FGN, 2004). Agriculture is the mainstay of the economy of the State. This is basically due to the rich arable land suitable for the growth of a wide range of tropical crops. Crops grown in the State include yam, cassava, maize, fruits and vegetable among some cash crops like oil palm, coconut and plantain. The people also keep livestock like fishes, goats, pigs, and poultry (Oruche *et al.*, 2012). Hence, there are a total of 303,333 farm families involved in agricultural production in the state (Ezealaji, 2011).

The state has 27 Local Government Areas grouped into three agricultural zones, viz, Orlu, Owerri and Okigwe. The state is made up of a total of 38 blocks, 63 farm cells and 326 circles for effective extension service delivery. Figure 3.1 shows the three agricultural zones of Imo State.

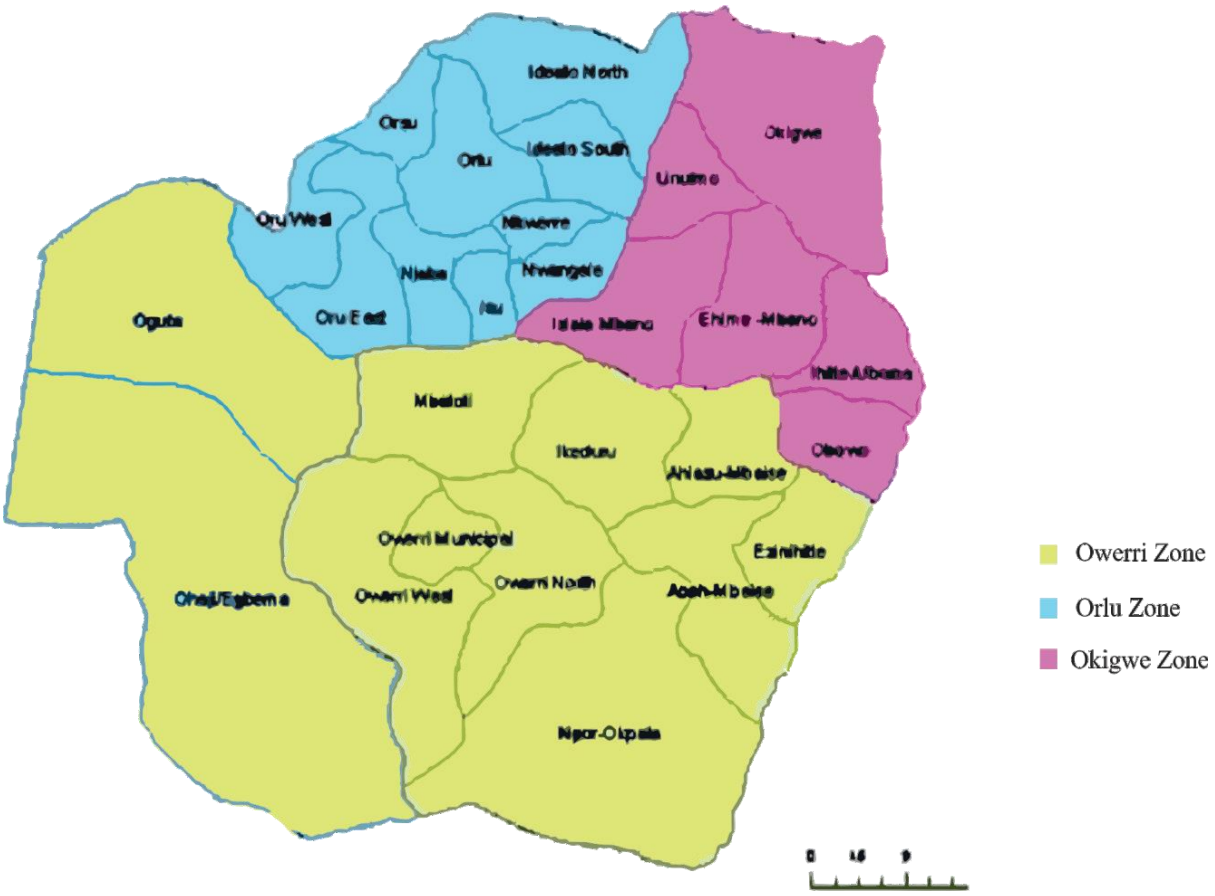

Figure 3.1: Map of Imo State Showing the three agricultural zones in the state

3.2 Sample Selection

The study was carried out across the three agricultural zones of the state, namely; Okigwe, Orlu and Owerri zones to ensure a proper representation of all catfish actors in the state. A multi-stage sampling technique involving stratification, purposive, proportionate and random sampling were used to draw the respondents of this study.

The first stage was a random selection of a Local Government Area (LGA) from each zone. Every local government area has at least all the catfish value chain actors represented in the sampling frame. Hence, three LGAs were selected in the entire study area for the study.

In the second stage, the communities in the already selected LGAs with predominant catfish activities were purposively selected for the study. Two communities were selected from each of these LGAs to give a total of six (6) communities for the study. At the community level, the sampling frame of 448 catfish actors consisting of catfish input suppliers, producers, processors

(smoked, cooked and grilled fish), marketers (traders) and consumers were sought by different catfish actors' associations registered with their corresponding directors of commerce, trade and agriculture of each LGA.

In the third stage, a stratified random sampling technique was used to select the different actors from each LGA, community by community. Due to the unequal number of each of the catfish actors across these communities, a proportionate to size sampling of 30% across the six (6) communities was used to select 37 input suppliers, 50 each of producers, processors and marketer (traders), as well as 30 consumers for the study. However, 36 input suppliers, 47 producers and marketers (traders) each, 50 processors and 29 consumers were found useful and used for data analysis.

The breakdown of the sampling procedure is presented in Table 3.1.

Table 3.1: Breakdown of the Sampling Procedure

Zone	**LGA**	**Community**	**Sample frame**	**Sample**	**Input suppliers**	**Producers**	**processors**	**marketers**	**consumers**
Okigwe	Okigwe	Ugbelle, Amakor	184	**54**	12	7	17	8	10
Orlu	Nwangele	Dimnanume, Aba	136	**72**	13	8	15	27	9
Owerri	Ohaiji/ Egbema	Umudukwo/ Umuagwo, Umuesita	126	**91**	12	35	18	15	11
			446	**217**	**37**	**50**	**50**	**50**	**30**

3.3 Data Collection

This study was conducted using data from primary sources. Primary data were collected using questionnaire alongside personal observation and key informant interviews. Data were collected from catfish input suppliers, producers, processors, marketers and consumers of catfish. 217 questionnaires (37 input suppliers, 50 catfish producers, 50 catfish processors, 50 marketers of

catfish and 30 consumers of catfish) were administered to the selected actors but only 36 input suppliers, 47 producers, 50 processors, 47 marketers and 29 consumers were used in the analysis and others were discarded due to inconsistent and invalid responses from them. The variables of interest included socio-economic characteristics such as age, sex, household size, level of education, membership of cooperative, years of experience in choice enterprise, produce consumed, income, household expenditure, marketing cost and returns, quantity of catfish produced, market prices of inputs and outputs, etc.

3.4 Data Analyses

Data were analyzed using descriptive statistical tools such as percentages, means, charts and frequency distribution and functional analytical tools such as value chain map and multiple regression technique, costs and returns analysis, gross margin analysis, net income model, multinomial logit model and Z-statistics.

Objective 1 which was to map the catfish value chain actors and their roles was achieved using functional analytical technique.

Objective 2 which was to describe of socio-economic characteristic of catfish input suppliers, producers, processors, marketers and consumers was realized using descriptive statistical tools such as frequency, mean and percentages.

Objective 3 which was to estimate and compare the costs and returns along the catfish value chain was achieved using the cost and returns model.

$$NI = TR - TC \quad (3.1)$$

$$TC = TVC + TFC \quad (3.2)$$

where,

NI = Net Income [₦ /per production cycle (7 months)]

TC = Total Cost [₦ /per production cycle (7 months)]

TVC = Total variable costs [₦ /per production cycle (7 months)]

TFC = Total Fixed Costs [₦ /per production cycle (7 months)]

TR = Total Revenue [₦ /per production cycle (7 months)

Total revenue was obtained by multiplying the average quantity of sold with the average price. The fixed costs are however depreciated to obtain the actual value of the variable per production cycle. The straight line method was used to calculate the depreciation of the equipments, and the formular given as:

$$\text{Depreciation} = \frac{\text{Cost price – Salvage value (₦)}}{\text{Expected life span (years)}} \quad . \quad . \quad . \quad . \quad (3.3)$$

A positive NFI shows that an enterprise is a profitable one and worth continuing. A negative NFI signifies otherwise, that is, a loss and a business not worthy of continuing or joining.

In addition, the value share model was used to estimate the value added share of each of the primary actors. According to Coulibaly *et al*., (2010), the value added is the amount of value that each actor in the chain adds. It is the difference between the price the actor pays for a measure of his produce, and the price she or he sells the same measure after adding value.

$$VA = P_1 - P_{-1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3.4)$$

Where P_1 = price actor offered to sell amount of valued product to the subsequent actor

P_{-1} = price actor purchased amount of the product from the preceding actor.

Hence, value share is the percentage share of an actor in the total value added in the value chain system. It is noteworthy that activities of the input suppliers, producers, processors and marketers were considered for value added share in the study.

Objectives 4 which was to estimate the factors which influence the choice of enterprise of value chain actors was analyzed using Multinomial Logit Regression method. The multinomial logit regression model is specified as thus;

$$Y_i = f(X_i, U_i) \quad . \quad . \quad . \quad . \quad . \quad . \quad (3.5)$$

$$Y = \beta_0 + \beta_1 X_1 + \cdots + \beta_8 X_8 + U. \quad . \quad . \quad . \quad . \quad (3.6)$$

$$P_r(Y_i = j) = \frac{e^{\beta_i x_{ij}}}{1 + e \sum_{m=1}^{4} e\beta_i x_{ij}}, J = 1,2,3,. \quad . \quad . \quad . \quad (3.7)$$

$$P_r(Y = 0) = \frac{1}{1 + e \sum_{m=1}^{4} e\beta_i x_{ij}}. \quad . \quad . \quad . \quad . \quad . \quad (3.8)$$

(base category)

$$\frac{\delta P_j}{\delta X_i} = P_j(\beta_{ij} - \sum P_j\beta_{ij}) = marginal\ effect \quad . \quad . \quad . \quad (3.9)$$

Where;

$P_r(Y_i = j)$ = Probability of catfish actors choosing any of the enterprise, relative to the base category Pr (Y=0)

β_i or $\beta_0 - \beta_8$ = Coefficient of the estimated variables.

j = Number of available enterprise options (producers, processors, marketers)

m = level of the available enterprises (number)

X_i = Vector of the predictor (of the i^{th} explanatory variable)

Y_i = Choice of enterprise system; J = 1, 2, 3.

X_1 = Age (years)

X_2 = Gender (Male = 1, female = 0)

X_3 = Marital Status (Dummy variable, married = 1, others = 0)

X_4= Household size (Number of persons)

X_5= Experience in business (Number of years)

X_6= Membership of cooperative (member =1, non-member=0)

X_7 = Net Value Added (Naira)

X_8= Education Level (Number of years spent in school)

U_i = error term

The producer enterprise was considered as the reference category against which the remaining outcomes was compared. The choice of enterprise systems adopted followed the modified classification of (Petrucci, 2009) and it is as follows:

1 = producer enterprise (Reference category)

2 = processor enterprise

3 = marketer enterprise

Objective 5 was analyzed using Multiple Regression analysis. The model estimates the determinants of value added amongst catfish producers, processors and marketers. First, Obasi (2014) and Dewally *et al.*, (2013) identified demographic characteristics of value chain actors to include: age, gender, marital status, experience, household size, level of education, training and costs incurred such as production cost, transfer cost, marketing cost, depreciation on equipment and other costs consistent with value chain and returns recorded.

The multiple regression model is implicitly presented as follows:

$$Y_i = f(X_1, X_2, X_3, X_4, X_5, \dots, X_n + e) \quad . \quad . \quad . \quad (3.10)$$

Where;

Y_i= Value added of catfish actors (Naira)

i =1, 2, 3 for producers, processors and marketers respectively.

X_1 = Age of respondents (years)

X_2 = Gender (Male = 1, female = 0)

X_3 = Marital status (Dummy variable, married = 1, others = 0)

X_4 = Education level (Number of years spent in school)

X_5 = Household size (Number of persons in the household)

X_6 = Years of experience in value addition (years)

X_7 = Membership of cooperative society (member =1, non-member = 0)

X_8 = Depreciation of fixed assets (Naira)

X_9= Amount of credit used (Naira)

X_{12} = Quantity of fish produced in Kg (for producers); Processing cost (Naira) (for processors) or cost of marketing in (Naira) for Marketers

e = error term

In determining the factors that influence the net value added of the catfish actors; factors such as their socioeconomic characteristics, operating cost, amount of credit used, cost of acquired inputs, depreciation of fixed assets, quantity of fish produced, cost processing, and cost of marketing were subjected to multiple regression analysis. The linear, semi log, exponential and Cobb-Douglas functional forms were tried using Ordinary Least Square Technique and the estimated functions were evaluated in terms of the statistical significance of the coefficient of multiple determinations (R^2) as indicated by F-value, the significance of the coefficients and the magnitude of t- values and follow a priori expectation and economical rational. Among the four functional forms: the one with the highest R^2 value, highest F-value, which tests the goodness of fit of the overall model, highest number of significant explanatory variables and consistency of the signs with a priori expectations was chosen as the lead equation.

Table 3.2: A priori Expectation of OLS regression for producers

	Variable	Measurement	Apriori Expectation
X_1	Association	Dummy	+/-
X_2	Family size	Continuous	+/-
X_3	Farming experience	Years	+/-
X_4	Educational level	Continuous (years)	+
X_5	Size of pond	Square meters	+
X_6	Extension visit	Continuous	+/-
X_7	Ownership of farm	Dummy	+

A priori expectations (Table 3.2) for variables X4, X5, and X7 will be positively associated with net income of the producers while X1, X2, X3 and X6 may either be positive or negative. For the Net farm income of processors in the value chain.

Table 3.3: A priori Expectation of OLS regression for Processors and Marketers

	Variable	Measurement	Apriori Expectation
X_1	Age	Years	+
X_2	Household size	Continuous	+/-
X_3	Farming experience	Years	+
X_4	Gender	Dummy	+
X_5	Access to credit	Dummy	+
X_6	Association	Dummy	+
X_7	Ownership of farm	Dummy	+

A priori expectations (Table 3.3) for variables X1, X3, X4, X5, X6 and X7 will be positively associated with net income of the producers while X2 can either be positive or negative.

3.5 Test of Hypotheses

Hypothesis 1 which stated that Catfish value chain actors' choice of catfish enterprise in Imo state is not positively influenced by the level of education, access to credit, marital status, age and information access was tested using z-values from the results of multinomial logit regression model used to achieve objective iv.

Hypothesis 2 which stated that there is no significant difference between the net incomes earned by the various actors in catfish value chain tested in the three agricultural zones in Imo State was tested using Analysis of Variance. The Analysis of Variance (ANOVA) was performed using the Levene's and Scheffe test of the Analysis of variance (ANOVA) multiple means comparison. The ANOVA model is specified following (Ohajianya & Osuji 2012).

$$F = \frac{MSSB}{MSSW} = \frac{SSB/(k-1)}{SSW/(n-k)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.11$$

TSS (total sum of square) = SSW + SSB …… 3.11

$$\text{SSW (sum of square within group)} = \sum_{i=1}^{n_j} \sum_{j=1}^{n} (\overline{X_{ij}} - \overline{\overline{X}}_j)^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\text{eq 3.12}$$

$$\text{SSB} = \sum_{i=1}^{n} (\bar{X}j - \overline{\overline{X}})^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{eq 3.13}$$

Where,

X_{ij} = i^{th} net return of the chain actor j

$\overline{Xj}$ = Mean net return responding actors j

$\overline{\overline{X}}$ = Grand mean adaptation score of actors

F = Value by which the statistical significance of the mean differences was judged

SSB = Sum of squared deviations between the scores

SSW = Sum of squared deviations within the scores

n_j = Sample size of chain actors' farmers in state j

n = Sample size of chain actors' farmers

K = Number of states

k-1 = Degrees of freedom for SSB (numerator)

n-k = Degrees of freedom for SSW (denominator)

After these tests, the F calculated was compared with the F tabulated. The rule that null hypothesis be accepted if the estimated is less than the tabulated value of F at 5% level of significance was adopted.

Hypotheses 3 was tested using the t-values resulting from the multiple regression analyses to be performed to achieve objective 5. The multiple regression analysis produced t-values and compared with t-critical values at specified alpha level and n-k degrees of freedom to test hypotheses 3.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1: Catfish Value Chain Mapping and Roles of the Actors

The Value Chain Map of Catfish in Imo State was presented in Figure 4.1.It used the functional analysis to analyze the various actors and their functions in the value chain of catfish in the study area. This shows the map of the overall catfish value chain, the segments, their interdependencies and linkages in the study area. According to the map illustrated in Figure 4.1, the value chain of the catfish farming industry in Imo State has several direct and indirect actors at different levels interacting together to form a functional system. These actors along the entire value chain carry out both primary and support activities and can be categorized as actors in inputs suppliers, production, marketing, research, finance and legislation as discussed underneath.

Input Supplier

The input dealers in the catfish aquaculture value chain were involved in the sale of brood-stock, feeds, and equipment to the catfish aquaculture farmers. They also met the training needs of catfish aquaculture farmers in the study area with respect to the use of appropriate feeds in terms of quality and quantity. Also, they played an advisory role with respect to stocking density and quality. The major actors and suppliers of inputs (i.e. Brood-stocks, feeds and equipment) in the study area were private individuals who mostly raised their capital personally. Also, they were categorized into wholesalers and retailers. Since they were independent marketers, they supplied input to the farmers at the normal market prices in an open market. Input dealers were not subsidized by the government at all levels, so prices of input bought by the catfish farmers were not subsidized.

4.1: Map the catfish value chain actors and their roles

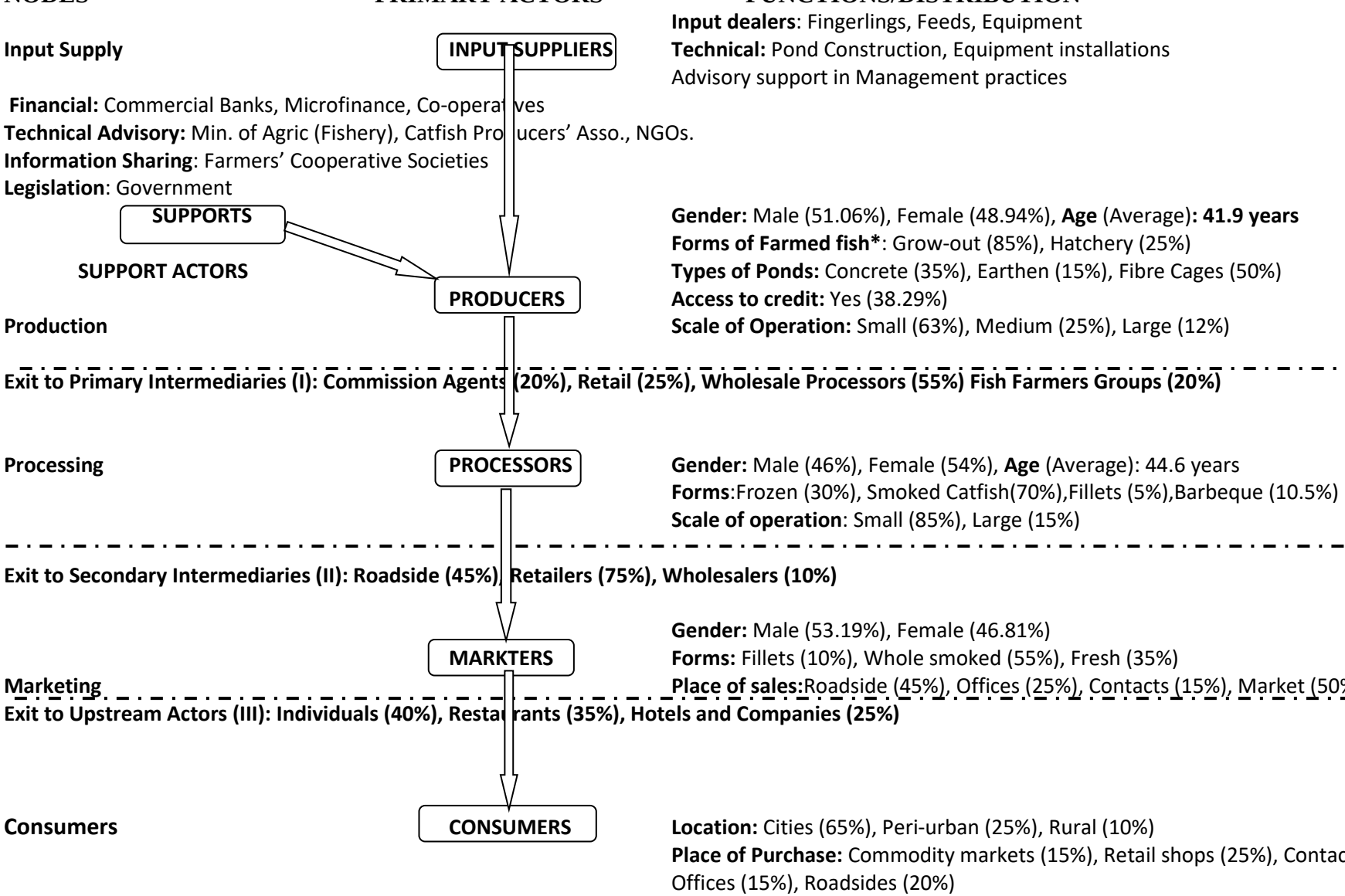

Figure 4.1: Catfish Value Chain Map in Imo State, Nigeria.

Producers

The catfish farmers are the most important actors in the industry. These are both grow-out farmers and hatchery producers. Based on the survey carried out, the mean age of the farmers was 41.9 years. About 51.06% of them were male, Majority (50%) of them used artificial ponds/fibre cages to culture catfish, and they are mostly small-scaled farmers (63%). Most farms have a production cycle of six to eight months in which period the catfish under good management is expected to weigh approximately 0.8 to 1 kilogram (Isyagi et al., 2009a). The produced fish goes through the intermediary channels of marketing involving other actors or farmers themselves. The processing and marketing section of the industry involves middlemen (local collectors/ commission agent, retailers, wholesalers), and fish farmers' groups whose chief aim is sales to the best bargain buyer. The middlemen collect the live catfish from farms and distribute it. Live fish is pooled from different farms in case one farmer cannot raise the required volume. Processors and local market retailers get farmed catfish from these middlemen. There are both artisanal processors; processing less than 100 kilograms of live catfish per day; and industrial processors with the capacity to process over one ton of farmed catfish per day. Processed products of catfish on market are fillets, smoked whole fish. Lastly, the grow-out catfish ends with the local consumers.

Processors

The next primary actors are the processors who are involved majorly in adding value to catfish by transforming it into various products. The processing segment of the catfish value chain in the study area is fast becoming an industry of its own as it served as a means of employment for many of the unemployed youths and retired individuals. Majority (54%) of them are female, with average age of 44.6 years. Smoked fish is the major value added product processed from catfish with 70% of the processors involved in it because smoked catfish aquaculture is the most preferred type that is mostly consumed and there is high demand for it. Processing of catfish aquaculture into smoked fish was very common in the study area and was an industry gradually opening up to more participants due to low takeoff capital. Majority of them are small-scale operators (85%) processing between 10kg and 20kg every day. In some rural areas where the market day was once in five day, they targeted market days and make the best of their sales. Since small scale processing is cheaper and not expensive, the equipment

used in small scale processing was mostly fabricated by the local technicians. Furthermore, only about 15% of the processors were large scale processors. They processed above 20kg per day using big and high-tech equipment in processing catfish in the study area. They were majorly patronized by the government and big organizations. They have a bigger market within the cities because that was where the larger population and people who can afford their products are. Advertisement for large scale processors was often by branded cars and personal links.

About 30% of the processors also engaged in frozen processing, according to them, they will remove the entrants inside the catfish after buying fresh from the producers and store in a cold room to preserve it after which it will be sold to individual consumer, restaurants and hotels. Also, about 10.5% of the processors were into barbeque. This is mostly consumed by big hoteliers and during special ceremony such as Annual General Meetings (AGM) of big corporate organizations. This accounted for the major reason why the percentage of those who were into its processing was few because it is expensive. The fillet is the boneless processed fish consumed by the old people and very few (5%) of the processors were into its processing.

Marketers

Marketers are the actors involved in the distribution of processed catfish to the reach of the consumers. In the study area, about 53.2% of the marketers were male. They are involved in marketing fillets (10%), whole smoked fish (55%), Fresh (35%) reaching their consumers at different selling points such as roadside (45%), offices of the public and private employees (25%), contacts at restaurants, hotels, supermarkets (15%), markets (50%). Majority of them are into retail operation (75%) because it is not capital intensive. Also, because catfish required serious and careful post harvest management, to ensure that the fish does not lose its taste. Therefore, many marketers who may not be able to procure good cold room and have access to big generator may not be able to go into wholesales catfish marketing in the study area. These retailers require reasonable amount of money to start catfish retailing business in stall and shops located in strategic business locations at the densely populated areas and mostly within the market environs. While the roadside marketers required very minimal amount of money to start roadside catfish marketing. They were mostly found along the road and in some cases, they move from one office to another to market their

products. They market mostly smoked and fillet catfish because they were already packaged in nylon and sealed. Also, most unemployed youths were involved in the roadside catfish marketing.

Consumers

Catfish and its products are important source of nutritious food in most of the families of respondents interviewed, whether male or female. The frequency of consumption was however, different for each individual. The study showed that catfish was mostly consumed by the people in the cities (65%) in the study area. Since, most of the big hotels and restaurants were in the cities and semi-urban areas, therefore, this accounted for the major reason why most consumers were in these areas. Thy common place of purchase are commodity markets (15%), retail shops (25%), contacts (25%), offices (15%) and roadsides (20%). Again, the income of about 65.4% of the household consumers of catfish interviewed in the study area were within ₦10,000- ₦100,000 per month, about 10.5% of the respondents were within the income bracket of ₦101,000 - ₦250,000 per month, and 2.5% of the respondent's income were above ₦250,000 per month. So catfish is not expensive for the respondents. Furthermore, the average price of catfish consumed by the respondents was ₦1000 per kilogram (kg). Also, about 18.5% of the household catfish consumer claimed they normally consumed 1kg per week and 8.6% claimed they usually consume 2kg per week.

Support Actors

Collaborations between farmers and support actors can be divided into four major categories i.e. financial, technical advisory support, information and knowledge, and legislation. Although, most farmers interviewed finance their operations through personal savings and in-kind supports from relatives. However, with increasing information on the financial viability of the aquaculture projects, several banking institutions are showing interest in providing loans to farmers for capital and management finance (Nafula 2010; Ssebisubi, 2010). About 38.29% of them had access to financial information from credit institutions;

As regards legislation, the government is the sole actor in the aquaculture legislative instrument in Nigeria, the modern organization and administration of Nigeria fisheries started in 1942, through 1969 when the national fisheries plan was developed and training of the manpower

required for the development of the fishing industry which led to the establishment of the federal fisheries school was established in Lagos, promulgation of the "Decree on the Research Institutes Establishment Order in 1975 which paved way for the for the creation of Nigerian Institute for Oceanography and Marine Research(NIOMR), charged with fisheries research; Federal Department of Fisheries (FDF), charged with fisheries development; Lake Chad Research Institute, based in Maiduguri, Borno State and Kanji Lake Research Institute, located in New Bussa, Niger State (www.fmard.gov.ng assessed on 13th April, 2019).

In addition, Technologies and innovations like fish handling equipment, techniques of feeding fish and smoking fish were attributed to training by the Fisheries and Aquaculture Departments of the State and Federal Ministries of Agriculture and Natural Resources. The departments had been involved in the allocation of fishing inputs to the Fishermen Cooperative Societies through the respective State Governments, release of fishing inputs to the beneficiary Cooperative Societies under the Growth Enhancement Support (GES) Scheme through the respective State Governments and identification/collaboration with the local fishing gear fabricating companies for easy access and affordability by the fishermen. Other activities of the Government in supporting catfish farmers include legislation and enforcement on feed quality standardization and certification, fish meal supply and development, brood state development and management unit, hatchery standardization and certification and fingerlings supply and management. The government is equally involved in aquaculture skills development and acquisition in the areas that borders on management of aquaculture technology transfer, aquaculture vocational skill development, youths-in-aquaculture programme and **c**apacity building for fish processors (www.fmard.gov.ng assessed on 13th April, 2019).

4.2: Socio-economic Characteristics of the Catfish Actors in Imo State.

4.2.1: Gender

Table 4.1 shows the gender distribution of the catfish value chain actors in the study area.

Table 4.1: Distribution of the Catfish Value Chain Actors according to their Gender

Actors	Input suppliers (n=36)	Producers (n=47)	Processors (n=50)	Marketers (n=47)	Consumers (n=29)
Gender	**%**	**%**	**%**	**%**	**%**
Male	47.22	51.06	46.00	53.19	51.72
Female	52.78	48.94	54.00	46.81	48.28
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Field Survey Data, (2019).

According to Table 4.1, 52.78% of the input suppliers were females while 47.22% of them were males, 51.06% of the catfish producers were males while 48.94% of them were females. About 54% of the catfish processors were females while 46% of them were males. Also, 53.19% of the catfish marketers were males while 46.81% of them were females. About 51.72% of the consumers were male while 48.28% of them were female. This suggests that both gender had fair participation in the catfish value chain in the study area, there was more male involvement in the catfish production and marketing while females are dominant in the catfish input supply and processing. More male catfish producers in the study area could be associated with the fact that more male Nigerians have more landed property than their female counterparts, hence more male respondents had more open spaces for catfish aquaculture production. This result agrees with those of Olawoye (2001), Ayanwuyi *et al.,* (2010) and Nwankwo and Mbanasor (2012) who in separate studies in Oyo and Imo States, found that more males were involved in catfish production than their female counterparts. However, the involvement of more female in catfish processing could be a reflection of the small-scale level of most catfish processors, which provides avenue for the active engagement of women processors thereby provides opportunity

for the division of labour among family members in that while the heads of the family engaged in catfish production, the wives and children, as the case may be will be involved in the processing and both gender jointly market the processed catfish. The result is in line with the findings of Adebayo (2013) who opined that processing of catfish are more dominated by female gender than male. The Partnership Initiatives in the Niger Delta (PIND) (2011) opined that women play a central role in catfish processing and marketing, contributing about major proportion in Nigeria. However, the finding corroborates the study of Amos (2013) who observed that males constituted the majority of catfish marketing in Wamba LGA of Nassarawa state. Ogunwande *et al.*, (2012) similarly, opined that more male consumers of catfish was justifiable as most men consumed catfish as food away from home in the restaurants, relaxation centres and hotels. This disagreed with the findings of Ogunwande et. al. (2012) that observed that female respondents are the ones that consumed catfish more since they visited the market to purchase the commodity in most cases and cook it for the entire household members but this ignored the fact that most men also consumed catfish as food away from home while relaxing with friends and associates in the public joints.

4.2.2: Age Distribution

Table 4.2 shows the age distribution of catfish value chain actors in the study area.

Table 4.2: Distribution of the Catfish Value Chain Actors according to their Age

Actors	Input suppliers (n=36)	Producers (n=47)	Processors (n=50)	Marketers (n=47)	Consumers (n=29)
Age (years)	**%**	**%**	**%**	**%**	**%**
23-32	25.00	19.15	14.00	19.15	24.14
33-42	41.67	34.04	28.00	34.04	37.93
43-52	27.78	29.79	30.00	31.91	31.03
53-62	2.78	10.64	20.00	8.51	3.45
63-72	2.78	6.38	8.00	6.38	3.45
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Mean	**39.0 years**	**41.9 years**	**44.1 years**	**41.8 years**	**39.8 years**

Source: Field Survey Data, (2019).

Table 4.2 shows that 41.67% of catfish input suppliers were in the age range of 33 – 42 years, followed by 27.78% of them in the age range of 43 – 52 years and the least was 2.78% of them in the age ranges of 53-62 years and 63-72 years respectively, and the mean age was 39 years. About 34.04% of catfish producers were in the age range of 33 - 42 years, followed by age range of 43 – 52 years which had 29.79% of catfish producers while the least was age range of 63 – 72 years with about 6.38% of the catfish farmers and the mean age of the catfish farmers was 41.9 years. Also 30% of the catfish processors were in the age range of 43-52 years, about 28% of them were in between 33-42 years, while 8% of them were in the age range of 63 – 72 years and their mean age was 44.1 years. However, age distribution of catfish marketers followed a similar trend with that of catfish producers as 34.04% of them were in the age range of 33 – 42 years, followed by 43- 52 years that had about 31.91% of the catfish marketers, the least was 63-72 years with about 6.38% of them and the mean age was 41.8 years. The age distribution of the consumers showed that 37.93% of them were in the age range of 33-42 years and the least is 3.45% of them in age ranges of 53-64 years and 63-72 years respectively. This shows a similar trend with input suppliers, producers and marketers in the study area. A number of similar

studies of Bolorunduro (2008), Sikiru, *et al.*, (2009) and Ayanwuyi *et al.*, (2010) who in their separate studies observed that participants in the catfish input supply, production, processing, marketing as well as consumption are within the 40 years age bracket. This implies that these value chain actors are within the youthful, energetic, productive and innovative age and could readily adopt new techniques for increased performance level. This is expected to result in a positive influence in catfish value chain performance outlook particularly that youthful consumers dominate the value chain. According to Ogunwande et. al. (2012), bulk of active and agile population consumed more of catfish as it is required as body builder, for they get themselves involved in highly energy sapping activities.

4.2.3: Marital Status

Table 4.3 shows the marital status distribution of the catfish value chain actors in the study area.

Table 4.3: Distribution of the Catfish Value Chain Actors according to their Marital Status

Actors Marital Status	Input suppliers (n=36) %	Producers (n=47) %	Processors (n=50) %	Marketers (n=47) %	Consumers (n=29) %
Single	19.44	25.53	22.00	21.28	24.14
Married	66.67	57.45	58.00	61.70	58.62
Divorced	8.33	10.64	12.00	10.64	**10.35**
Widowed	5.56	6.38	8.00	6.38	**6.89**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Field Survey Data, (2019).

As indicated in the Table 4.3, majority (66.67%, 57.45%, 58%, 61.70% and 58.62%) of the catfish input suppliers, producers, processors, marketers and consumers respectively were married. This implies that majority of the actors were married. This is expected to influence catfish value chain activity among the respondents in that catfish value addition business is mostly carried out by married persons in the study area as it is effort-tasking and requires some form of assistance and large labour requirement. The result supports the idea that married people are likely to engage in economic activities more since they are said to live a more settled lifestyle. This finding is in consonance with Akintode (2009) who found that marital status is a factor that suggests a high level of responsibility and great capability for sound decision making among farmers. Ogunwande *et al.*, (2012) indicated that the married individuals formed the highest consumers of catfish as responsible catfish consumers prefer cooking at home and preferably feed their respective household members with the commodity. More so, it is a good source of animal protein that is less harmful to the body.

4.2.4 Household Size

Table 4.4 shows the household distribution of catfish value chain actors

Table 4.4: Distribution of Respondents by Household Size

Actors	Input suppliers (n=36)	Producers (n=47)	Processors (n=50)	Marketers (n=47)	Consumers (n=29)
Household size	**%**	**%**	**%**	**%**	**%**
1- 3	2.78	10.64	28.00	17.02	3.45
4-6	58.33	55.32	50.00	51.06	55.17
7-9	38.89	34.04	22.00	31.91	41.38
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Mean	**6 persons**	**5 persons**	**5 persons**	**5 persons**	**6 persons**

Source: Field Survey Data, (2019).

Table 4.4 shows that majority (58.33%, 55.32%, 50%, 51.05% and 55.17%) of the catfish value chain actors had a household size that ranged from 4 – 6 persons per household with the mean household size of 5 persons for producers, processors and marketers, and 6 persons for input suppliers and consumers respectively. This implies that enough hands (family labour) were engaged in carrying out catfish value addition activities ranging from production, processing to marketing operations. The household members may help in providing some functions at a reduced cost which is an incentive to accost efficient value chain system. This result agrees with Adebayo (2012) and Ladu *et al.,* (2013) in their separate studies, that family size can serve as source of free and cheap labour as children of different sexes engage in helping their parents or guardians to market different forms of fish. The involvement of these children in marketing of processed catfish helps in timely marketing thereby reducing post-harvest loss. Quartey (2005) also opined that household size affects efficiency since there may be synergies from larger household size in both production and consumption. However, higher household size influenced

a decreasing consumption of high quality food like catfish whose price is far reaching for the average income individuals with large household size to feed. This collaborates the findings of Olayemi (2004) and Ogunwande *et al.* (2012) that large household size is an implication for lower consumption of catfish by large household respondents because of the catfish meager supply and high price which is usually too high for large households to afford.

4.2.5: Level of Education

Table 4.5 shows the distribution of respondents according to their level of education

Table 4.5: Distribution of Respondents by their Level of Education

Actors	Input suppliers (n=36)	Producers (n=47)	Processors (n=50)	Marketers (n=47)	Consumers (n=29)
Educational Level	**%**	**%**	**%**	**%**	**%**
0 (No formal Education)	2.78	6.38	6.00	8.51	3.45
1-6 (Primary Education)	8.33	8.51	26.00	17.02	6.90
7-12 (Secondary Education)	47.22	51.06	40.00	44.68	51.72
13-18 (Tertiary Education)	41.67	34.04	28.00	29.79	37.93
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Mean	**12.6 years**	**11.9 years**	**10.3 years**	**10.9 years**	**12.7 years**

Source: Field Survey Data, (2019)

Table 4.5 shows that 47.22%, 51.06%, 40%, 44.68% and 51.72% of the catfish input suppliers, producers, processors, marketers and consumers respectively had attained secondary education which is between 7 – 12 years of schooling, followed by 41.67%, 34.04%, 28%, 29.79% and 37.93% of catfish input suppliers, producers, processors, marketers and consumers respectively who had attained tertiary education which is 13 – 18 years of schooling. The least was no formal education with 2.78%, 6.38%, 6.00, 8.51% and 3.45% of the catfish input suppliers, producers, processors, marketers and consumers respectively. The mean number of years spent in school by them were 12.6years, 11.9years, 10.3years, 10.9years and 12.7 years respectively. The implication of this finding is that most of the catfish value actors in the study area were moderately educated with different educational background. This might be due to the metropolitan nature of the study area and is expected to have a positive correlation with production as these actors avail themselves for the adoption of new innovations in their methods of catfish production, processing and marketing strategies employed which could positively affect the overall catfish value chain performance outlook in the study area. This finding is line with the outcomes of Alene et. al., (2000) and Ajana (2005) that observed the positive relationship between education and farmer's rate of adoption of improved practices.

4.2.6 Value chain experience

Table 4.6 shows the distribution of respondents by value chain experience

Table 4.6: Distribution of Catfish Value Actors by value chain experience

Actors Years of Experience	Input suppliers (n=36) %	Producers (n=47) %	Processors (n=50) %	Marketers (n=47) %	Consumers (n=29) %
1-5	47.22	48.94	48.00	55.32	48.28
6-10	47.22	40.43	36.00	29.79	44.83
11-15	2.78	4.26	10.00	8.51	3.45
16-20	2.78	6.38	6.00	6.38	3.45
Total	100.0	100.0	100.0	100.0	100.0
Mean	**5.9 years**	**6.5 years**	**6.5 years**	**6.5 years**	**6.0 years**

Source: Field Survey Data, (2019)

It was shown in Table 4.6 that 47.22%, 48.94%, 48%, 55.32% and 48.28% of input suppliers, producers, processors, marketers and consumers respectively had an experience of between 1 - 5 years, followed by 47.22%, 40.43%, 36%, 29.79% and 44.83% of the input suppliers, producers, processors, marketers and consumers respectively who had experience of between 6 – 10 years, with mean experience of 5.9 years, 6.5 years, 6.5 years, 6.5 years and 6.0 years for input suppliers, producers, processors, marketers and consumers respectively. It can be deduced from this result that majority of the actors fall within the lowest years of experience, which implies that catfish value chain technology has recently been adopted by majority of the respondents in Imo State which could impact significantly on their profitability in their respective ventures. This is collaborated by the findings of Nwankwo and Mbanasor (2012) who obtained mean years of experience of 7.3 years for catfish farmers in the State and Awodu *et al.,* (2001), Akinrotimi *et al.,* (2010) and Williams *et al.,* (2012) found that their ability to manage fish pond efficiently depends on the years of experience.

4.2.7 Membership of Cooperatives

Table 4.7 shows the distribution of respondents by membership of cooperative

Table 4.7: Distribution of Catfish Value Actors by membership of cooperative

Actors	Input suppliers (n=36)	Producers (n=47)	Processors (n=50)	Marketers (n=47)
Memb. of Cooperative	**%**	**%**	**%**	**%**
Yes	55.56	36.17	18.00	29.79
No	44.44	63.83	82.00	70.21
Total	**100.0**	**100.0**	**100.0**	**100.0**

Source: Field Survey Data, (2019)

- **indicates that response is not available**

The results presented in Table 4.7 showed that 44.44%, 63.83%, 82% and 70.21%) of the input suppliers, producers, processors and marketers respectively did not belong to any catfish value chain actors' association, while 55.56%, 36.17%, 18% and 29.79% of them respectively belonged to the cooperative association. Membership of a cooperative enables actors to interact with other each other, share their relevant information, knowledge, provide technical assistance and credit for business expansion. In addition, the cooperative in most cases help the actors to bargain for favourable price for their products and could pool the bulk of the individual members' products together in other to attract high pricing power. The implication of these results is that most of the actors in the study area do not enjoy the assumed benefits accruing to cooperative societies through pooling of resources together for a better expansion and effective management of resources. This finding is in line with Odebiyi (2010) and Omowe (2016) that cooperative groups ensure that their members derive benefits from the groups such as they could not derive individually.

4.3 Estimate and compare the costs and returns along the catfish value chain

The section estimates the costs and returns of the actors along the catfish value chain to evaluate and compare net value added by each actor involved along the catfish value chain. The value added of an actor in the chain is achieved as the price differential of the value added product sold to the subsequent actor and the price the primary product acquired from the preceding actor. In that case, value added of the producers is the price differential of the catfish sold to the processors and fingerlings acquired from the input suppliers and this captured the form transformation, place and time value added in the course of the respective activities of actors in the chain (Coulibaly et. al., 2010). In addition, value added share implies the percentage share of an actor in the total value added in the value chain system. The result of the value added of the actors (input suppliers, producer, processor and marketer) in catfish value chains is presented in Table 4.8.

Table 4.8: Estimate and compare the costs and returns along the catfish value chain

Input Suppliers			Producers			Processors			Marketers		
Items	**Qty**	**Value (₦)**	**Items**	**Qty**	**Value (₦)**	**Items**	**Qty**	**Value (₦)**	**Items**	**Qty**	**Value**
Fingerling brooded *(P_{fp})	20,000(5.25)	105,000.00	Fingerling stocked*(P_{fs})	1,435.11(24.51)	35,175.37	Harvested Fish (P_{hf})	1,271(473.19)	601,424.49	Catfish bought (P_{fs})	813.05(1,205)	979,725.25
Fish feeds in bags	193.3(6,333.33)	1,185,572.69	Breeding stock*	2(1,932.34)	3,062.97	Cost of labour		13,710.00	Transport		28,575.53
Artificial ponds	19(87,500)	1,662,500.00	Local feeds in bags	62.19(2,227.87)	152,228.15	**Variable Cost**		**615,134.49**	**Variable Cost**		**1,008,300.78**
Concrete ponds	12(206,666.7)	2,480,000.40	Exotic feeds in bags	5.74(7,178.72)	41,208.93	Oven		10,145.69	Commission		3,400
Earthen ponds	**22(9**6,667)	2,126,674.00	Vitamins in kg	0.83(959.57)	796.24	Wheel barrow		1,161.15	Rent on stall		2,208.51
Liming material	250(**271.49**)	67,872.50	Anti-biotic in kg	0.38(1,187.23)	454.69	Trays		1,064.93	Coop Levy		254.47
Accessories	3(763.89)	2,291.67	Lime in kg	13.31(371.49)	4,943.64	Bowl		2,271.88	Govt. Levy		92.77
Fishing equipment	20(22,500)	450,000.00	**Variable Cost**		**237,869.99**	Refrigerator		4,877.60	Wheelbarrow		5916.4
Harvesting gear	17(834.83)	14,192.19	Ponds		59,597.08	Basins		1,920.00	Tray		2,737.50
Value of inputs acq'd		**8,094,103.45**	Fishing gear		9,842.01	Artificial ponds		4,772.00	Bowl		1,479.17
Rent on shop		10,377.78	Fishing nets		2,585.42	Interest on loan		18,100.00	Refrigerator		11,057.31
Transport		5,188.89	Pumping machine		14,192.19	**Total Fixed Cost**		**44,313.25**	Basin		1,500.00
Salary/wages of staff		334,442	Interest on capital		130,750.00	**Total Cost**		**659,447.74**	Artificial ponds		1,973.81
Interest on capital		67,105	**Total Fixed Cost**		**216,966.70**	Qty Marketed (P_{pf})	826.15(1,205)	995,510.75	Interest on loan		43,200.00
Operating cost		**417,113.67**	**Total Cost**		**454,836.69**	**Total Revenue**		**995,510.75**	**Total Fixed Cost**		**73,819.94**
Total cost		**8,511,217.12**	Catfish sold (P_{cs})	1,296.81(473.19)	613,638.75	**Gross Income**		380,376.26	**Total Cost**		**1,082,120.72**
Fingerling sold*(P_{fs})	19,800(24.51)	485,298.00	**Total Revenue**		**613,638.75**	**Net Income**		**336,063.01**	Catfish sold (P_{cs})	793.05(2,950)	2,339,497.50
Fish feeds in kg	193.3(7,178.72)	1,387,646.58	**Gross Income**		375,768.76	**Profit Margin**		**33.63%**	**Total Revenue**		**2,339,497.50**
Artificial ponds	19(170,000)	3,230,000.00	**Net Income**		**158,802.06**	**Value Added (V_{apr}) per catfish= P_{hf} - P_{pf}**		**731.81**	**Gross Income**		**1,331,196.72**
Concrete ponds	12(350,000)	4,200,000.00	**Profit Margin**		**25.88%**	**Total value added**	**826.15(731.8)**	**604,584.83**	**Net Farm Income**		**1,257,376.78**
Earthen ponds	22(133,333.33)	2,933,333.26	**Value added (V_{ap}) per catfish = P_{cs} - P_{fs}**		**448.68**	**Value added share (V_{spr}) = V_a/CVA**		**24.85%**	**Profit Margin**		**53.75%**
Liming material	250(**371.49**)	92,872.50	**Total value added**	**1,296.81(448.68)**	**581,852.71**				**Value added (V_{am}) per catfish = P_{fs} – P_{cs}**		**1745**
Accessories	3(937.5)	2,812.50	**Value added share (V_{sp}) = V_a/CVA**		**15.24%**				**Total value added**	**793.05 (1,745)**	**1,383,871.25**
Fishing equipment	20(30,000)	600,000.00							**Value added share (V_{sm}) = V_a/CVA**		**59.26%**
Harvesting gear	17(9,666.67)	164,333.39									
Value of output sold		**13,096,296.23**									
Gross Income		5,002,192.78									
Net Income		**4,585,079.11**									
Profit Margin		**35.01%**									
Value added (V_{ai}) per fingerling = P_{fs} - P_{fp}		**19.26**									
Total value added	**19,800 (19.26)**	**381,348.00**									
Value added share (V_s) = V_a/CVA		**0.65%**									

Source: Field Survey Data, 2019
**** Measured as per one***
CVA= Chain Value Added = $\sum(V_{ai} + V_{ap} + V_{apr} + V_{am})$ ***=₦2946.72/kg***

1 fingerling = 6.25g
[₦ /per production cycle (7 months)]
Figures in parentheses are the unit prices of the respective items.

For the input suppliers whose activities were centered on production and supplies of primary products to the producers. They brood and sell fingerlings, sell fish feeds, construct fish ponds and render technical services to the producers. The quantities of fingerling brood was 20,000 fingerlings at ₦5.25 per fingerling, with total valued at ₦105,000, fish feeds was 193.3 bags at ₦6,333.33 per bag, with total valued at ₦1,185,572.69 and artificial ponds was 19 ponds at ₦87,500 per pond, with total valued at ₦1,662,500. Concrete ponds was 12 ponds at ₦206,666.7 per ponds, with total valued at ₦2,480,0000 and earthen ponds was 22 ponds at ₦96,667 per pond, with total valued at ₦2,126,674, liming materials was 250 bags at ₦271.49 per bag, with total valued at ₦67,872.50, accessories was 3 sets at ₦763.89 per set, with total valued at ₦2,291.67, fishing equipment was 20 sets at ₦22,500 per set, with total valued at ₦450,000 and harvesting gears was 17 sets at ₦834.83 per set, with total valued at ₦14,192.19. These gave a total value of acquired inputs as ₦8,094,103.45. The operating cost include shop rent which was ₦10,377.78, transportation was ₦5,188.89, salary and wages for technical and non-technical staff was valued at ₦334,442.00, interest paid on borrowed capital was ₦67,105. All these gave a sum of ₦417,113.67. Therefore, total costs of input acquisition and operating cost summed up to ₦8,511,217.12.

While supplying these acquired inputs to the producers, the quantities of fingerling brooded and sold was 20,000 fingerlings at ₦24.51 per fingerling, with total valued at ₦485,298; the 193.3 bags of fish feeds was sold at ₦7,178.72 per bag, with total valued at ₦1,387,646.58; the 19 artificial ponds constructed were sold at ₦170,000 per pond, with total valued at ₦3,230,000; Concrete ponds was ₦350,000 per ponds, with total valued at ₦4,200,000 and earthen ponds was ₦133,333.33 per pond, with total valued at ₦2,933,333.26, liming materials was 250 bags at ₦371.49 per bag, with total valued at ₦92,872.50, accessories was 3 sets at ₦937.5 per set, with total valued at ₦2,812.5, fishing equipment was 20 sets at ₦30,000 per set, with total valued at ₦600,000 and harvesting gears was 17 sets at ₦9,666.67

per set, with total valued at ₦164,333.39. These gave a total value of output sold as ₦13,096,296.23. With this estimation, the gross and net income were computed as ₦5,002,192.78 and ₦4,585,079.11 respectively and the profit margin was 35.01%. The value added by the input supplier is given as the price difference in the price of the brooded fingerlings sold to the producer **(**₦24.51**)** and cost of the brooded fingerlings by the input supplier **(**₦5.25**)** which is given as ₦19.26 hence with the total quantity of 20,0000 fingerlings sold, this gave a total value added of ₦381,348.00.

For the producers' model, the intermediate items were fingerlings, breeding stocks, feeds, vitamins, antibiotics and lime, the quantities of fingerling stocked was 1,435.11 fingerlings at ₦24.51 per fingerling, with total valued at ₦35,175.37 and breeding stock was 2 matured adults at ₦1,932.34 valued at ₦3,062.97, local and exotic feeds were 62.19kg and 5.74kg at ₦2,447.87/kg and ₦7178.72/kg valued at ₦152,228.15 and ₦41,208.93 respectively. The quantities of vitamins, antibiotics, lime were 0.83kg, 0.38kg and 13.31kg at N959.57/kg, ₦1187.23/kg and ₦371.49/kg valued at ₦796.24, ₦454.69 and ₦4,943.64 respectively. The depreciation values of ponds, fishing gears and nets and pumping machine used were ₦59,597.08, ₦9,842.01, ₦2,585.42 and ₦14,192.19 respectively and the interest on borrowed capital was N130,750. These total costs of production summed up to ₦454,836.68. However, the quantity of matured catfish harvested was 1,296.81kg sold at ₦473.19/kg which gave a value of ₦613,638.75 and the gross and net income were ₦375,768.76 and ₦158,802.06 respectively. The value added by the producers is given as the price difference in the price of the catfish sold to the processors **(**₦473.19**)** and price of the fingerlings purchased from the input supplier (₦24.51) which is given as ₦448.68 hence with the total quantity of 1,296.81kg of catfish sold, this gave a total value added of ₦581,852.1.

For the processor, the value of harvested catfish bought from producers were 1,271kg at ₦473.19/kg which was valued at ₦601,424.49. The depreciation costs involved in processing

activity were oven (₦10,145.69), wheelbarrow (₦1,161.15), trays (₦1,064.93), bowl (₦2,271.88), refrigerator (₦4,877.60), Basin (₦1,920) and artificial pond (₦4,772), which total sum was ₦26,213.25, interest on loan was N18,100 and cost of labour used in processing was ₦13,710, therefore the total cost of processing was ₦659,447.74. With the quantity of processed and sold catfish of 826.15kg at ₦1205/kg which gave a value of ₦995,510.75. The gross and net income were computed as ₦380,376.26 and ₦336,063.01 respectively and the profit margin was 33.63%.The value added by the processors is given as the price difference in the price of the processed catfish sold to the processors **(**₦1,205**)** and price of the fresh catfish purchased from the producers (₦473.19) which is given as ₦731.81 hence with the total quantity of 826.15kg of catfish sold, this gave a total value added of ₦604,584.83.

For the marketers, catfish bought was 813.05kg at ₦1205 which is valued at ₦979,725.25, other marketing activities with associated costs were transport (₦28,575.53), commission (₦3,400), interest on loan (₦43,200), rent on stall (₦2,208.51), cooperative levy (₦254.47), government levy (₦92.77), the depreciation costs of the fixed assets were wheelbarrow (₦5,916.40), tray (₦2,737.50), bowl (₦1,479.17), refrigerator (₦11,057.31), basin (₦1,500), artificial ponds (₦1,973.81) and these cost were valued at ₦73,819.94 and total cost of marketing was ₦1,082,120.72. With the quantity of catfish sold estimated as 793.05kg at ₦2,950/kg which is valued at ₦2,339,497.50, the gross and net income were computed as ₦1,331,196.72 and ₦1,257,376.78 respectively and the profit margin was 53.75%. The value added by the marketers is given as the price difference in the price of the marketed catfish sold to the consumers **(**₦2,950**)** and price of the fresh catfish purchased from the producers (₦1,205) which is given as ₦1,745 hence with the total quantity of 793.05kg of catfish sold, this gave a total value added of ₦1,383,871.25.

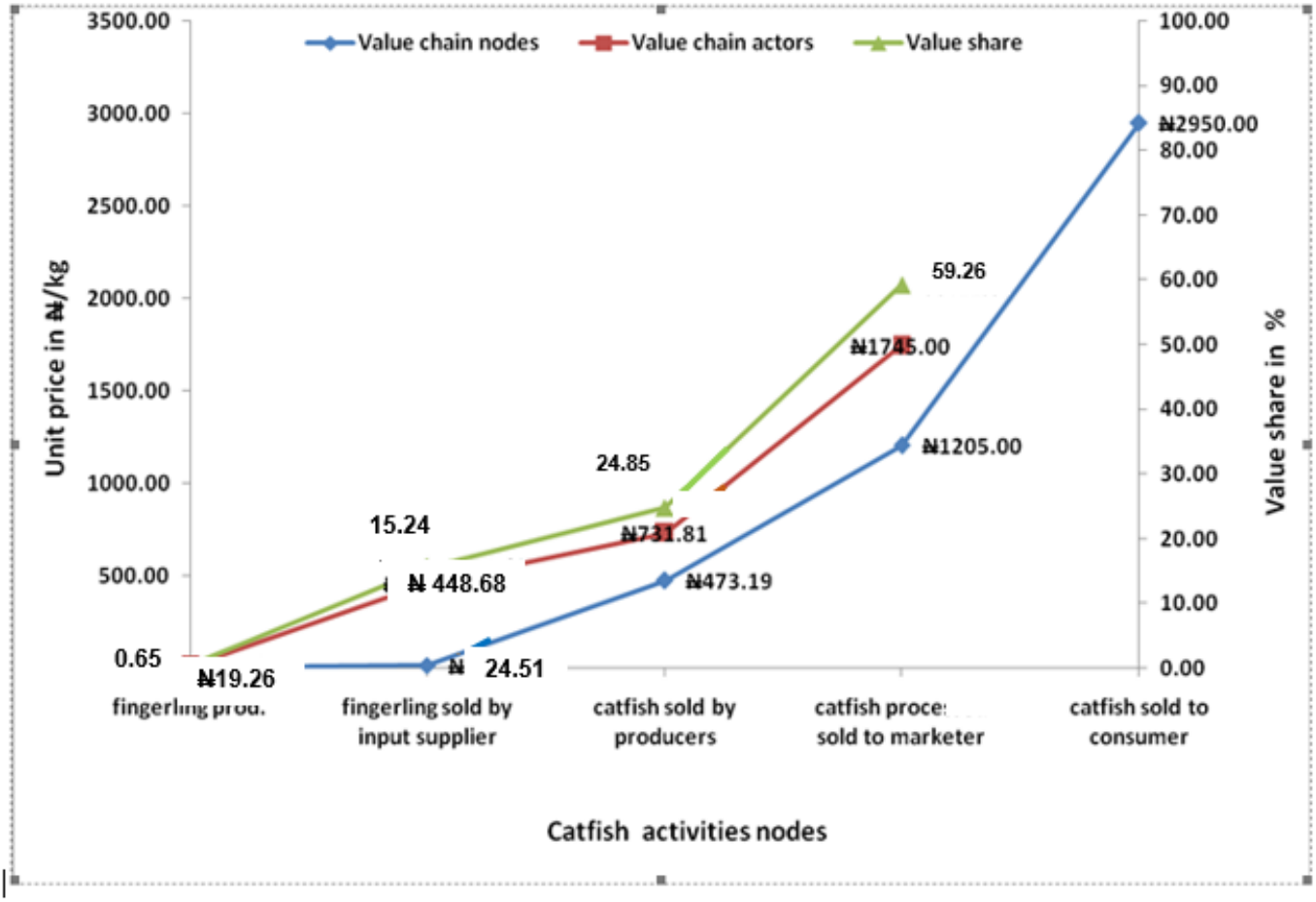

Figure 4.2: Price flow and value added share of the catfish value chain actors

The figures 4.1 above shows the price flow and value added share of the catfish value chain actors respectively. It was depicted that the unit cost of brooding fingerling by the input suppliers was ₦5.25/kg, input suppliers sold at ₦24.51/kg to the producers. The producers sold the matured catfish at ₦473.19/kg to the processors, the processors in turn sold the processed catfish to the marketers at ₦1,205/kg. The marketers sold the catfish to the final consumers at ₦2,950/kg. Based on the price flow across the catfish nodes, it was estimated that value added by the input suppliers, producers, processors and marketers was ₦19.26/kg, ₦448.68/kg, ₦731.81/kg and ₦1,745/kg respectively. The total value added in the catfish value chain system was ₦2,946.72/kg. This gave the value added share of 0.65%, 15.24%, 24.85% and 59.26% for input suppliers, producers, processors and marketers respectively. It

implies that value added share of the actor increases along the catfish value chain from the input suppliers with least value added share and the marketers with the highest value added share. Marketers create the place, time and possession utilities as related to satisfying (gives utility to) of what, where, when and how consumers buy, obtained information on the buying behavior and purchase decisions from the final consumers thereby played vital role in value chain structure.

Hypothesis 1: There is no significant difference in the net value added earned by the various actors in catfish value chain in the study area.

Testing of hypothesis one which states that there are no significant differences in net value added among the catfish value chain actors in Imo State was performed using the Analysis of Variance (ANOVA) and the result is presented on Table 4.9-4.11. From the Table 4.10, the F-calculated (7.94) was greater than F-tabulated (2.65) at 5% significant level and degree of freedom (2, 174). The null hypothesis that there are no significant differences in net value added among the catfish value chain actors in Imo State, Nigeria therefore was rejected and the alternative accepted. This result of significant differences was further exposed to multiple comparism post -hoc test (Scheffe test) which ascertains the sources of the differences. Before-hand, a Bartlett's test of equality of error variances of chi^2 value was 270.5362 ($p < 0.000$) showed that the assumption of homogeneity of variance was not violated as it was shown in Table 4.10 and Table 4.11 labelled multiple comparisons which gave the result of the post-hoc tests.

Table 4.9: Average net value added of the three actors in catfish value chain

Actors	Mean (₦)	Std. Deviation	N
Input suppliers	381,348.00	2,372,204	32
Producers	581,852.71	699569.94	47
Processors	604,584.83	496265.94	50
Marketers	1,383,871.25	125220.34	47

Source: computed from ANOVA

Table 4.10: Analysis of Variance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Between groups	2.062e13	3	.682e12	7.94	0.0001
Within groups	2.0975e14	172	1.2195e12		
Total	2.3881e14	15	1.3646e12		

Source: computed from ANOVA
Bartlett's test of equality of error variances – $chi^2(3) = 270.5362$ Prob.> $chi^2 = 0.000$

Table 4.11: Multiple comparism of the Post-Hoc
Table 4.11 labelled multiple comparisons which gives the result of the post-hoc tests

Actors	Input suppliers	Producers	Processors
Producers	200,504.71		
	(0.009)		
Processors	223,236.83	22,732.12	
	(0.005)	(1.000)	
Marketers	1,002,523.25	802,018.54	779,286.42
	(0.000)	(0.002)	(0.024)

Source: computed from ANOVA
Figures in parentheses are the p-values
**** = significant at 5%, ** = significant at 1%***
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity - $chi^2(1) = 7.25$, Prob > $chi^2 = 0.0071$

The statistical significance of the differences between each pair of group is presented on Table 4.11. From the Table 4.11, the mean difference value (I-J) indicated that there is significant difference amongst the actors in the catfish value chain, the mean difference between marketer and processors was ₦779,286.42 ($p<0.024$) which implies that the marketers' net value addition is significantly higher than processors' at 5% statistical level.

Also, marketers' net value added was significantly higher than input suppliers by ₦1,002,523.25 ($p<0.000$), net value added of the marketers was significantly higher than that of producers by ₦802,018.54 ($p<0.002$), producers' net value added was significantly higher than input suppliers by ₦200,504.71 ($p<0.009$), processors' net value added was significantly higher than by input suppliers' 223,236.83 ($p<0.005$) and also higher not significantly than the net value added of and producers by 22,732.12 ($p<1.000$). It could be concluded that the net value added of the actors were significantly different across the catfish value chain nodes.

4.4: Factors that influence the choice of catfish enterprise of value chain actors.

Table 4.12 shows the result of the coefficients of Multinomial Logit Model of the catfish value chain.

Table 4.12: Result of the Coefficients of the Multinomial Logit Model of the Catfish Value Chain

	Input suppliers			Producers			Marketers		
Variables	**Coef.**	**Std. Err.**	**Z**	**Coef.**	**Std. Err.**	**Z**	**Coef.**	**Std. Err.**	**Z**
Age	-0.054	0.016	-3.36**	-0.028	0.014	-2.010*	-.006	0.016	-0.37
Gender	0.492	0.301	1.630	0.623	0.266	2.340*	0.931	0.304	3.060**
marital status	-0.086	0.194	-0.440	-0.157	0.175	-0.090	-0.019	0.199	-0.100
household size	0.339	0.799	4.240**	0.264	0.065	4.030**	0.131	0.074	1.760
marketing experience	0.003	0.421	0.080	0.034	0.034	0.990	0.051	0.037	1.370
Mem. of association	1.204	0.329	3.660**	0.854	0.304	2.810**	0.407	0.353	1.150
Net value added	1.130e-7	1.250e-7	0.910	-8.220e-7	2.350e-7	-3.500**	-8.570e-6	9.510e-7	-9.020**
Educational level	0.668	0.178	3.750**	0.438	0.143	3.050**	-0.014	0.162	-0.09

Number of obs = 176 LR $chi^2(24)$ = 333.35 Prob > chi^2 = 0.0000
Log likelihood = -558.085 Pseudo R^2 = 0.2300
Chi^2 for IIA ranges from -10.05 to – 0.86
N/B: Base Outcome is the Processors' Category
Source: Result from STATA 14 software

Multinomial Logistic Model was used to assess the factors influencing actors' choice of enterprises in catfish value chain. It is a choice model used when there are more than two dependent variables, in this instance, the three actors namely input suppliers, producers, processors and marketers involved in catfish value chain and individual actor cannot engage in more than one activity at a particular time hence the four activities were mutually exclusive. It is expected that an actor's decision in the choice of catfish enterprises is influenced by a number of factors which include age, gender, marital status, household size, marketing experience, membership of association, net value added and educational level. In this multinomial logistic model, the multiple choice of being a catfish input supplier, producer, processor and marketer was modelled simultaneously. The processor was taken as the base/reference category following Petrucci (2009) that in a multinomial model, the category with highest number of frequency was used as a reference category and the result of the coefficients of the explanatory variables was presented in Table 4.12.

The data were tested for the validity of the independence of the irrelevant alternatives (IIA) assumptions by using the Hausman test for IIA. For the Hausman test, the chi-Square ($\chi 2$) ranged from - 10.05 to – 0.86 with p-value of 1.00. Based on this, the test failed to reject the null hypothesis of independence of the value chain actors specified in the model, suggesting that the multinomial logit (MNL) specification was appropriate to model choice of an actor in the four different activities in the study area. Also, this implies that the application of the MNL specification to model the determinants of enterprise choice in catfish value chain was justified. The likelihood ratio statistics as indicated by $\chi 2 = 333.35$ are highly significant ($P < 0.00001$), and this also suggests that the model has a strong explanatory power. The pseudo-R^2 value of 0.2300 represent a good-fit model as indicated in Zepeda (1990), Rahji and Fakayode (2009) and Petrucci (2009) that pseudo R^2 values that ranged between 0.1585 and 0.3665 respectively is desirable as it connotes absence of multi-collinearity in the model. The significant Pseudo-R^2 is indicative of good fit and the correctness of the estimated model expressing the robustness of the model as it means that slope coefficients of the explanatory variables were not equal to zero and they collectively determine the factors responsible for the choice of enterprises by actors in catfish value chain.

In the input suppliers' model shown in Table 4.12, age (-0.054, $p<0.01$), household size (0.339, $p<0.01$), membership of association (1.204, $p<0.01$) and educational level (0.668, $p<0.01$) were significant explanatory variables. This implies that youthful individual tends to choose to be an input supplier rather than processor in the catfish value chain while aged individual tends to become a processor rather than an input supplier. In addition, an individual with large household size tends to be an input supplier instead of being a processor. Individual with membership of association is more likely to be an input supplier rather than a processor and an educated individual is more likely to choose to become an input supplier rather than a processor.

In the producers' category, the significant variables are age (-0.028, $p<0.05$), gender (0.623, $p<0.05$), household size (0.264, $p<0.01$), membership of association (0.854, $p<0.01$), net value added (-3.220e-7, $p<0.01$) and educational level (0.438, $p<0.01$). This implies that youthful individuals tend to choose to be a producer rather than a processor and an aged individual tends to choose to be a processor rather than a producer; in the same vein, male individual would choose to be a catfish producer rather than a processor and female individuals would prefer to be a processor to a producer; an individual with large household size tends to be an producer instead of being a processor; Individual with membership of association is more likely to be a producer rather than a processor; a low amount of net value addition in production would discourage an individual to choose being a producer rather than a processor and vice-versa, which means that a low amount of net value addition in production would encourage an actor to choose to be a processor rather than a producer and an educated individual is more likely to choose to be a producer rather than a processor.

In the marketers' category, the two significant explanatory variables were gender (0.931, $p<0.01$) and amount of net value added (-3.570e-6, $p<0.01$), were significant variables. This implies that male individual would choose to be a catfish marketer rather than a processor and a low amount net value addition in marketing would discourage an individual to choose being a marketer rather than a processor and vice-versa, which means that a high amount of net value addition in marketing would discourage an actor to choose to be a processor rather than a marketer.

Table 4.13: Results of the Marginal Effects of the Multinomial Logit Model of the Catfish Value Chain

	Input suppliers		Producers		Processors		Marketers	
Variables	**dy/dx**	**Z**	**dy/dx**	**z**	**dy/dx**	**z**	**dy/dx**	**z**
Age	-0.0067	-2.850**	-0.0020	-0.700	0.0084	2.900**	0.3219e-3	1.230
	(0.0023)		(0.0029)		(0.0029)		(0.2621e-3)	
Gender	0.0268	0.590	0.0992	1.800	-0.1366	-2.460*	0.0106	1.700
	(0.0451)		(0.0551)		(0.0555)		(0.0062)	
Marital Status	-0.0010	-0.040	-0.0300	-0.830	0.0299	0.820	0.0012	0.370
	(0.2908)		(0.0363)		(0.0363)		(0.0032)	
Household size	0.0347	2.830**	0.0328	2.330*	-0.0665	-4.900**	0.9335e-3	-0.740
	(0.0123)		(0.0141)		(0.0136)		(0.1264e-2)	
Activity	-0.0025	-0.390	0.0074	1.030	-0.0055	-0.760	0.6733e-3	1.060
Experience	(0.0064)		(0.0071)		(0.0072)		(0.6351e-3)	
Mem. of Assoc.	0.1309	2.830**	0.0971	1.630	-0.2242	-3.510**	-0.0038	-0.700
	(0.4621)		(0.0595)		(0.0638)		(0.0053)	
Net Value	1.26e-7	4.240**	-1.42e-7	-2.470*	1.70e-7	3.930**	-1.53e-7	-3.060**
Added	(2.84e-8)		(5.77e-8)		(4.32e-8)		(5.00e-8)	
Years of formal	0.0768	2.840**	0.0470	1.530	-0.1175	-3.900**	-0.00627	-1.810
education	(0.0271)		(0.0307)		(0.0301)		(0.0035)	

dy/dx = marginal effects

* = significant at 5%, ** = significant at 1%

Source: Result from STATA 14 software

According to Adeoti, Coster and Gbolagun (2013), the coefficients of the parameter estimates provides the directions of effect of the independent variables on the dependent variables estimates but don't represent the actual magnitude of change of the effect thus the marginal effects of each independent variables on the dependent variables measures the expected change in probability of a particular choice made with respect to a unit change in an independent variable and the result of the marginal effects was presented in Table 4.13. According to Rahji and Fakayode (2009), the positive sign implies that the probability of an actor's choice to be in any of the other three activities relative to the reference group (which in this case is processors' category) increases as these significant explanatory variables increase. For input suppliers' category, it was shown in the result that marginal effects of age was -0.0067 ($p<0.01$) indicating age has negative influence of the changing in probability of choosing to be a catfish input supplier rather a processor at 1% level of significant. This implies that an increasing age of an actor by 1 year tends to reduce the probability of choosing to be an input supplier over a processor by 0.067%, it could also be deduced that

youthful actor has a 0.067% higher probability than an aged actor to choose to be an input supplier rather than a processor; this means that there is the probability of being an input supplier rather than a processor decreases with increasing age of the actor. The marginal effect of the household size was 0.0347 ($p<0.01$) indicated that the household size has a positive influence on the probability of choosing to be an input supplier rather than a processor at 1% level of significance, the value of the marginal effect shows that an increase in the household size of the catfish actor by one person, would increase the individual probability of choosing to being an input supplier rather than a processor by 3.4%; the marginal effect of the membership of association was 0.1309 ($p<0.01$) indicated that the membership of association has a positive influence on the probability of choosing to be an input supplier rather than a processor at 1% level of significance, the value of the marginal effect shows that an actor who is a member of an association has a higher probability of 13.09% in choosing to be an input supplier rather than being a processor; the value of the marginal effect of net value added in catfish production was 1.26e-7 ($p<0.01$). This implies that as the net value addition of an actor increases by ₦1, the probability of choosing to be an input supplier rather than a processor increases by 1.26e-5%, this invariably connotes that a low amount of net value addition of input supplying activities would discourage an individual to choose to be an input supplier rather than a processor and the marginal effect of the years of formal education was 0.0768 ($p<0.01$) indicated that the years spent in formal education has a positive influence on the probability of choosing to be an input supplier rather than a processor at 1% level of significance, the value of the marginal effect shows that an increase in the years of formal education of the catfish actor by one year, would increase the individual probability of choosing to an input supplier rather than a processor by 7.7%.

For producers' category, it was shown in the result that marginal effects of household size were 0.0328 ($p<0.01$) indicating household size has positive influence on the change in

probability of choosing to be a catfish producer rather a processor at 1% level of significant. The value of the marginal effect shows that an increase in the household size of the catfish actor by one person would increase the individual probability of choosing to a producer rather than a processor by 3.3%. In addition, the value of the marginal effect of amount of net value added in catfish production was -1.420e-7 ($p<0.05$). This implies that as the net value addition of an actor increases by ₦1, the probability of choosing to be a producer rather than a processor decreases by 1.420e-5%, this invariably connotes that a low amount of net value addition of production would discourage an individual to choose to be a producer rather than processor.

For processors' category, it was shown in the result that marginal effects of age was 0.0084 ($p<0.01$) indicating age has positive influence of the changing in probability of choosing to be a catfish processor rather than any other three choice categories at 1% level of significant. This implies that an increasing age of an actor by 1 year tends to increases the probability of choosing to be a processor over any other categories by 0.084%, it could also be deduced that youthful actor has a 0.084% lower probability than an aged actor to choose to be a processor rather than any other categories; this means that there is the probability of being a processor rather than any other choice categories increases with increasing age of the actor. The marginal effect of gender was -0.1366 ($p<0.05$), implying that a male catfish value chain actor has a 13.66% lower probability to choose to be a processor rather than any other categories than a female catfish value chain actor. This means that there is a lower probability for a male individual to be a catfish processor than his female counterpart. The marginal effect of the household size was -0.0665 ($p<0.01$) indicated that the household size has a negative influence on the probability of choosing to be a processor rather than any other categories at 1% level of significance, the value of the marginal effect shows that an increase in the household size of the catfish actor by one person, would decrease the individual

probability of choosing to a processor rather than any other categories by 6.65%; the marginal effect of the membership of association was -0.2242 ($p<0.01$) indicated that the membership of association has a positive influence on the probability of choosing to be a processor rather than any other category at 1% level of significance, the value of the marginal effect shows that an actor who is a member of an association has a lower probability of 22.42% in choosing to be a processor rather than be any other actor; the value of the marginal effect of net value added in catfish production was 1.70e-7 ($p<0.01$). This implies that as the net value addition of an actor increases by ₦1, the probability of choosing to be a processor than any other actor by 1.70e-5%, this invariably connotes that a high amount of net value addition of processing activities would encourage an individual to choose to be an processor rather than any other actor and the marginal effect of the years of formal education was -0.1175 ($p<0.01$) indicated that the years spent in formal education has a negative influence on the probability of choosing to be a processor rather than any other actor at 1% level of significance, the value of the marginal effect shows that an increase in the years of formal education of the catfish actor by one year, would decrease the individual probability of choosing to a processor rather than any other actor by 11.75%.

For marketing category, only the amount of net value added (-1.53e-7, $p<0.01$). this implies that as the net value addition of an actor increases by ₦1, the probability of choosing to be a marketer rather than a processor decreases by -1.53e-7%, this invariably connotes that a low amount of net value addition of marketing activities would discourage an individual to choose to be a marketer rather than a processor.

Although marginal effect showed a marginal probability change in choice categories given a unit change in the significant explanatory variable. However, according to Rahji and Fakayode (2009), the quasi–elasticities would better estimate the degree of responsiveness of actors' choice as a result of a unit change in the explanatory variables in the model and the

result was presented in Table 4.14. The positive value of quasi-elasticities indicates that 1% increment in the explanatory variable results to a percentage increment in the choice of an activity relative to reference category while negative quasi-elasticities implies a percentage decrease in the choice of an activity relative to reference category as a result of 1% increment in the explanatory variable. In addition, a quasi-elasticity value of above unity indicates elastic values which implies that 1% change in the explanatory variables result in a more proportionate change in the choice of an activity in catfish value chain relative to reference category and a value that is lesser than unity indicates inelastic values which means that 1% change in explanatory variable result in a lesser proportionate change in the choice of a particular activity in catfish value chain relative to reference category.

Table 4.14: Results of the Quasi-Elasticities of the Multinomial Logit Model of the Catfish Value Chain

	Input suppliers		**Producers**		**Processors**		**Marketers**	
Variables	**eyex**	**z**	**eyex**	**z**	**eyex**	**z**	**eyex**	**z**
Age	-1.2946	-2.780**	-0.2144	-0.700	0.9596	2.820**	0.7156	1.300
	(0.4653)		(0.3053)		(0.3403)		(0.5496)	
Gender	0.0604	0.590	0.1249	1.790	-0.1828	-2.430*	0.2774	2.220*
	(0.1020)		(0.0699)		(0.0752)		(0.1251)	
Marital Status	-0.0093	-0.040	-0.1535	-0.830	0.1624	0.830	0.1239	0.370
	(0.2661)		(0.1859)		(0.1968)		(0.3327)	
Household size	0.8215	2.710**	0.4328	2.290*	-0.9344	-4.700**	-0.2566	-0.760
	(0.3032)		(0.1893)		(0.1990)		(0.1953)	
Activity	-0.0718	-0.390	0.1172	1.030	-0.0934	-0.760	0.2232	1.140
Experience	(0.1837)		(0.1139)		(0.1230)		(0.1953)	
Mem. of Assoc.	0.1866	2.780**	0.0773	1.630	-0.1897	-3.370**	-0.0623	-0.720
	(0.0671)		(0.0474)		(0.0563)		(0.0865)	
Net Value	0.4130	4.510**	-0.2614	-2.410*	0.3315	3.890**	-5.8477	-8.190**
Added	(0.0915)		(-0.1087)		(0.0851)		(0.7143)	
Years of formal	0.7124	2.700**	0.2434	1.520	-0.6469	-3.800**	-0.6755	-2.360*
education	(0.2638)		(0.1603)		(0.1700)		(0.2858)	

eyex = Quasi-Elasaticity

* = significant at 5%, ** = significant at 1%

Source: Result from STATA 14 software

Based on the significant variables of the input suppliers' model, quasi-elasticity of age was -1.2946 ($p<0.01$) which means it is elastic and significant at 1% statistical level, this implies that 1% increase in the age of an actor results in a 129.46% more proportionate decrease in the choice of a being an input supplier relative to being a processor. The value of the quasi-

elasticity of the household size was 0.8215 ($p<0.01$) which indicates that it is inelastic and implies that at 1% level of statistical significance, 1% increase in the household size results in an 82.15% lesser proportionate decrease in the choice of a being a input supplier relative to being a processor. The quasi-elasticity value of the membership of association was 0.1866 ($p<0.01$) indicates that it is inelastic and an individual that belong to an association has 18.66% lesser proportionate choice of being an input supplier relative to being a processor than an individual without any association membership. The quasi-elasticity value of the net value added was 0.4130 ($p<0.01$) indicates that it is inelastic and 1% increase in net value added of producers, results in 41.30% lesser proportionate increment in the choice of being an input supplier relative to being a processor. In addition, the quasi-elasticity of years of formal education was 0.7124 ($p<0.01$) which indicates inelasticity and 1% increase in years of formal education would result to 71.24% more proportionate increase in the choice of being an input supplier relative to processor.

For the producers' model, the value of the quasi-elasticity of the household size was 0.4328 ($p<0.05$) which indicates that it is inelastic and implies that at 1% level of statistical significance, 1% increase in the household size results in a 43.28% lesser proportionate increase in the choice of a being an input supplier relative to being a processor. The quasi-elasticity value of the net value added was -0.2614 ($p<0.01$) indicates that it is inelastic and 1% increase in net value added of producers, results in 26.14% lesser proportionate reduction in the choice of being an input supplier relative to being a processor.

For choice of processors; the quasi-elasticity of age was 0.9596 ($p<0.01$) which means it is inelastic and significant at 1% statistical level, this implies that 1% increase in the age of an actor results in a 95.96% more proportionate increase in the choice of a being a processor relative to being any other actor. The quasi-elasticity of the gender was -0.1828 ($p<0.05$), this

indicated that gender is inelastic, significant at 1% statistical level and that a female actor has 18.28% lesser proportionate choice of being in processor' category than her male counterpart relative to being in any other category. The quasi-elasticity household size of –0.0934 ($p<0.01$) indicated that household size is inelastic and 1% increase in the household size would result in 9.34% lesser proportionate reduction in the choice of being a processor relative to being in any other category. The quasi-elasticity of membership of association was -0.858 ($p<0.05$) implies that membership of association is inelastic and individual that belong to association had 85.8% lesser proportionate choice of being in processors' category than non-members of any association relative to being in any other category. The quasi-elasticity of the net value added of 0.3315 ($p<0.01$) shows that it is inelastic and 1% increase in net value added would result in 33.15% lesser proportionate increase in the choice of being a processor relative to being in any other category relative to being in any other category. The quasi-elasticity of years of formal education of -0.6469 ($p<0.01$) shows that it is inelastic and 1% increase in years of formal education would result in 64.69% lesser proportionate decrease in the choice of being a processor relative to being in any other category.

For the marketers' model, quasi-elasticity of gender was 0.2774 ($p<0.05$) which means it is inelastic, significant at 5% statistical level and that male actors had 27.74% lesser proportionate choice of being in marketers' category relative to processors' category than their female counterparts. The quasi-elasticity value of the net value added was -5.8477($p<0.01$) indicates that it is elastic and 1% increase in the net value added of the processor, results in 584.77% decrease in the choice of being a marketer relative to being a processor. The quasi-elasticity value of the years of formal education was -0.6755 ($p<0.05$) indicates that it is elastic and 1% increase in the years of formal education of the marketers, results in 67.55% decrease in the choice of being a marketer relative to being a processor.

Hypothesis 2: Factors such as level of education, gender, marital status, age, household size, experience, membership to association and net value added do not have significant influence on catfish value chain actors' choice of catfish enterprise in Imo state.

The result of the multinomial logit model was used to test this hypothesis, it was shown that the significant coefficients in the input suppliers' model were age (-0.054, $p<0.01$), household size (0.339, $p<0.01$), membership of association (1.204, $p<0.01$) and years of formal education (0.668, $p<0.01$) implying that they are significant effects on the input suppliers' choice in the model; in the producers' model, age (-0.028, $p<0.05$), gender (0.266, $p<0.05$), household size (0.264, $p<0.01$), membership of association (0.854, $p<0.01$), amount of net value added (-3.220e-7, $p<0.01$) and years of formal education (0.438, $p<0.01$) were significant explanatory variables which implies that they are significant effects on the producers' choice in the model; In the marketers' category, the two significant explanatory variables were gender (0.931, $p<0.01$) and amount of net value added (-8.570e-7, $p<0.01$) were significant variables which implies that they are significant variables therefore, the null hypothesis was rejected for these significant variables but accepted for the insignificant variables specified in the model.

4.5: Determinants of net value added amongst catfish input suppliers, producers, processors and marketers

4.5.1: Determinants of net value added of the input suppliers

The result of the multiple regression analysis on the determinants of net value added of the input suppliers is shown in Table 4.15

Table 4.15: Regression result of the determinants of net value added of catfish input suppliers

Variable	Linear	Exponential	Semi-log	Double-log(L)
Constant	-1.756e6	12.312	-2.253e7	0.073
	(-4.305) **	(23.175) **	(-8.112) **	(0.069)
Age	2.470e4	0.0243	5.553e5	-0.882
	(3.845)**	(2.903)	(0.900)	(-3.781) **
Gender	-2.144e6	0.089	-1.077e6	-0.249
	(-1.884))	(0.599)	(-3.554) **	(-2.172) *
Marital Status	-1.908e4	0.069	1.314e4	0.092
	(-0.247)	(0.694)	(0.067)	(1.242)
Years in School	3.527e4	-0.015	1.406e6	0.4083
	(2.654)*	(-0.853)	(5.499)**	(4.224)**
Household size	1.388e5	-0.080	5.321e5	0.128
	(3.877))**	(-1.722)**	(5.394)**	(3.433)**
Experience	-6.6340	-0.005	-1.336e6	0.513
	(-3.344))**	(0.188)	(-5.217) **	(5.302) **
Membership of Cooperatives	-2.287e3	0.115	-4.659e5	-0.164
	(-0.019)	(0.159)	(-1.489)	(-1.383)
Operating cost	-8.909	6.340e-6	1.342e6	-0.667
	(3.075))**	(1.679)	(-5.911) **	(-7.770) **
Amount of Credit Used	0.017	2.560e-8	5.354e4	0.816e-3
	(0.122)	(0.143)**	(2.190)*	(-0.088)
Cost of acquired inputs	-0.209	-3.600	1.946e5	0.125
	(-0.721)	(-0.954)**	(0.964)	(1.640)
R-squared	0.959	0.698	0.725	0.826
N	32	32	32	32
F-statistic	203.352**	19.637**	22.391**	40.217**

** significant @ 1%, * significant @ 5%
F-tab @ 1% = 3.20
Source: Result of Regression model run with E-views 10

The result show that all the functional forms were statistically significant at 1% level of probability, implying that any of the functional forms is adequate in estimating and explaining the determinants of net value added of the input suppliers. However, the Double-log functional form was chosen as the lead equation and used for further analysis of the data.

The Double-log function was also chosen based on other consideration such as value of the F-Statistic (40.217), highest number of significant variables and *apriori* expectation.

The result shows that the estimated coefficient of multiple determinations (R^2) was 0.826 and this indicates that 82.6% in the variation of the net value added of Catfish input suppliers was explained by the explanatory variables included in the model and the remaining 7.4% of the variation in net value added was as a result of the omitted variables. The F-statistics of 40.217 is greater than F- tab of 3.20 which means it was significant (i.e F-cal > F-tab at 1%). This indicated the significance of F-value which is the measure of goodness of fits of the double log regression model in explaining the influence of these factors on net value added.

Out of ten explanatory variables in the model, three of them were statistically significant at 5% and according to their signs of these significant variables years in school, household size and experience were positive and significant which indicate that increase in the quantity of these variables would lead to an increase in the net value added of catfish input supplier while age, gender, and operating cost had negative coefficient signs which indicate that increase in the quantity of these variables would lead to a reduction in the net value added of a catfish input suppliers *ceteris paribus*.

The coefficient of the years in school was 0.4083 ($p<0.01$), positive and significant at 1%, indicating that as the years of schooling of catfish input suppliers increased their net value added increased proportionately. It means educated catfish producers tend to achieve higher net value added than their illiterate counterpart. The higher the level of farmer's education, the better is his/her decision-making ability, especially in the adoption of new technologies and innovation to improve his efficiency, productivity and net value addition in the system. This corroborates the findings of Olarinde and Kuponiyi, (2012) that education is an important factor that determines adoption of new innovations. It provides readability consciousness and awareness, which enable decisions to be made.

The coefficient of the household size was 0.128 ($p<0.011$) is positive and significant at 11% which indicates that as the household size of the catfish input supplier increases, their net value added increases proportionately. The reason is because large household size is an indication of availability of family labour and less spending on hired labour, thereby reducing their expenditure and increases net value added at the same time. The coefficient of the production experience was 0.513 ($p<0.01$), positive and significant at 1%. This implies that input suppliers with high years of experience in catfish production tend to achieve a higher output performance. According to Ogundari and Ojo (2007), agricultural ventures involves a lot of risks and uncertainties; therefore, to be competent enough to handle all the vagaries of agriculture, actors must have stayed in farming business for quite some time.

Conversely, the coefficient of the age was 0.882 ($p<0.01$), positive and significant at 1%, and indicates that as the age of the input supplier increases, their net value added decreases proportionately This is because the innovativeness and optimism of the entrepreneur as well as his mental capacity to cope with the challenges of his business activities and his mental and physical abilities to do manual work decrease with age. The study results concur with those by Nwaru and Iwuji (2005) who reported that entrepreneurship gradually becomes less as the age of the entrepreneur increases. The coefficient of gender was -0.249 ($p<0.05$) indicating that gender have inversely relationship with the net value addition and female input suppliers have lower net value added than their male counterpart. This is because most male have access to required skills, training and other resources to perform better than their female counterpart which is implicative in improving their net value added. The coefficient of operating cost was -0.667 ($p<0.01$), negative and significant at 1%, indicating that as the operating cost increases, their net value added decreases, implying that cost of operation in delivering value added services in the catfish value chain has indirect relationship with the value net value addition obtainable from the catfish input supply.

4.5.2: Determinants of net value added of the producers

The result of the multiple regression analysis on the determinants of net value added of the catfish producers is shown in Table 4.16.

Table 4.16: Regression result of the determinants of net value added of catfish producers

Variable	Linear(L)	Exponential	Semi-log	Double-log
Constant	-1.917e4	12.720	-2.972e6	5.461
	(-0.20145)	-14.993	(-4.288)	-3.181
Age	-1.526e3	-0.015	1.603e4	-0.449
	(-2.702)**	(-1.097)	(-0.099)	(-1.238)
Gender	3.167e4	-0.255	1.102e5	-0.100
	(-1.148)	(-1.035)	(-1.378)	(-0.561)
Marital Status	2.411e4	0.069	-7.796e3	0.002
	-1.303	-0.417	(-0.148)	-0.018
Years in School	6.639e3	-0.035	7.830e3	-0.403
	(2.258)**	(-1.339)	(2.898)**	(-3.270)**
Household size	5.688e3	-0.257	-3.954	-0.980
	(2.194)*	(-3.361)**	(-14.775)**	(-3.713)**
Production Experience	5.621e3	0.035	2.1693	0.099
	(1.960)*	(-1.016)	(-0.038)	(-0.779)
Membership of Cooperatives	-2.380e3	-0.432	9.357e4	-0.297
	(-0.777)	(-1.582)	(-1.077)	(-1.539)
Depreciation of Fixed Assets	-1.074	0.000	5.220e4	-0.053
	(-1.898)*	(-1.629)	(-0.958)	(-0.438)
Amount of Credit Used	-1.404e5	-0.927	-1.911e5	-0.953
	(-4.646)**	(-3.450)**	(-2.223)*	(-4.981)**
Quantity of Fish produced	285.553	0.001	383742.300	1.413
	(14.149)**	(4.673)**	(5.386)**	(8.875)**
R-squared	0.966	0.807	0.707	0.836
n	47	47	47	47
F-statistic	102.754**	18.921**	9.921**	18.414**

** significant @ 1%, * significant @ 5%
F-tab @ 1% = 3.20
Source: Result of Regression model run with E-views 10

The result show that all the functional forms were statistically significant at 1% level of probability, implying that any of the functional forms is adequate in estimating and explaining the determinants of net value added of the input suppliers. However, the linear functional form was chosen as the lead equation and used for further analysis of the data. The linear function was also chosen based on other consideration such as value of the F-Statistic (18.414), highest number of significant variables and *apriori* expectation.

The result shows that the estimated coefficient of multiple determinations (R^2) was 0.966 and this indicates that 96.6% in the variation of the net value added of Catfish producers was explained by the explanatory variables included in the model and the remaining 3.7% of the variation in net value added was as a result of the omitted variables. The F-statistics of 102.754 is greater than F- tab of 3.20 which means it was significant (i.e F-cal > F-tab at 1%). This indicated the significance of F-value which is the measure of goodness of fits of the linear regression model in explaining the influence of these factors on net value added.

Out of ten explanatory variables in the model, seven of them were statistically significant at 5% and according to the signs of these significant variables, years in school, household size, production experience and quantity of fish produced were positive and significant which indicate that increase in the quantity of these variables would lead to an increase in the net value added of catfish producers while age, depreciation of fixed assets and amount of credit used had negative coefficient signs which indicate that increase in the quantity of these variables would lead to a reduction in the net value added of a catfish producers *ceteris paribus*.

The coefficient of the years in school was 6.639e3 ($p<0.01$), positive and significant at 1%, indicating that as the years of schooling of catfish producers increases their net value added increase proportionately. It means educated catfish producers tend to achieve higher net value added than their illiterate counterpart. The higher the level of farmer's education, the better is his/her decision-making ability, especially in the adoption of new technologies and innovation to improve his efficiency, productivity and net value addition in the system. This corroborates the findings of Olarinde and Kuponiyi, (2012) that education is an important factor that determines adoption of new innovations. It provides readability consciousness and awareness, which enable decisions to be made.

The coefficient of the household size was 5.688e3 ($p<0.05$), positive and significant at 5% which indicates that as the household size of the catfish producers increases, their net value added increase proportionately. They reason is because large household size is an indication of availability of family labour and less spending on hired labour, thereby reducing their expenditure and increases net value added at the same time.

The coefficient of the production experience was 5.621e3 ($p<0.05$) is positive and significant at 5%, implying that as the catfish farmers' years of experience in catfish production increases, he/she tends to achieve a higher output performance. This is because, experienced producers tend to manage risks and uncertainties better overtime. According to Ogundari and Ojo (2007), farming involves a lot of risks and uncertainties; therefore, to be competent enough to handle all the vagaries of agriculture, marketers must have stayed in farming business for quite some time.

In addition, coefficient of quantity of fish produced was 285.553 ($p<0.01$), positive and significant at 1% and this indicated that as the quantity of fish produced increases, their net value added increases as well, implying that scale of operation has direct relationship with the value net value addition obtainable from the catfish production.

Conversely, the coefficients of age, depreciation value of fixed assets and amount of credit used were 1.526e3 ($p<0.01$), -1.074 ($p<0.05$) and -1.404e5 ($p<0.01$) respectively. This shows that these variables have inverse relationship with the net value addition and their increases result to reduction in the net value added of catfish producers.

4.5.3: Determinants of net value added of the processors

The result of the multiple regression analysis on the determinants of net value added of the catfish processors is shown in Table 4.17.

Table 4.17: Regression result of the determinants of net value added of catfish processor

Variables	Linear	Exponential	Semi-log	Double-log(L)
Constant	6.245e5	11.972	-7.596e6	0.596
	(1.731)	(50.603)	(-6.212)	(0.469)
Age	2304.549	-0.016	-4.315e4	-0.514
	(0.328)	(-3.593)**	(-0.25539)	(-2.926)**
Gender	-6.054e4	0.079	6.337e4	7.889e-2
	(-0.442)	(0.901)	(0.820)	(0.981)
Marital Status	-1.589e5	0.406e-2	8.187e4	0.531
	(-1.775)*	(6.854e-2)	(1.580)	(9.847)**
Years in school	1.423e4	-0.683e-2	-6.762e4	0.257
	(1.141)	(-3.786)**	(-1.735)*	(6.338)**
Household size	-5.719e3	1.073e-2	1.550e5	3.434e-2
	(-0.206)	(0.579)	(2.333)**	(0.497)
Processing Experience	-2.015e4	2.011e-2	-8.768e4	0.186
	(-1.109)	(1.715)*	(-1.257)	(2.566)**
Member of Cooperatives	4.459e5	3.665e-2	8.384	7.044e-2
	(2.291)**	(0.333)	(0.901)	(0.727)
Depreciation of fixed assets	4.454	3.070e-6	-4.567e4	1.729e-2
	(0.746)	(1.348)	(-0.826)	(0.301)
Amount of credit used	-8.628e4	0.438	2.183e5	0.324
	(-0.394)	(2.997)**	(1.692)*	(2.414)*
Cost of processing	-13.241	0.108e-3	9.606e5	1.384
	(-1.024)	(13.309)**	(10.290)**	(14.248)
R-squared	0.289	0.859	0.802	0.883
n	50	50	50	50
F-statistic	12.462**	23.663**	15.844**	29.426**

** significant @ 1%, * significant @ 5%
F-tab @ 1% = 3.20
Source: Result of Regression model run with E-views 10

The result show that all the functional forms were statistically significant at 1% level of probability, implying that any of the functional forms is adequate in estimating and explaining the determinants of net value added of the input suppliers. However, the double-log functional form was chosen as the lead equation and used for further analysis of the data. The double-log function was also chosen based on other consideration such as value of the F-Statistic (29.426), highest number of significant variables and *apriori* expectation.

The result shows that the estimated coefficient of multiple determinations (R^2) was 0.883 and this indicates that 88.3% in the variation of the net value added of catfish processors was explained by the explanatory variables included in the model and the remaining 11.7% of the variation in net value added was as a result of the omitted variables. The F-statistics of 29.426 is greater than F- tab of 3.20 which means it was significant (i.e F-cal > F-tab at 1%), this indicated the significance of F-value which is the measure of goodness of fits of the Cobb-Douglas regression model in explaining the influence of these factors on net value added.

Out of ten explanatory variables in the model, five of them which include age (-0.514, $p<0.01$), marital status (0.531, $p<0.01$), years in school (0.257, $p<0.01$), processing experience (0.186, $p<0.01$) and amount of credit used (0.324, $p<0.05$) were statistically significant which implies that these variables have statistical significance effects on the net value added of the catfish processors. According to their signs, marital status, years in school, processing experience and amount of credit used were positive and significant meaning that their respective increases would result to an increase in the net value added of catfish processors while only age had negative coefficient signs which indicate that increase in the age of the processor would lead to a reduction in the net value added of a catfish processors *ceteris paribus*.

More explicitly, the positive coefficient of marital status showed that married processors have higher net value added than the single individuals, educated catfish processors tend to achieve higher net value added than their illiterate counterpart, catfish processor with high years of experience in catfish production tends to achieve a higher output performance and high amount of credit used have positive effect on the net value addition. On the other hand, negative coefficient of the age of the processor showed that aged processors have lesser net value added than the young individuals in catfish processing.

4.5.4: Determinants of net value added of the marketers

The result of the multiple regression analysis on the determinants of net value added of the catfish marketers is shown in Table 4.18.

Table 4.18: Regression result of the determinants of net value added of catfish marketer

Variable	Linear	Exponential	Semi-log(L)	Double-log
C	1.437e5	10.259	-5.904e4	7.861
	(1.234)	(10.037)	(-0.120)	(1.771)
Age	2.253e3	0.012	8.862e4	0.494
	(1.236)	(0.770)	(2.072)**	(0.753)
Gender	4.218e4	0.661	3.419e4	0.571
	(1.055)	(1.885)*	(0.881)	(1.632)
Marital Status	7.805e3	0.123	1.13e4	0.136
	(0.334)	(0.599)	(0.494)	(0.659)
Years in school	-4.309e3	-4.289e-3	4.228	-9.960e-2
	(-1.224)	(-0.139)	(1.986)**	(-10.853)**
Household size	-4.779e3	5.658	-4.193e4	-0.360e-3
	(-0.508)	(0.685)	(-0.980)	(-9.340e-4)
Marketing experience	5.650e3	4.933e-2	3.382e4	0.227
	(1.337)	(1.3312)	(1.344)	(1.002)
Membership of cooperatives	-3.311e4	-0.427	-1.973e4	-0.341
	(-0.828)	(-1.217)	(-0.511)	(-0.980)
Depreciation of fixed assets	-1.352	-5.970e-07	8.894e3	0.184
	(-0.877)	(-4.410e-2)	(0.366)	(9.884)**
Amount of credit used	-1.134e5	-0.480	-1.120e5	-0.580
	(-2.158)**	(-1.041)	(-2.141)**	(-1.231)
Cost of marketing	2.068	3.220e-05	-8.622e3	-1.513e-2
	(0.318)	(0.564)	(-6.835)**	(-3.63)
R-squared	0.382	0.291	0.607	0.383
n	47	47	47	47
F-statistic	12.227	10.474593	62.476	21.421

** significant @ 1%, * significant @ 5%
F-tab @ 1% = 3.20
Source: Result of Regression model run with E-views 10

The result show that all the functional forms were statistically significant at 1% level of probability, implying that any of the functional forms is adequate in estimating and explaining the determinants of net value added of the input suppliers. However, the Semi-log functional form was chosen as the lead equation and used for further analysis of the data. The Semi-log function was also chosen based on other consideration such as value of the F-Statistic (29.426), highest number of significant variables and *apriori* expectation.

Based on the model with the highest significant R^2 value as indicated by F-value which test the goodness of fit of the overall model, highest number of significant explanatory variables and consistency of the signs with a priori expectations, the semi-log functional form was selected as the lead equation. The result shows that the estimated coefficient of multiple determinations (R^2) was 0.802 and this indicates that 80.2% in the variation of the net value added of catfish marketers was explained by the explanatory variables included in the model and the remaining 19.8% of the variation in net value added was as a result of the omitted variables.

The F-statistics of 15.844 is greater than F- tab of 3.20 which means it was significant (i.e F-cal > F-tab at 1%), this indicated the significance of F-value which is the measure of goodness of fits of the semi-log regression model in explaining the influence of these factors on net value added.

Out of ten explanatory variables in the model, four of them which include age (8.862e4, $p<0.01$), years in school (0.4228, $p<0.01$), amount of credit used (-1.120e5, $p<0.01$) and cost of marketing (-8.622e3, $p<0.01$) were statistically significant which implies that these variables have statistical significance effects on the net value added of the catfish marketers. According to their signs, age, and years in school were positive and significant meaning that their respective increases would result to an increase in the net value added of catfish processors while amount of credit used and cost of marketing indicated that increase in the amount of credit used and cost of marketing of would lead to a reduction in the net value added of a catfish marketers *ceteris paribus*.

More explicitly, the positive coefficient of age showed that aged marketers tends to have higher net value added than the young individuals and educated catfish marketers tend to achieve higher net value added than their illiterate counterpart. On the other hand, negative coefficients of the amount of credit used and cost of marketing showed that increases in the

amount of credit borrowed and cost of marketing activities would reduce the net value added in catfish marketing.

Hypothesis 3: Socio-economic characteristics of the catfish value chain actors do not have significant influence on the value addition in the study area.

For the producers' model, seven of them were statistically significant at 5% and they include years in school (6.639e3, $p<0.01$), household size (5.688e3, $p<0.05$), production experience (5.621e3, $p<0.05$) and quantity of fish produced (285.553, $p<0.01$) which were positive while age (-1.526e3, $p<0.01$), depreciation of fixed assets (-1.074, $p<0.05$) and amount of credit used (-1.404e5, $p<0.01$) had negative coefficient signs which indicate that increase in the quantity of these variables would lead to a reduction in the net value added of a catfish producers *ceteris paribus* which implies that these variables have statistical significant effects on the net value added of the catfish processors.

For the processors' model, out of ten explanatory variables in the model, five of them which include age (-0.514, $p<0.01$), marital status (0.531, $p<0.01$), years in school (0.257, $p<0.01$), processing experience (0.186, $p<0.01$) and amount of credit used (0.324, $p<0.05$) were statistically significant which implies that these variables have statistical significant effects on the net value added of the catfish processors.

For the marketers' model, four of them which include age (8.862e4, $p<0.01$), years in school (0.4228, $p<0.01$), amount of credit used (-1.120e5, $p<0.01$) and cost of marketing (-8.622e3, $p<0.01$) were statistically significant which implies that these variables have statistical significance effects on the net value added of the catfish marketers. From the foregoing, the null hypothesis was rejected for these significant variables but accepted for the insignificant variables specified in the model.

4.6: Constraints of value addition among catfish producers, processors and marketers.

Table 4.19 shows the various constraints faced by catfish value chain actors in the study area

Table 4.19: Distribution of Catfish Farmers in Imo State by major constraints

	Input suppliers		Producers		Processors		Marketers	
Constraints	**Freq***	**%**	**Freq***	**%**	**Freq***	**%**	**Freq***	**%**
High cost of labour	14	43.75	8	17.02	15	31.91	14	28.00
Low pricing of fish	8	25.00	35	74.47	38	80.85	44	88.00
High cost of activity	17	53.13	44	93.62	34	72.34	20	40.00
High cost of transport	23	71.88	35	74.47	40	85.11	35	70.00
Inadequate finance	28	87.50	19	40.43	31	65.96	28	56.00
Poor infrastructural facilities	13	40.63	23	48.94	30	63.83	27	54.00
high mortality of catfish	9	28.13	44	93.62	35	74.47	32	64.00
Low patronage	18	56.25	Nil	Nil	18	38.30	6	12.00

* Multiple responses.

Source: Field Survey, 2019

The result shows that majority of the catfish input suppliers (93.62%) faced the problem of inadequate finance as most of them operate under small-scale enterprise with little or no incentive of government for external financing. Also, high cost of transportation (71.88%) due to dilapidated road networks connecting urban and rural settlements; low patronage (56.25%) as most producers are knowledgeable in fingerling hatchery, pond construction and local feed formulation; high cost of activity (53.13%) due to the fact that most of the equipment used in catfish subsector are imported and greatly influenced by fluctuation of Nigerian Naira in the international market; high cost of labour (43.75%) as a result of low interest of young people in agricultural activities, poor infrastructural facilities (40.63%) due to low government support in the agricultural sector and gross infrastructural decay in the country, high mortality of catfish (28.13%) as a result of poor brooding procedure as well as risks and uncertainties association relation to fingerling hatching process and low pricing of

fish (25%) which is as a result of poor patronage, supply glut at some time of the year and lack of cooperation among the input suppliers to fix price and control the market.

The catfish farmers indicated high cost of activity (93.62%) and high mortality of catfish (fingerlings) after purchase (93.62%) as the major constraints of catfish production. Fish feed is the most important input in catfish production and it is always imported with exorbitant price given the low foreign exchange rate Nigerian local currency commands in the international market. In addition, high mortality of fingerlings experienced by the producers is also an important concern, particularly after purchasing and stocking. This is in consonance with earlier submissions of Ocmer (2006), Ugumba *et al.*, (2008) and Olagunju (2007) in their separate studies identified high cost of feeds and mortality rates as a major setback to profits realizable from catfish farming business venture. Also, about 74.47% of the catfish producers indicated high cost of transport and low pricing of harvested catfish as a constraint to catfish farming business, Other constraints are poor infrastructure (48.48%), inadequate finance (40.43%) and high cost of labour (17.02%). This is in consonance with Sikiru *et al*., (2010) who identified inadequate finance as one of the major constraints in catfish production.

For the processors, the major constraints faced were high cost of transport, high mortality of catfish after purchase, high cost of activity, inadequate finance and poor infrastructure with 85.11%, 74.47%, 72.34%, 65.96% and 63.83% of them respectively. Other constraints faced were low patronage (38.30%) and high cost of labour (31.91%). High transport cost is associated with poor road networks linking the production sites to the processors. They travelled long distances in search of catfish to be purchased, with high attendant cost of transport. In addition, low pricing of processed fish is a major discouragement to the processors, especially when the price could not cover the associated processing cost. High mortality of catfish after purchase posed serious loss to the net value added attributed to

catfish processing. Poor infrastructure with evident high cost of processing such as equipment (kilns) and inadequate finance and coupled with low patronage were some of the constraints to catfish processing activities which is a source of discouragement to the existing processors and new entrants as well.

For catfish marketers as illustrated in Table 4.17, there major constraints were low pricing of price (88%), high cost of transport (70%), high mortality of catfish after purchase (for those involved in fresh catfish marketing), inadequate finance (56%), poor infrastructure (54%) and high cost of marketing activity (40%). These constraints formed major limitations to profitable catfish marketing.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The results indicated that the actors along the entire value chain carry out both primary and support activities and can be categorized as actors in inputs suppliers, production, marketing, research, finance and legislation. The actors include input supplier, producers, processors, marketers, consumers and support actors which performed collaboration roles such as financial, technical advisory support, information and knowledge, and legislation. About 47.22% of the input suppliers were males, 51.06% of the catfish producers were males, about 46% of the catfish processors were males, 53.19% of the catfish marketers were males and 51.72% of the consumers were male. 41.67% of catfish input suppliers were in the age range of 33 – 42 years with the mean of 39 years. About 34.04% of catfish producers were in the age range of 33 - 42 years with the mean age of 41.9 years. Also 30% of the catfish processors were in the age range of 31-40 years and their mean age was 44.1 years, 34.04% of marketers were in the age range of 33 – 42 years with the mean age of 41.8 years and 37.93% of consumers are in the age range of 33-42 years with the mean age of 39.8 years. Majority (66.67%, 57.45%, 58%, 61.70% and 58.62%) of the catfish input suppliers, producers, processors, marketers and consumers respectively were married.58.33%, 55.32%, 50%, 51.05% and 55.17%) of the catfish value chain actors had a household size that ranged from 4 – 6 persons per household with the mean household size of 5 persons per household for producers, processors and marketers and 6 persons per household for input suppliers and consumers respectively. Also, 47.22%, 51.06%, 40%, 44.68% and 51.72% of the catfish input suppliers, producers, processors, marketers and consumers respectively had attained secondary education which is between 7 – 12 years of schooling with the mean of 12.6years, 11.9years, 10.3years, 10.9years and 12.7 years respectively. 47.22%, 48.94%, 48%, 55.32%

and 48.28% of input suppliers, producers, processors, marketers and consumers respectively had an experience of between 1 - 5 years with mean values of 5.9 years, 6.5 years, 6.5 years, 6.5 years and 6.0 years for input suppliers, producers, processors, marketers and consumers respectively. About 55.56%, 36.17%, 18% and 29.79% of input suppliers, producers, processors and marketers respectively belong to the cooperative association.

For the input suppliers, total value of output sold as ₦13,096,296.23 and cost of input acquisition and operating cost summed up to ₦8,511,217.12, the gross and net incomes were computed as ₦5,002,192.78 and ₦4,585,079.11 respectively and the profit margin was 35.01%. The value added which is the price difference in the price of the brooded fingerlings sold to the producer **(**₦24.51**)** and cost of the brooded fingerlings by the input supplier **(**₦5.25**)** was given as ₦19.26 hence with the total quantity of 20,0000 fingerlings sold, this gave a total value added of ₦381,348.00. For the producers, total costs of production summed up to ₦454,836.68 and the quantity of matured catfish harvested was 1,296.81kg sold at ₦473.19/kg which gave a value of ₦613,638.75 and the gross and net income were ₦375,768.76 and ₦158,802.06 respectively. The value added is given as the price difference in the price of the catfish sold to the processors **(**₦473.19**)** and price of the fingerlings purchased from the input supplier (₦24.51) which is given as ₦448.68 hence with the total quantity of 1,296.81kg of catfish sold, this gave a total value added of ₦581,852.1. For the processor, the total cost of processing was ₦659,447.74 and the quantity of processed and sold catfish of 826.15kg at ₦1205/kg which gave a value of ₦995,510.75. The gross and net income were computed as ₦380,376.26 and ₦336,063.01 respectively and the profit margin was 33.63%.The value added is given as the price difference in the price of the processed catfish sold to the processors **(**₦1,205**)** and price of the fresh catfish purchased from the producers (₦473.19) which is given as ₦731.81 hence with the total quantity of 826.15kg of catfish sold, this gave a total value added of ₦604,584.83.

For the marketers, total cost of marketing was ₦1,082,120.72 and quantity of catfish sold estimated as 793.05kg at ₦2,950/kg which is valued at ₦2,339,497.50, the gross and net income were computed as ₦1,331,196.72 and ₦1,257,376.78 respectively and the profit margin was 53.75%. The value added is given as the price difference in the price of the marketed catfish sold to the consumers **(**₦2,950**)** and price of the fresh catfish purchased from the producers (₦1,205) which is given as ₦1,745 hence with the total quantity of 793.05kg of catfish sold, this gave a total value added of ₦1,383,871.25. The total value added in the catfish value chain system was ₦2,944.5/kg with value added share of 0.41%, 15.54%, 24.83% and 59.22% for input suppliers, producers, processors and marketers respectively.

In addition, the post-hoc comparison test indicated that there is significant difference amongst the actors in the catfish value chain, the mean difference value (I-J) indicated that there is significant difference amongst the actors in the catfish value chain, the mean difference between marketer and processors was ₦779,286.42 ($p<0.024$) which implies that the marketers' net value addition is significantly higher than processors' at 5% statistical level. Also, marketers' net value added was significantly higher than input suppliers by ₦1,002,523.25 ($p<0.000$), net value added of the marketers was significantly higher than that of producers by ₦ 802,018.54 ($p<0.002$), producers' net value added was significantly higher than input suppliers by ₦200,504.71 ($p<0.009$), processors' net value added was significantly higher than input suppliers' by ₦223,236.83 ($p<0.005$) and also higher not significantly than the net value added of and producers by 22,732.12 ($p<1.000$) the net value added of the processors is significantly higher than that of the producers by ₦166,603.43 ($p<0.01$).

The result of the multinomial logistic model showed the Hausman chi-Square ($\chi 2$) test ranged from -10.05 to -0.86 with p-value of 1.0 suggesting that the multinomial logit (MNL) specification was appropriate to model choice of an actor in the three different activities in

the study area. The likelihood ratio statistics as indicated by $\chi 2 = 333.35$ are highly significant ($P < 0.00001$), and this also suggests that the model has a strong explanatory power. The pseudo-R^2 value of 0.23 represents a good-fit model. Age (-0.054, p<0.01), household size (0.339, p<0.01), membership of association (1.204, p<0.01) and educational level (0.668, p<0.01) were significant explanatory variables in the choice to be input suppier relative to processor. Age (-0.028, p<0.05), gender (0.623, p<0.05), household size (0.264, p<0.01), membership of association (0.854, p<0.01), net value added (-3.220e-7, p<0.01) and educational level (0.438, p<0.01) were significant explanatory variables in the choice to be producer relative to processor. Gender (0.931, p<0.01) and amount of net value added (-3.570e-6, p<0.01), were significant variables for the choice of marketer relative to processor.

The result of the marginal effects shows that age (-0.0067; p<0.01), household size (0.0347; p<0.01), membership of association (0.1309; p<0.01), net value added (1.26e-7; p<0.01) and year of formal education (0.0768; p<0.01) in catfish production were significant marginal effects in the input suppliers' category; Household size (0.0328; p<0.05) and net value added (-1.42e-7, p<0.05) were significant marginal effects in the producers' category; age (0.0084; p<0.01), gender (-0.1366; p<0.05), household size (-0.0665; p<0.01), membership of association (-0.2242; p<0.01), net value added (1.70e-7; p<0.01) and year of formal education (-0.1175; p<0.01) were significant marginal effects in the processors' category and only net value added (-1.53e-7; p<0.01) was significant marginal effect in the marketers' category. A further analysis indicated that the significant quasi–elasticities for input supplier were age (-1.2946; p<0.01), household size (0.8215; p<0.01), membership of association (0.1866; p<0.01), net value added (0.4130; p<0.01) and year of formal education (0.7124; p<0.01); Household size (0.4328; p<0.05) and net value added (-0.2614, p<0.05) were significant quasi–elasticities in the producers' category; age (0.9596; p<0.01), gender (-0.1828; p<0.05), household size (-0.9344; p<0.01), membership of association (-0.1897;

p<0.01), net value added (0.3315; p<0.01) and year of formal education (-0.6469; p<0.01) were significant quasi–elasticities effects in the processors' category and only gender (0.2774; p<0.05), net value added (-5.8477; p<0.01) and year of formal education (-0.6755; p<0.05) were significant quasi–elasticities effects in the marketers' category.

This implies that the null hypothesis was rejected for these significant variables but accepted for the insignificant variables specified in the model.

The result of the multiple regression models of the determinants of net value addition in catfish value chain showed that years in school, household size and experience were positive and significant determinants of net value added of input supplier while age, gender, and operating cost were negative significant variables of the net value added of a catfish input suppliers; positive variables in the producers' model were years in school, household size, production experience and quantity of fish produced were positive and while age, depreciation of fixed assets and amount of credit used were significant negative explanatory variables. In the processors' model, age, marital status, years in school, processing experience and amount of credit used were statistically significant which implies that these variables have statistical significance effects on the net value added of the catfish processors and age, years in school, amount of credit used and cost of marketing were statistically significant which implies that these variables have statistical significance effects on the net value added of the catfish marketers. Based on this result, the null hypothesis was rejected for these significant variables but accepted for the insignificant variables specified in the model.

Majority of the catfish input suppliers indicated inadequate finance (87.50%) and high transportation cost (71.88%), low patronage (56.25%), high cost of activity (53.13%), high cost of labour (43.75%) and poor infrastructural facilities (40.63%). Majority of the catfish farmers (93.62%) indicated high cost of activity and high mortality of catfish (fingerlings) after purchase as the major constraints of catfish production, 74.47% of the catfish producers

indicated high cost of transport and low pricing of harvested catfish as a constraint to catfish farming business, Other constraints are poor infrastructure (48.48%), inadequate finance (40.43%) and high cost of labour (17.02%).

For the processors, the major constraints faced were high cost of transport, high mortality of catfish after purchase, high cost of activity, inadequate finance and poor infrastructure with 85.11%, 74.47%, 72.34%, 65.96% and 63.83% of them respectively. Other constraints faced were low patronage (38.30%) and high cost of labour (31.91%) and low pricing of price (88%), high cost of transport (70%), high mortality of catfish after purchase (for those involved in fresh catfish marketing), inadequate finance (56%), poor infrastructure (54%) and high cost of marketing activity (40%) formed major limitation to profitable catfish marketing.

5.2 Conclusion

Based on the findings of the study, it was concluded that both gender had fair participation in the catfish value chain in the study area as more male were involved in the catfish production and marketing while females are dominant in the catfish input supply and processing. The value added share of the actor increases along the catfish value chain from the input suppliers with least value added share and the marketers with the highest value added share. Educated youthful male actors with large household size and membership of cooperative society possessed more advantages in choosing activity with high amount of net value added. Low number of actors in the cooperative society indicates uncoordinated structure, poor cooperation among actors in the State which could hinder effective synergy in the delivery of a better performed catfish value chain system.

Years in school, household size and experience were positive and significant determinants of net value added of input supplier while age, gender, and operating cost were negative significant variables of the net value added of a catfish input suppliers. Positive determinants such as amount of net value added for producers include years in school, household size,

production experience, quantity of fish and age, depreciation of fixed assets but amount of credit was negative determinants. Age, marital status, years in school, processing experience and amount of credit influenced net value added positively among processors and age, years in school, amount of credit used were positive and cost of marketing was negative significant variables amongst the marketers.

High cost of activity, high mortality of catfish (fingerlings) after purchase, inadequate finance, high cost of labour, high cost of transport, high mortality of catfish after purchase, high cost of activity, inadequate finance and poor infrastructure, low patronage, low pricing of price and poor infrastructure and high cost of marketing activity were major constraints faced in Catfish value chain in the study area.

5.3 Recommendations

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

i. Government and all relevant stakeholders should provide adequate infrastructure to and adequate rural road network for quick evacuation of inputs and output, power for processing and storage including cold chain to increase value addition and improve shelf life of catfish products.

ii. Catfish farmers should source for locally formulated feeds, which are often cheaper. This will reduce the overall cost of production and consequently improve the net farm income.

iii. The percentage of catfish chain actors using credit requires that catfish chain actors should be assisted to obtain bank credit by reducing the administrative bottlenecks associated with bank loans.

iv. It is very pertinent for primary actors to form well-coordinated co-operative societies as to enable them pool their resources together for effective collaboration with support

actors such as input suppliers, government, insurance companies and other necessary organization for better performance of the catfish value chain.

v. Due to the fact that most of the actors depended on their meager personal savings in financing their activities, this study recommends that catfish value chain actors should strengthen themselves financially by forming cooperative groups whereby members could have access to loans at a very low rate and farm inputs could be purchased in bulk to be shared among members at a reduced cost. The produce could also be sold in bulk, thereby lowering the average cost of marketing.

5.4 Contribution to Knowledge

The study established that values are added along all the catfish chain, from input supply, production, processing and marketing, the least being production and the highest in marketing. Unhealthy competition and rivalry however exist among the chain actors in the area.

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