CODESRIA

Dissertation By

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DEPARTMENT OF AGRICULTURAL ECONOMICS
FACULTY OF AGRICULTURE
UNIVERSITY OF NIGERIA
NSUKKA

ANALYSIS OF FACTOR-PRODUCT RELATIONSHIP IN PISCICULTURE VALUE CHAIN IN LAGOS STATE, NIGERIA.

APRIL, 2016

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BEING AN M.SC DISSERTATION SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL ECONOMICS, FACULTY OF AGRICULTURE, UNIVERSITY OF NIGERIA, NSUKKA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (M.Sc) DEGREE IN AGRICULTURAL ECONOMICS

APRIL, 2016.

CERTIFICATION

I, Ogunmefun, Samuel Oluwatobi, a postgraduate student of the Department of Agricultural Economics and with registration number PG/M.Sc/12/63070, have satisfactorily completed the requirements of the course and research works for the award of Master of Science in Agricultural Economics (Farm Management and Production Economics). The work in this thesis is original and has not been submitted in part or full for any other diploma or degree of this or any other university.

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Ogunmefun, Samuel O.
(Student)

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Prof. (Mrs.) A. I. Achike (Dissertation Supervisor)	Date	Prof. S.A.N.D. Chidebelu (Head of Department)	Date

DEDICATION

This dissertation is dedicated to great minds and inventors this world had ever known:

Inventor of Electricity – **Michael Faraday**

Inventor of Telephone – **Alexander Graham Bell**

Inventor of Computer – **Charles Barbage**

Inventor of the Internet – **Robert E. Kahn** and **Vint Cerf**

And

Above all, the Creator of all Creations – **JESUS CHRIST**

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I also wish to acknowledge everyone that had contributed, criticized and encourage me in diverse ways through this research work. First on that list is my supervisor, Prof. (Mrs.) Anthonia I. Achike, who went out of way to teach, guide, supervise and mentor me through the duration of my programme (as she did during my undergraduate programme).

Looking backward, I'd like to appreciate the support of my darling parents, Mr. and Mrs. M. A. Ogunmefun; who regardless of their financial situation did not hesitate to support my dream and aspiration of being a renowned scholar. Your love, guidance and prayers have always carried me through the rough patches of this life. May God keep you longer in this world to reap the good fruits of your labour (Amen). Also to my siblings and family members (Mr. & Mrs. A. O. Solanke, Ogunmefun Hannah, Ogunmefun Imoleayo, Mr. M. A. Sarumi, Ms. Sarumi Temitope, Mr. Oludele Jiboku, Ms. Wemimo Onabanjo and Ogunmefun Deborah) who supported me financially, morally and spiritually all through this programme, I appreciate all your efforts and pray that the good Lord will replenish your contributions in hundred folds.

To the entire staff, Department of Agricultural Economics, University of Nigeria, Nsukka I wish to extend my profound gratitude to you all for your immense contributions in making me an enlightened graduate. May God continue to shower you with all the wisdom you required to get to your desired goals.

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ABSTRACT

The broad objective of the study was to analyze factor-product relationship in pisciculture value chain in Lagos state, Nigeria. The specific objectives were to: (i) determine the socio-economic characteristics of the pisciculture farmers and examine influence on their output, (ii) identify the value chain steps in pisciculture enterprise, (iii) determine the factor-product relationship and estimate the technical efficiency in the value chain, (iv) estimate the costs and returns of pisciculture value chain and (v) identify the various constraints facing the pisciculture value chain. The study adopted the survey design. It utilized mainly primary data. A structured close-ended questionnaire was used to collect information from the 120 fish farmers in the area. Data generated were analyzed using the stochastic frontier analysis (SFA), budgetary analysis, rate of return; test of difference in mean and value chain analysis. Average output of fish per production cycle was 14,000kg, while an average farm size (land) was 1.97ha per farmer. Average scores for farming experience, household size and years of schooling were 11.7years, five persons and 14.4 years respectively. The farmers were young as indicated by mean age of 43years. The result showed that all farmers (100%) culture fingerlings, juveniles and market size fishes while only few carryout hatching of eggs (40%) and culture fries (50%) in pisciculture enterprise in the state. Mean scores for pond size ($\bar{X}$=2.22m^2) and feed ($\bar{X}$=3.12₦/ha) were also recorded. Six factors namely, farm size, labour, feed, fertilizer, stocking capacity and depreciation value with coefficients of 0.02, 0.28, 0.03, 0.04, 0.40 and 0.20 respectively exerted significant ($p<0.05$) effects on the output of fish. All the production variables analyzed were positive except farm size and feed. The major determinants of efficiency were identified to be farm size and stocking capacity. The farmers are fairly efficient technically, with a mean efficiency estimate of 0.88 ($\bar{X}$=88%). An average profit of N5,371,497.753 was recorded per farmer per farming cycle with a 2.2 return on investment (ROI) for farmers without value chain; while an average profit of N6,734,290.39 and a 2.0 return on investment was indicated on the other hand for farmers with value chain; indicating an average difference in margin of N1,362,792.64 between these farmers per production cycle. Also, the study revealed that hatching of eggs which only takes place in one week generates an average profit of N71,457.18 to the farmers while culturing of fries only generates on the average after two weeks a net profit of N16,928.36, while on the other hand, culturing of fingerlings which take up to four weeks generates an average profit of N467,856.72. Post-fingerlings culturing rakes in an average profit of N187,856.72 after four weeks while juvenile culture gives an average profit of N2,987,856.72 after four weeks while raising fish to market size which takes another four weeks produces on the average a profit of N1,542,223.29. It was therefore deduced that the highest profit in the chain of pisciculture enterprise remains culturing of juvenile and raising to market size respectively. Constraints to pisciculture enterprise in the state were high feed cost ($\bar{X}$>3.8), lack of credit ($\bar{X}$>3.6), high cost of inputs ($\bar{X}$>3.4) and poor technical know-how ($\bar{X}$>3.4). Value chain exerted no significant effect on the efficiency level (88%) of fish farmers in the area. This study therefore recommended that an aggressive awareness on the importance and training of pond fish farmers on value chain inculcation in their enterprise. Furthermore, provision of market and market information where these fish and fish products could be sold at profitable prices will enhance and ensure that farmers are not only food secured but also financially comfortable.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Food and Agricultural Organization (FAO, 2002) reported that an estimated 840 million people lack adequate access to food; and about 25% of these are in sub-Saharan Africa (Illoni, 2007). As the population grows and puts more pressure on natural resources, more people will probably become food insecure, lacking access to sufficient amount of safe and nutritious food for normal growth, development and an active/healthy life (Illoni, 2007). A number of countries in sub-Saharan Africa are characterized by low agricultural production, widespread economic stagnation, persistent political instability, increasing environmental damage, and severe poverty. Given these situations, it is therefore pertinent to provide the poor and hungry with a low cost and readily available strategy to increase food production using less land per caput, and less water without further damage to the environment (Pretty et al., 2003).

Aquaculture is the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants, is often cited as one of the means of efficiently increasing food production in food-deficit countries (Inoni, 2007). According to Zohar, Dayan, Galili and Spanier (2001), pisciculture (also called fish farming) is the principal form of aquaculture, while other methods may fall under mariculture. Fish farming is an aspect of aquaculture which involves the cultivation of fishes in ponds, tanks or other chambers from which they cannot escape. A wide range of fish farming does exist including growing of fish in earthen ponds, concrete tanks, cages, pens, run-ways, glass tanks, acrylic tanks, plastic tanks, Race-ways etc. (FAO FishStat Plus 2012). Pisciculture was derived from two words *Pisce*(s) which means fish(es) and *culture* which means rearing, raising or breeding of living things. Pisciculture is therefore defined as a branched of animal husbandry that deals with rational deliberate culturing of fish or fishes to a marketable size in a controlled water body (Encyclopedia, 2009). Consequently, there are two main types of pisciculture to be distinguished: (1) the rearing in confinement of young fishes to an edible stage, and (2) the stocking of natural waters with eggs or fry from captured breeders (Encyclopedia, 2009).

In Nigeria, total domestic fish production fluctuated between 562,972 to 524,700 metric tonnes in 1983 to year 2003; while the output of fish farming during this period was 20,476 to 52,000 metric tonnes. Fish farming accounted for between 3.64 and 9.92% of total domestic fish production in Nigeria within this period, while the bulk of production came from artisanal fishing. Although the outlook of aquaculture production is worrisome given the growing demand for fish and the declining yield of natural fish stocks due to over-exploitation, fish farming still holds the greatest potentials to rapidly boost domestic animal protein supply in Nigeria. Fish production currently contributes 3.5percent of Nigeria's Gross Domestic Product (GDP) and accounts for 0.2% of the total global fish production (Central Bank of Nigeria (CBN), 2011).as well as provides direct and indirect employment to over 6million people (Adekoya, 2004); but if optimally explored has the potential as an enterprise to contribute significantly to the possible creation of 30,000 jobs and generation of revenue of US$160 million per annum, which would invariably improve the agricultural sector and boost the Nation's economy at large (Federal Ministry of Agriculture and Rural Development, (FMARD), 2013). Fish farming is an integral component of the overall agricultural production system in Lagos State, Nigeria. The terrain of most part of the State is swampy and prone to seasonal flooding. This makes a vast expanse of land in these areas unsuitable for crop farming. The prevailing hydrographic conditions therefore make fish farming a very attractive alternative production to which the abundant land and water resources in Lagos State can be put (Inoni and Chukwuji, 2000).

An efficient method of production is that which utilizes the least quantity of resources in order to produce a given quantity of output. A production process that uses more physical resources than an alternative method in producing a unit of output is thus said to be technically inefficient. However, since economic efficiency embodies both technical and allocative efficiencies, once the issues of technical inefficiency have been removed the question of choosing between the set of technically efficient alternative methods of production, allocative efficiency, comes to fore. According to Oh and Kim (1980), allocative efficiency is the ratio between total costs of producing a unit of output using actual factor proportions in a technically efficient manner, and total costs of producing a unit of output using optimal factor proportions in a technically efficient manner. However, a farm using a technically efficient input combination may not be producing optimally depending on the prevailing factor prices. Thus, the allocatively efficient level of production is where the farm operates at the least-cost combination of inputs. According to Yotopoulos and Lau (1973), a firm is allocatively efficient if it was able to equate the value of marginal product (MVP) of each resource employed to the unit cost of that resource; in other words, if it maximizes profit. Therefore allocative efficiency measure, quantifies how near an enterprise is to using the optimal combination of production inputs when the goal is maximum profit (Richetti and Reis, 2003).

In addition to the facts above, Nigeria is proudly the most resourceful and vibrant African nation in the aquaculture industry and currently the leading producer of catfish in Africa (FMARD), 2013). "It is sad to note that we are still far behind in our efforts at reaching optimality (i.e. tapping the highest potentials from every resource use and production pattern) in fish farming thereby often leading to artificial glut, 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, this was in-line with the statement of Gradl, Ströh de, Martinez, Kükenshöner, and Schmidt (2012), who opined that involving smallholder farmers in commercial value chains can boost their incomes and improve their food security.

Value Chain according to Hempel (2010) is defined as every step, a fisheries business goes through from raw materials to the eventual end user. 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, Palash, Ali Mian and Mohan Dey, 2012). The chain of activities gives the products more added value than the sum of added values of all activities (FAO, 2011). 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). Moreover, fishery value chain can be defined as interlinked value-adding (Department of Fisheries (DoF), 2002).

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 for 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 achieve competitive strengths and core competencies in the marketplace (Dubay, Tokuoka, and Gereffi, 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 (DoF, 2002; Alam et al, 2012).

Furthermore, value chain offers the customer a level of value that exceeds the cost of the activities, thereby resulting profit margin (Da 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 enables rural residents to capture more margins from their farm produce, however, this is only possible if the credit and other constraints are resolved (Stanton 2000). 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).

1.2 Problem Statement

Fish farming in Lagos state and Nigeria at large till date remains an untapped goldmine based on the fact that Nigeria is a maritime nation, it is also blessed with a vast population of over 160million people and a coastline measuring approximately 853kilometres. According to Tobor (1990), there are about 1.75million hectares of suitable land for aquaculture in Nigeria and 25% of this will yield 656,820tonnes of fish per year when placed under cultivation. Similarly, about 6,450tonnes of fish can be produced annually from 75,000 hectares of coastal lagoons (Kapertsky, 1981). In spite of the great potentials of fish farming in the study area, factors such as low technical knowledge on the part of fish farmers and the high cost of production inputs have constrained its contribution to increased food supply and poverty reduction. Furthermore, the efficiency or inefficiency of utilization of available resources for fish farming has remained an unanswered question in the quest for increased Pisciculture production in Lagos State in particular, and Nigeria at large.

According to FAO (2009), around 50% of fish demanded is currently being met by local supply in Nigeria. Adekoya and Miller (2005) backed this up by stating that domestic fish production of about 500,000metric tons is supplied by 85% of artisan fish-folk. According to Nigeria Bureau of Statistics (NBS, 2011), it was estimated that annual fish demand in the country was about 2.66million as against the annual domestic production of about 0.78million, giving a demand-supply gap of about 1.8million metric tons. Regrettably, the supply of food fish has been on the decline and this is due to consistent declines from the country's major source of food fish (Ugwumba and Chukwuji, 2010). This shortfall is said to be abridged by the importation of 680,000metric tonnes annually consuming about N50billion in foreign exchange (Odukwe, 2007), therefore ranking Nigeria as the highest importer of frozen fish in the world with an annual foreign exchange drain of N50billion (Dauda, 2010; CBN, 2012). The imminent challenge therefore, is to increase the potentials of pisciculture as well as bridging the wide gap between fish demand and supply in Nigeria.

The interest on pisciculture has increased over the years rapidly as a result of the awareness of the importance of this practice to individuals and the economy at large, as well as the advantages attached to it. Oladeji and Oyesola (2002) further observed that various attempts by the government to improve fish supply in the country by importation failed, therefore prompting the Government of Nigeria to initiate various programs such as: Presidential Initiative on Fisheries and Aquaculture Development (2003); Aquaculture and Inland Fishery Project (AIFP); National Accelerated Fish Production Project (NAFPP); Fishing Terminal Projects (FTP); Fisheries Infrastructures Provision/Improvement (FIP); Presidential Initiative of Aquaculture (PIA); Commercial Agriculture Credit Scheme (CACS); Agricultural Credit Guarantee Scheme (ACGS); Nigerian Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL) Programme Initiated by the Central Bank of Nigeria (FMARD, 2012) and currently, Agricultural Transformation Agenda (ATA), (2013). Momoh (2009) noted further that several government parastatals in Nigeria planned to collaborate to establish industries for expanding production, canning and further processing of fish produce, particularly tilapia and cat fish which can easily multiply in large numbers and grow rapidly. Despite all these interest shown so far by the government and the private sectors in the production of fish generally, the gap between the demand of fish and domestic supply in Nigeria have ever been widening (FMARD, 2012; 2013).

Worthy of note is the fact that local supplies in terms of inputs do not match the required outputs. That is, fish production cannot single-handedly increased without the increment in other factors needed for the proper production and development of fish(es) such as feeds, fertilizers (organic and inorganic), drugs and other implements. According to Adikwu, and Yusuf, (1997) and Ikpi (2011), of all inputs required in rearing fish, feed costs more than 40% of capital investment, while labour follows suit with about 15%. This is evident as the NBS record showed that Nigeria spends N117.7billion annually on the importation of fish feeds over the last decade (NBS, 2012). Though the Federal Government however had disclosed recently that Nigeria is saving N300 million annually from the substitution of imported fish feeds, with an estimate of 25percent of the 45,000metric tones imported into the country (NBS, 2012) this is still a far cry from what we should be aspiring for.

The absence of value chain in the production of fish had hindered the vast opportunities that exists in this enterprise waiting to be exploited, which will in all ways improve the profit margin of the farmers, create more job opportunities, increase the quality of produce delivered to the consumers also ensuring the availability of the produce all year round in Lagos state and beyond. Undeniably, there is a crucial gap on the analysis of factor-product relationship in pisciculture production and more significantly on the assessment of pisciculture value chain in the study area.

Although a number of studies had been carried out on technical efficiency of fish farming and value chain of fish farming independently, worthy of note are: Kee-Chai, Maura, Virginia and Ian (1982) who studied "*Inputs as related to output in milkfish production in the Philippines*"; Onoja, and Achike, (2011) who also studied "*Resource Productivity In Small-Scale Catfish (Clarias gariepinus) Farming In Rivers State, Nigeria: A Translog Model Approach*"; while on the other hand, *"A study on the Value Chain Assessment of the Aquaculture Sector in Indonesia"* was conducted by Ardjosoediro and Goetz (2007); Ardjosoediro and Neven, (2008) further studied "*The Kenya Capture Fisheries Value Chain: An AMAP-FSKG Value Chain Finance Case Study*"; Macfadyen, G. et al. (2011), also conducted a study on *"Value-Chain Analysis of Egyptian Aquaculture"*; Russell and Hanoomanjee (2012) released a "*Manual on Value Chain Analysis and Promotion in Southern Africa"*; to mention a few, Nwosu and Onyeneke, (2013) studied "*The Effect of Productive Inputs of Pond Fish Production on the Output of Fish in Owerri Agricultural Zone of Imo State, Nigeria*". From the above-listed studies, it is obvious that very few studies (if any at the moment) are available on Analysis of factor-product relationship in pisciculture value chain, and most especially in Lagos state, Nigeria. Due to the aforementioned scenario, this study therefore intends to bridge the research gap by analyzing the factor-product relationship in pisciculture value chain in Lagos State, Nigeria.

1.3 Objectives of the Study

The broad objective of this work is to analyze factor-product relationship in pisciculture value chain in Lagos state, Nigeria. The specific objectives are to:

i. describe the socio-economic characteristics and examine their influence on pisciculture farmers output;
ii. identify the value chain steps in pisciculture enterprise;
iii. determine the factor-product relationship at every steps and estimate the technical efficiency in value chain pisciculture enterprise;
iv. estimate the cost and returns of pisciculture value chain in this area;
v. identify the various constraints facing pisciculture value chain;
vi. derive relevant policy recommendations based on the findings.

1.4 Hypothesis

The following null hypothesis will be tested:

$H_0$1: Socioeconomic characteristics of pisciculture farmers have no influence on their output;

$H_0$2: Pisciculture farmers are not technically efficient; and

$H_0$3: Pisciculture value chain is not profitable.

1.5 Justification

The findings of the study will be useful for potential and practicing fish farmers, policy makers, researchers, extension agents and the general public at large. It will aid potential fish farmers in their enterprise selection, resource use efficiency 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 research 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 also give 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 pisciculture value chain in the study area.

1.6 Limitation of the Study

This study would have suffered greatly if not for the patronage of the Council for the Development of Social Science Research in Africa (CODESRIA), who through their "2015 Small Grants Programme for Thesis Writing" sponsored this dissertation from top to bottom. This enabled the researcher to carry out this survey thoroughly. The researcher due to time constraints could only sample 120 pond fish farmers in Lagos State out of the estimated over 1.5million pisciculturists in this area. Also, bad road network and poor transportation system hindered my accessibility to some areas, as they require ferrying through the sea to get there and getting a boat sailor on charter, which proved quite exhaustive.

On the other hand, some of the respondents withheld some information like average annual income as they presume that this information will be used against them to calculate their tax. Finally, the duration (12months – 2 fish production cycles) of this research was not enough as fishing in Lagos state is produced all year round. It would have been better to observe the effects of pisciculture over (at least) four fish production cycle to properly ascertain the efficiency level of pond fish farmers in this area.

CHAPTER TWO

LITERATURE REVIEW

2.1 Concept of Fish Farming (Pisciculture)

Fish farming is an aspect of aquaculture involving all activities associated with the scientific and organized rearing and cultivation of fish. It is a form of controlling of the environment or intervention in the rearing process to enhance production such as regular stocking, feeding, protection from diseases and predators as well as good husbandry practices (Enabulele, 2009). The breeding, rearing, and transplanting of fish by artificial means is called pisciculture, in other words, fish farming (FAO FishStat Plus, 2008). Fish farming is an aspect of aquaculture which involves the cultivation of fishes in ponds, tanks or other chambers from which they cannot escape. A wide range of fish farming does exist including growing of fish in earthen ponds, concrete tanks, cages, pens, run-ways, glass tanks, acrylic tanks, plastic tanks, Race-ways etc. (FAO FishStat Plus 2012). Pisciculture was derived from two words *Pisce*(s) which means fish(es) and *culture* which means rearing, raising or breeding of living things. Pisciculture is therefore defined as a branched of animal husbandry that deals with rational deliberate culturing of fish or fishes to a marketable size in a controlled water body (Encyclopedia, 2011). According to Zohar, Dayan, Galili and Spanier (2001), pisciculture is the principal form of aquaculture, while other methods may fall under mariculture. Consequently, there are two main types of pisciculture to be distinguished: (1) the rearing in confinement of young fishes to an edible stage, and (2) the stocking of natural waters with eggs or fry from captured breeders (Encyclopedia, 2011).

According to Achionye-Nzeh and Ajayi (2003), rearing of fishes in natural environment like lakes, ponds, rivers, cages, streams and pens and feeding the fishes to grow and attain table size in a short period is the main objective of fish farming. This practice is alien to Africa; it originated from China and was introduced to Nigeria by the Europeans (FAO, 2009). Several methods of successful production of fish is practiced but the popular and simple technique is the earthen pond, which is the basic unit of fish farming worldwide and it is dependent on natural production of fish feed (FAO, 2009). Pisciculture has many advantages, among them are: fish is readily available than to catch, choice fish are grown and fed extra to make them grow better for markets and the number taken is controlled (FAO FishStat Plus, 2009).

Generally, there are wide variations of husbandry techniques, not only from country to country but also between levels of development and technical sophistication. Apart from earthen ponds, concrete lined ponds are also used by farmers (Ndu, 2006), the disadvantage of which includes constant feeding of the fish by farmers. However, netting enclosure is a combination of pond and cage cultures where natural food production can occur (Plumb, 1999). Depending on the stocking density, single species of fish can be reared in a pond or multiple species of fish may grow in the same pond (Swift, 1993). In the integrated system of fish production, fish farming is usually combined with either poultry or animal husbandry where the excrement fertilizes fish ponds and stimulates food production (Ayinla et al., 1989). The principal fish species stocked in Nigeria are Catfish: *Clarias gariepinus* (Oresegun et al., 2007); Carp: *Cyprinus carpio, Heterobranchus bidorsalis*, *Gymnarchus niloticus* and Tilapias: *Oreochromis niloticus* and *Heterotis niloticus* (Anetekhai et al., 2004).

2.2 Prospect of Fish Farming

The fish industry remains the most unexplored investment sector in Nigeria compared with the importation of frozen fish in the domestic market (Kudi et al., 2008). A sure means of substantially solving the demand-supply gap is by embarking on widespread small scale fish production. The potential of fish farming in developing countries is great, as it offers economical source of protein rich food. According to UN survey, the fish production from aquaculture in 1985 stood at 10million tons close behind beef, pork and poultry (FAO, 1995). Comparatively, fish do not use much energy to maintain body heat or for locomotion and have a food to flesh conversion rate of 1.5 to 1.0 as against beef's 7.0 to 1.0 and chicken's 2.3 to 1.0 (Nazri, 1991). Momoh (2009) highlighted some of the prospects of fish farming to include steady and regular availability of cheap source of protein, with regular public enlightenment, more people will engage in fish production as a source of income, employment and high quality protein. The establishment of suitable extension services with qualified staff, exchange of information and personnel between countries, and an expanded system of collection and dissemination of information are all good for aquaculture development in Africa (FAO, 1995).

2.3 Relevance of Fish Farming

A well-organized farmer or investor can enter fish farming and establish a farm enterprise to help reduce risk by diversifying the variety of on-farm activities. This offers a farmer an option to start small and “test the waters”, then, when the business of fish farming is understood and some degree of success has been achieved, the activity can be expanded with more investment and production. The best fish farmers start small and live at the farm and are “hands on” managers who learn to understand the husbandry of fish in water, which is very different from terrestrial farming of animals or crops. Nevertheless, fish farming development is following the poultry industry and is facing similar challenges in its development: 1) the need to educate farmers, 2) the need for quality stocks of fish of known origins, 3) the need for high quality feeds, 4) the need for record keeping among fish farmers, and 5) the need for quality extension support.

2.4 Value Chain in Pisciculture Enterprise: Concept

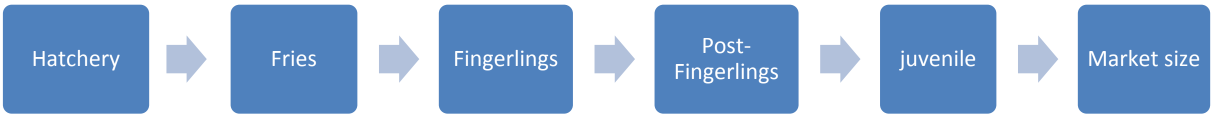
The concept of value chain can be understood in the words of Russell and Hanoomanjee (2012), who explained value chain as a link that binds all the steps in production, processing, and distribution, together preceding steps and the steps that follow. It includes aspects such as: physical, economic and social logistics between raw material input and consumption; the supply chain and flow of payment including value adding margins; and allows Fisheries Administration and fishing industry personnel to address value chain issues, so as to maximize value within their commercial operations. The concept of the value chain is really quite simple. It just means that we link all the steps in production, processing, and distribution together, and that we analyze each step in relation to the preceding steps and the steps that follow. Hempel et al (2007) defines value chain as 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.

Value chains for pisciculture therefore differ from fish to fish and from country to country, and frequently within regions, this is because, value chains of economically important species, such as tuna, salmon, skipjack, shrimp, tilapia, etc composed of several nodes and products that pass through longer chains before it gets to the final consumer (De Silva, 2011). In contrast, some of the species are not economically important, but socially important, such as Hilsa for Bangladesh, Mackerel for Thailand etc, consists with shorter chains before it gets to the final consumer (De Silva, and Masahiro, 2006). 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. Moreover, fishery value chain can be defined as interlinked value-adding (Finfish Organization, 2008). In Michael Porter's description of the value chain as noted by Hempel (2010), he identifies the various steps, or links, in the generic value chain:

- **Inbound logistics**: the receiving and warehousing of raw materials and their distribution to manufacturing as they are required;
- **Operations**: the process of transforming inputs into finished products and services;
- **Outbound logistics**: the warehousing and distribution of finished goods;

- **Marketing and sales**: the identification of customer needs and the generation of sales;
- **Service**: the support of customers after the products and services are sold to them.

Fig 2.1: An Operational Value Chain chart



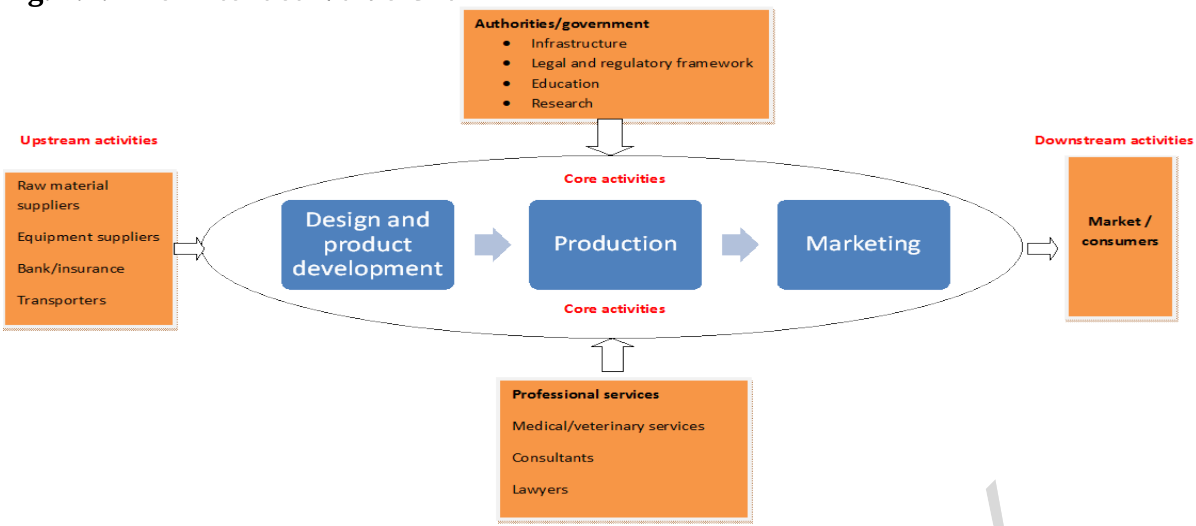
Source: Field Survey (2014)

The figure above depicts a clear and simple chart of the various production processes fish farmers most likely explore in their enterprise. But it must be noted that this process varies with individual farmers or management as they intend to differ in the actual size for the market as well as some might prefer to start from any stage and/or stop at any stage of the production depending on the profit they intend to capture and target customers. For example, a farmer might decide to start his own production from fries or from fingerlings and feed the fish to market size while another farmer might prefer to hatch the eggs and sell at the fingerling stage or post-fingerlings stage in which he would not have to feed to maturity thereby saving himself the cost of feeds and other additional cost on raising them.

There are also ranges of activities within each link of the chain. Although often depicted as a vertical chain, intra-chain linkages are most often of a two-way nature – for example, specialized design agencies not only influence the nature of the production process and marketing, but are in turn influenced by the constraints in these downstream links in the chain. The most important implication of applying the value chain approach, however, is the fact that all decisions made at one step in the process have consequences for the following steps, and often such decisions may be irreversible (Hempel et al, 2008). For example, if you kill and dress the fish when you catch it, this means you cannot sell it as a live fish later.

Also of note in their work, Hempel et al (2008) obliged that value chain does not only include a straight line. There are external activities that influence activities within the value chain proper. For the sake of simplicity, we may call these external parts of the value chain upstream activities and downstream activities. If we include the surrounding environment in this model, we are expanding the value chain, in a way. In such an expanded model, we may distinguish between the core activities, which include the producer's /industry's own activities, and upstream and downstream activities. Upstream activities provide inputs into the industry, while downstream activities relate to the outputs from the industry.

Fig. 2.2: The Extended Value Chain



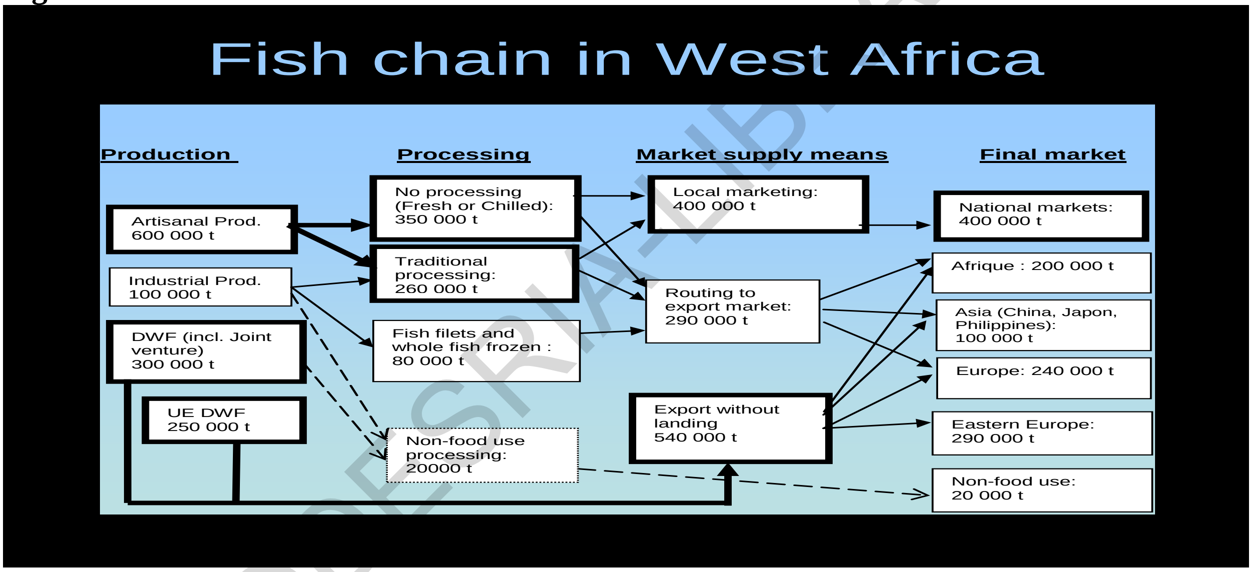
Source: (Hempel, 2010)

Value chain analysis looks at every step, a fisheries business goes through, from raw materials to the eventual end user. The goal is to deliver maximum value for the least possible total cost. A value chain is therefore a chain of activities. Products pass through all activities of the chain in sequence and at each activity the product gains some value. The chain of activities gives the products more added value than the sum of added values of all activities. It is important not to mix the concept of the *value* of the product with the *costs* of producing it (Hempel, 2010). This is also in agreement with Harland (1996) where he opined that the value chains for most of the fish species start from oceans and end up with consumer markets far from thousands of miles. The value chain framework shows that the value chain of a producer/ industry or a company may be useful in identifying and understanding crucial aspects to achieve competitive strengths and core competencies in the marketplace. The model also reveals how the value chain activities are tied together to ultimately create value for the consumer (Shamsuddoha, 2007).

Shamsuddoha (2007), further revealed that the nature of value chain activities differs greatly in accordance with the types of species and producers. The value chains of producers/companies have undergone many changes in the last two decades due to advancements in technology facilitating change at a very rapid pace in the business environment (Roheim, 2008). Roheim (2008), obliged further that outsourcing will cause major changes in organizations and their value chains, with significant managerial implications. Value chain analysis is an innovative, sector-based approach to competitiveness focuses on getting more value from goods and services produced for export (Shamsuddoha, 2007). Porter (1985) noted that the goal of value chain is to offer the customer a level of value that exceeds the cost of the activities, thereby resulting profit margin. 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 (Porter, 1985). 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 (Roheim, 2008). A value chain has three key parts, these are:

- **Supply** focuses on the raw materials supplied to manufacturing units, including how, when and from what location.
- **Manufacturing** focuses on converting these raw materials into semi-finished or finished products.
- **Distribution** focuses on ensuring these products reach the consumers through an organized network of distributors, warehouses and retailers.

Fig 2.3: Fish Chain in West Africa



Source: ICTSD Dialogue on Fisheries in ACP-EU Negotiations on Economic Partnership Agreements Mombasa, February, 2010

2.5 The Value Chain Concept Applied To Fish Farming Enterprise

The general concept of the value chain is easily adapted to the fisheries and aquaculture industries. In fact, the value chain is very similar for the two industries, although some parts may differ slightly. In the fisheries industry, one may describe the value chain as in Figure 4 below, consisting of seven links. The fishing vessel catches or harvests the fish and brings it to the landing site or port, where there is some primary processing – such as for example sorting and freezing or chilling – taking place. From here the fish is transported to secondary processing, such as for example filleting and freezing. The product is then shipped to the wholesaler, who distributes it further to the retailer before it ends up with the consumer.

Upstream activities produce inputs to the core activities, both products and services. Typical upstream activities are illustrated in this figure, and include feed suppliers, transporting companies, research organizations, veterinarians, equipment suppliers etc.

Downstream activities are those related activities that handle the products from the core activities, i.e. the output of the core activities, such as harvesting, live transport, processing, exporting and distribution. Over the years, a wide variety of both upstream and downstream activities has been developed to support the aquaculture industry.

2.6 Value Chain Map of Inputs (Factors)

Yela, Ovuezirie, Udah, and Arinze (2011), reported that the value chain map presents a visual depiction of the various functions involved in the production of fish up to the consumption by the end markets, and the various actors who deliver those functions and the linkages between those enterprises. The various functions in the pisciculture value chain include:

2.6.1 Inputs

<u>Feed</u>: The major inputs for cultured/farmed fish are feeds, medicines, fertilizers and other materials used in constructing and maintaining the ponds like water, labor, nets, etc. Feed accounts for about 60% to 65% of the total cost of production for fish in a cultured environment.

<u>Feed Considerations</u>: Catfish (*Clarias heterobranchus* and the hybrid) is a very suitable fish species for the development of fish farming in Nigeria, due to its hardiness, tolerance, fast growth rate, ease of reproduction and ability to derive atmospheric oxygen. However, Clarias is a carnivore fish; its nutritional requirements are high and expensive. The availability of affordable, quality catfish feed is an issue in Nigeria and needs to be addressed.

<u>Feed Availability in Nigeria</u>: There are basically 3 types of feed available to fish farmers in the Niger Delta and the country as a whole:

i. Imported Feeds - These are extruded floating feeds high in protein and fat, made available to catfish growers at a retail price of N300/kg to N350/kg (usually in 15kg bags at N4,500 to N5,000). This is considered an extremely high price. The high price is partly due to the high cost of ingredients and the high cost of marine transportation from the country of manufacture to Nigeria. In order to reduce the cost of fish production, there is need to reduce transportation cost of feed. However, given the very high quality of imported feed, the demand exists in Nigeria. Imported feed are said to have high feed conversion ratios (FCR), yielding 1 kg of fish for 0.9 to 1.4 Kg of feed (FCR of 1:09 – 1:1.4). The most popular imported fish feed are Coppens and Multifeed.

ii. Local Feeds - These are produced by local manufacturers in Nigeria. The feeds are based mostly on ingredients obtained locally and sold at the retail price of N160-180/ kg (usually in 20kg bags at about N360/bag). Fish meal (which is imported) and blood meal are usually used to provide animal protein in the fish feed. About 72% of all fishmeal in Nigeria is imported and this makes up about 30% of fish feed. The high cost of importation of the fishmeal is responsible for the high cost of feed in the country. There are a few feed manufacturers in Nigeria, based primarily in Lagos, including CHI, UAC, etc. Presently, the combined annual production of fish-feed in the country is estimated at about 600 – 700 tons.

iii. Homemade Feeds - These are feeds produced by catfish farmers themselves, involving home based operations with simple and mostly inadequate facilities. They have minimal access to quality feed ingredients, finance, storage facilities etc. As feed plants, their operations appear below the minimum economic size. Some farmers believe that their "home-made" feed contains enough protein for the fish. The major difficulty is in purchasing extrusion machines which could make the feed float. The advantage of floating feed is that the fish could easily spot the feed and pick them up, even though the Clarias gariepinus is a bottom-feeder. However, farmers think surface-feeding implies that fish are feeding properly, which they interpret as an indication of the good fish health. The farmers who make some of their own feed complained about the high cost of pelletizing and drying machines. The perception that sinking pellets can be a source of pond pollution is quite prevalent.

2.6.2 Feed Manufacturing

Feed manufacturing is a separate value chain in itself. A feed manufacturing plant consists of typical machines, bins, silos, pelletizers, extruders, and dryers etc, representing significant capital requirement. The economic viability of the plant is conditioned by the ability to purchase and store raw materials cost-effectively, and the ability to effectively deliver and distribute the feeds. The minimum economic size is in the range of 6,000 tons and above per year. Under special country/market conditions, the minimum economic size could be lower (say, 3,000 ton/year). Our investigation revealed that there is no such large scale feed manufacturer in Nigeria. Catfish feeds are produced locally in Nigeria by 3-5 medium size plants (CHI, Fishline, Durante), with capacities in the range of hundreds of tons/year and many (hundreds) of Nano &

Micro feed producers, who operate home mixer operations to produce their own feed, some with aspirations to sell to others (Yela et al, 2011).

2.6.3 Hatcheries

Yela et al, (2011) also noted that given the rise in aquaculture across the country, demand for fingerlings is also growing rapidly. In the Niger Delta, especially medium and large-scale fish farmers are responding to the expanding demand by engaging in fingerling production. Most of the fingerling producers used to buy fingerlings/juveniles from outside the Delta (from Lagos and Ibadan), but now grow theirs and sell the excess. Also, a lot of standalone hatcheries have also emerged. In Rivers State for example, there are about 260 such standalone hatcheries with 60 of them being medium scale modern hatcheries. The major problem with marketing of the fingerlings is that, most out-growers are not aware of the existence of these hatcheries. The hatcheries in turn are not linked to small-scale out-grower farmers, who are the most likely people to buy their fingerlings. This leads to the belief that supply of fingerlings outweighs the demand. Our study reveals that some out-grower farmers still buy fingerlings from Lagos, while hatcheries nearby in the Delta are complaining about low patronage. There are a number of hatcheries presently operational in the Niger Delta and these provide more than 90% of the fingerlings/ juveniles required by out-grower fish producers. The hatcheries come in two categories:

Integrated Systems

Some farmers who are out-grower fish producers also have hatcheries within their farms and produce their own fingerlings/juveniles and sell the excess to other out-grower fish farmers who need them. Most of these farmers are either medium scale or large scale commercial farmers. It is estimated that up to 60% of the fingerlings used by out-grower farmers come from these hatcheries.

i. <u>Stand Alone Hatcheries</u>- Standalone hatcheries which are not part of an integrated system also have sprung up due to rising demand for fingerlings in the Niger Delta. Rivers State is believed to have the largest number of these hatcheries in the Delta with about 200 small hatcheries and 60 medium scale modern hatcheries.
ii. <u>Small Scale Hatcheries</u> - The small scale hatcheries are those that are established with the very basic facilities, producing between 20,000 – 30,000 fingerlings/juveniles per cycle.
iii. <u>Medium Scale Modern Hatcheries</u> - Medium scale hatcheries have modern facilities and produce between 50,000 to 100,000 fingerlings per cycle.

For the market to function efficiently there is need to link hatcheries and out-grower farmers. Prices of fingerlings/juveniles are as follows:

- ✓ Fingerling (5g, 4 weeks old) - N10 to N15
- ✓ In between (Post Fingerlings) - N 30 to N40
- ✓ Juvenile (10 g, 6 weeks old) - N50

Types of Hatcheries

Indoor Hatcheries: This is usually the complete unit of fish breeding system constructed in a housed area for fish breeding. It consists of concrete tanks with a network of water distribution system usually perforated to allow splashing for oxygen aeration when in use. Other components may include rooms for storage of work materials or tools, table usually for the spawning activity, dissecting of male fish, stripping of female fish and bowls, syringes, beakers, spoons, etc, that are usually used during breeding sessions.

Outdoor Hatcheries: This is mostly characterized by the sample materials as in the indoor hatchery but only differs in the facilities being outdoors and uncovered.

Simple Hatcheries: This could be in the form of the normal water bath or aluminum troughs for the production of fingerlings. There also may use electric aerators where affordable but this is not mandatory.

Complex Hatcheries: This kind of hatchery is usually more organized, with flow through water systems and equipped with a laboratory facility. Water quality parameters equipment and tools are usually in use here with very high number of technical instruments installed to monitor hatching of eggs, feeding and sanitation of the hatchery chambers of tanks.

2.7 Production (Out-Grower Fish Farmers)

Yela et al, in conjunction with the Foundation for Partnership Initiatives in the Niger Delta (PIND) (2011), reported that the Niger Delta is home to three categories of out-grower fish farmers. As illustrated in table 9 below, the categories differ by production capacity, production output, and annual income earned. The categories of out-grower fish farmers are also different from each other based on the production system they utilize and prefer. For example, small scale farmers overwhelmingly use the green-water/earthen pond system compared to the flow through system operated by large scale farmers.

Table 2.1: Output Based on Water Area and System Used

S/NO	Small Scale Farmers			Medium Scale Farmers		Large Scale Farmers	
				Ton/year			
Production capacity (ton/year)	5	20	40	80	120	240	480
Production/week (kg/week)	104	500	750	1750	2,500	5,000	10,000
Total income (Naira/year)	2million	8million	16 million	32 million	48 million	96 million	192 million
1				Earthen pond system(green water)			
Water area (Ha)	0.12	0.5	0.9	1.9	2.6	5.5	10.7
Total area(Ha)	0.16	0.6	1.2	2.5	3.4	7.1	13.9
Make up(m^3/day) water	29	110	220	458	635	1318	2563
Labor	1	5	9	15	16	18	19
2				Recirculatory System (RAS)			
Water area (Ha)	0.01	0.03	0.07	0.20	0.26	0.46	0.78
Total area(Ha)	0.02	0.07	0.13	0.40	0.51	0.91	1.52
Make up(m^3/day) water	6	23	46	91	137	274	549
Labor	1	4	5	8	13	16	19

Source: Final Report, Catfish Farming Industry Supply Chain Development Programme, June 2008, MSME Nigeria.

Small Scale Farmers (Household Growers)**:** These are farmers who mainly buy fingerlings or juveniles and grow them until ready for sale. They have no brooders nor grow their own fingerlings. Most of them have a single or few ponds (usually within their residential compounds) and produce at small scale for personal consumption and sell the excess. Some commercial farmers start like this and then grow to become commercial farmers. These farmers usually buy 250-500 fingerlings and then grow them. This type of small-scale farmer makes up about 80% of total number of producers. They usually produce about 100 Kgs (0 .1 tons) per month. Small scale commercial farms also exist and they produce between 0.4 – 5 tons/month and have about 3,000 – 5,000 fish under management.

Medium Scale Commercial Farmers (Also Have Hatcheries): These produce mainly to sell to consumers through wholesalers and usually have fairly large farms. Most of those that were visited had their own hatcheries and have brooding stock and facilities for artificial insemination. They also employ workers and persons knowledgeable in fisheries to run the farms. The output of these farms are between 5 – 10 tons per month and have about 5,000 – 20,000 fish under management.

Large Scale Commercial Farms: These are similar to the medium scale farmers except for the process sophistication and output, which is above 10 ton per month. Large scale farmers also employ a lot more people than the smaller operations and earn more revenue per year, ranging from 96 million to 192 million.

2.7.1 Production Methods

Fish farming practices and methods differ by farm size (USAID, 2006). Yela et al, (2011) gave an account that the most prevalent fish-farming practice in the Nigeria and especially Niger Delta is pond culture, simply because, as mentioned earlier, 80% of fish farming is practiced by small-scale out-grower fish farmers. In addition to pond culture, there are others that are being practiced:

Pond Culture: This involves raising fish in earthen ponds which are not raised from the earth but dug out in the ground. With the earthen ponds, water does not have to be changed daily and output is usually good as it is closest to the natural habitat of the fish and contains a lot of micro-organisms, which the fish feed on. The approach to maintaining ponds differ by where they are located:

- If the pond is in the upland area where the floor of the pond does not reach the water table, other sources of water have to be used (like water pumps), to fill the ponds.
- In areas where the floor of the pond is permanently below the water table (like parts of Bayelsa, Delta and Rivers States), water is retained in the ponds throughout the year and there is no need to fill the pond with water.
- Tidal brackish water swamps are where the water covers the mangrove flats in the high tide and recedes in low tide. A well-constructed pond would utilize the tidal water. When the water fills the pond, the sluice gates are locked and the water is trapped and the water can be drained off during low tide using exhaust valves.

Cage Culture: Cage culture occurs when fish are raised in cages that are lowered into a body of water. For successful cage culture, a suitable site should be selected. The shelter should not be exposed to wind or currents from the sea. In some areas the direction of the tidal current reverses daily. In such places, the feeding of the fish should be timed with stationery periods, when the current is about to reverse its course.

Pen Culture: Pen culture occurs when raising fish in an enclosed area of a body of water. The area should be sheltered from violent waves and the floor should be level with firm soil. The materials used for fencing the pen include bamboo, plastics, nylon netting and aluminum meshes. The poles which support the fencing are driven into the floor. The stocking rate is between 20 to 25 fish per cubic meter. For intensive farming, supplementary feeds are applied to support the high density of fish population. Feeding is usually done during stationery or at the slowest moment of the current.

Fish Culture in Tanks: Fish culture in tanks is the practice of rearing fish in tanks made of different materials. The most common are made of concrete but other materials like plastic, wood and fiber glass are also used. Before filling the tank with water, a layer of humus soil is placed at the bottom of the tank. The tank is constructed in such a way that it slopes slightly to one side and a level control pipe is installed at the deeper end. When the level of water is above the gauge line, the water flows into the vertical pipe and drains away.

Borrow-Pits Culture: In states like Bayelsa, Rivers, Delta and Cross River and other coastal states, fish can be raised in borrow-pits in swampy areas. These fish ponds retain water even in the dry seasons. These pits are converted to ponds by making bunds above the flood levels and stocking the fish.

Flow-through System: A flow-through system is the practice of raising fish in tanks (concrete, fiber or other materials) where there is a continuous flow of water and outflow of the used/waste water. There must be an abundance of water and most farms where this is the practice have bore-holes and water tanks with generators. Flow-through system of culturing fish is practiced in an environment where there is an abundant supply of good quality water continuously streaming into the pond. As the water increases in the pond, it removes the waste and uneaten feed through a controlled outlet valve (Mbakaogu (Esq.), 2009).

Water Recirculation System: Water from the tanks are treated and recycled for use. This system allows for mass production of fish where there is limited or poor quality of source water. It is highly technical and capital intensive (Yela et al, 2011).

2.8 Value Chain Map for outputs (Products)

Below presents a description of the flow of products, and maps the players and their roles in moving the products from production to final sale as presented in the reports of Yela et al, (2011).

Description by Channel: The channels are defined by technology and whether the fish has been processed or not. The two identified channels are:

1. Fresh Fish Channel: The fresh fish channel is mainly dominated by catfish; however there is a market for other cultured/farmed fishes, especially Tilapia. The hatcheries, both integrated and standalone provide fingerlings/juveniles to the out-grower farmers. All categories of farmers (small scale, medium scale and large scale) then sell to bulk buyers or fresh fish wholesalers. These then sell to market women and also to catering houses (restaurant, hotels, bukas, etc), who in turn sell to consumers (Mbakaogu (Esq.), 2009).
2. Smoked Fish Channel: The smoked fish channel for farmed/cultured fish is flourishing. Although many fish mongers smoke fish as a means of preservation, smoking also adds value to the fish. Most consumers use smoked fish in the cooking of soups and other local dishes to enhance the taste of the foods. From their studies the sale of smoked fish competes with that of fresh fish by a ratio of 1:1. The fish mongers who smoke fish usually are not very selective of fish at the farm gates and therefore usually receive a better price than their other counterparts, who specialize only in fresh fish sales. A kg of fresh fish at the farm gate in the Niger Delta usually costs about N500, but the buyers of smokers get theirs for an average of N450 per kg. After smoking such fish, it can fetch as much as N800 per kg as opposed to fresh, which sell for about N650 to N700. The map starts with the hatcheries, where fingerlings/juveniles are produced and then sent to the out-grower farmers, who then grow the fish and sell to wholesalers who specialize in smoking fish. Market women smoke the fish and then sell to other market women and catering houses (restaurants, hotels, etc). The market women or “mammies” then sell to consumers. Also, the smoker market women wholesalers sell smoked fish to traders who export them out of the Delta to other parts of the country. At times, certain exporters purchase large amount of fish from farmers and then employ the services of these smoker market women to smoke the batch of fish for them, before selling them outside the Delta (Mbakaogu (Esq.), 2009).

2.9 Value Chain versus Supply Chain

Value chains are concerned with what the market will pay for a product or service offered for sale. Moreover, market considerations differ from country to country, region to region and having close connection with food habits and consumption pattern of the people. The main objectives of value chain management are to maximize gross revenue and sustain it over time. Supply chains are concerned with what it costs and how long it takes to present the product for sale. The main objectives of supply chain management are to reduce the number of links and to reduce friction, such as bottlenecks, costs incurred, time to market etc. Good supply chain is essential to develop a value chain (ABT Associates, 2005).

Producers controlled value chains are cost driven while retailer controlled value chain are revenue driven. Key concerns of the producers are availability of fish in year round basis, minimize the seasonal gluts and shortages and cater for service oriented customers with fresh produce. Retailer controlled value chains are more concern on value addition, differentiation, change the face of the product and focus more on private brands and labels. Especially, which facilitates the retail giants to cater for their brand loyal consumers and establish image in both local and international market.

2.10 Constraints Facing Fish Farming

Unlike other developed countries, Africa has little aquaculture traditions and has been affected by a number of external problems that have prevented proper management and development, despite investment by the government. The main constraints facing the activity in Nigeria are:-

- Environmental Factors: Environmental factors are mainly physical forces of nature that arises due to extreme climatic and meteorological conditions (Agbabi and Fagbenro, 2006). These factors include excessive rainfall and flooding, water pollution, oil spillage, excessive heat and drought (Moyle et al., 1990; Enabulele 1999; Plumb, 1999). Other socio-cultural constraints include theft, pilferage and fraud. These factors may be external (from individuals) or internal (from employees) (Odoye et al., 2005).

- Financial Factors: These are due to unstable government financial policies. Fish farmers require repeated loans, in addition to loans for capital investment and start-up operational cost. Short term loans are meant for annual supplies of seed, feed, new equipment and expansion (Odoye et al., 2005)- Disease Factors: Fish being a poikilothermic animal tend to react quickly to environmental changes and this increases susceptibility of fish to infectious agent due to compromised immune response (Plumb, 1999). Myole (1990) also stated that stressed fish are more susceptible to diseases and parasites than fish which are held under optimum condition. Ahmed and Ambali (2005) reported that parasitic infections were found to be a common feature in fish population with nematode being significantly prominent.

- Physical Factors: Lack of adequate technology or technical information and expertise as regards hatchery, propagation and husbandry management affect fish production. Fish farmers should be provided with effective machinery and comprehensive information on the availability of tools that will enhance productivity of fish in Nigeria. Processing and preservation of fish are of utmost importance since it deteriorates immediately after harvesting.

Therefore, processing of fish after capture using high quality machines and preservation is imperative to prevent serious economic losses (Davies and Davies, 2009).

- <u>Business Factors</u>: Fish farmers also face market and consumer related risks. Such risks are due to loss of quality products, lack of market information, and health regulations.

2.11 Theoretical Framework

A theory is said to be a set of related statements that are arranged to give a functional meaning to a set of events. Theoretically, this work is based on the following theories which are as follows: production theory, law of demand and supply, value chain analysis, profit maximization theory, cobweb theory and the theory of minimization of costs. Basically, this work is anchored on the theory of production as it applies to agriculture. The relationship between factor of production (inputs) and the products (outputs) which is regarded as the production function will be studied under the factor-product relationship of production. In the production business of pisciculture, where there exists a lot of producers, prices guides producers in the choice of goods they produce and supply to the market for sale. The forces of demand and supply guides majorly production decisions. This means that the amount of any commodity produced at any time is a function of the interaction of demand and supply through price mechanism. Demand is the relationship that exists between series of quantities of product that will be produced and corresponding prices in a specified period. Changes in demand also occur because of distribution of income, population, tastes and prices of close substitutes or complementary goods (Hungate and Sherman, 1979). Jhingan (1997) noted that some factors that may influence the demand for a particular commodity are: price of the commodity, prices of substitutes, income, taste and fashion. The mathematical relationship is written thus:

$Q_d = D(P, P_s, Y, T)$ ceteris paribus

Where; Q_d=quantity demanded; P=price of the commodity; P_s=price of substitutes; Y=income; T=taste/fashion

Supply in theory refers to producers/suppliers eagerness to sell i.e. the amount of commodity that producers are willing to offer for sale at a given price and at a particular time. Supply also plays a significant role in production decisions which is also guided by price mechanism. Enabor (1999) noted that supply could be physical or economic. Physical supply refers to the available quantities or stocks of the product, while economic supply is the product reaching the market at a given price, time and place. Factors influencing the supply of a commodity are price of the commodity, cost of production of the commodity, price of bye-products, the available productive capacity, technological change and the weather. The supply function is written thus: Qs= S(P,C,P*,C*,T*,W) *ceteris paribus*, where: Qs = quantity supplied, P= Price of the commodity; C= cost of production; P*=price of bye-products; C*= available productive capacity; T*= technological change and W= weather.

The value chain analysis is a concept based on the economic value of a product from the producer/firm to the consumer. It is a business concept concerned with creating and sustaining superior performance. A product gains value as it passes through various stages of activities in the value chain, as it moves from producer to the ultimate consumer. As Potter M. (1985) rightly proposed that value chain is a tool for identifying ways to create more customer value. According to Kotler and Keller (2006), this model is designed in such a way that every producer/firm is a synthesis of activities performed to design, produce, market and support its product. The ultimate goal is maximization of value creation which culminates into cost minimization and profit maximization. This then pave the way for the next model utilized in this research study.

Profit maximization is another theory that supports this study. Although, empirical evidences overwhelmingly points towards other objectives of firms such as sales maximization, output maximization, satisfaction maximization etc. in the neo-classical theory of the firm is profit maximization. The firm maximizes its profit when it satisfies the two rules: Marginal Cost (MC) = Marginal Revenue (MR) and the MC curve cuts the MR curve from below. Maximum profit refers to the pure profits which are surplus above the average cost of production. It is the amount left with the entrepreneur after he has made payments to all factors of production, including his wage management. In other words, it is a residual income over and above his normal profits. The profit maximization condition of the firm can be expressed as:

$$\text{Max } \pi(Q)$$

Where $\pi(Q) = R(Q) - C(Q)$

Where $\pi(Q)$ is profit, R(Q) is revenue, C(Q) are costs and Q are the units of output sold.

According to Jhingan (1997), the two marginal rides and the profit maximization condition stated above are applicable both to a perfectly competitive firm and to a monopoly firm. The theory assumes that the objectives of a firm is to maximize its profits where profits are the difference between the firm’s revenue and costs given that the tastes and habits of consumers are constant. It also assumes that the firm produces a single, perfectly divisible and standardized commodity.

Furthermore, the movement up and down of agricultural price can be explained with cobweb theory. The cobweb model is an economic model that explains periodic fluctuation in prices of agricultural goods. It describes cyclical supply and demand where the amount produced must be chosen before the prices are observed. Producers' explanations about prices are assumed to be based on observations of previous prices. The model was coined 'cobweb theorem' in 1934 by Nicolas Kaldor. The cobweb model is based on time-lag between supply and demand decisions by farmers. For instance, if there is high price of maize and farmers expects this high price to continue, they would raise their production of maize relative to other crops. Therefore, when they go to the market, the supply will be high, resulting in low prices. If one the other hand, they anticipate low price to continue, they would decrease their production of maize for the next year, resulting in high prices again. Thus, the circle continues in a cobweb manner. Cobweb model is used to describe the dynamics of demand, supply and price over long period of time. There are many perishable agricultural commodities whose price and output are determined over long periods and they show cyclical movement. As prices move up and down the circle, quantities produce also seem to move up and down in a counter-cyclical manner. The cobweb model is an over-simplification of the real price determination process. The cobweb model is not merely an adjustment process of the market equilibrium but it also predicts on observable events. Its significance lies in the demand, supply and price behavior of agricultural commodities.

Another theory relevant to this study is the theory of minimization of costs. Producers choose combinations of inputs to produce a certain level of outputs at minimum cost. Cost minimization holds even for non-profit firms. Cost functions are derived functions. They are derived from the production function which describes the available efficient methods of production at any one time. Economic theory distinguishes between short-run cost and long-run cost. Short-run costs are cost over a period during which some factor of production (usually capital equipment and management) are fixed. The long-run costs are the cost over a period long enough to permit the change of all factors of production. In the long-run, all factors become variable. Both in the short and long-run, total cost is a multi-variable function, that is, total cost is determined by many factors. Symbolically, the long-run costs function is written as:

$$C = F(X, T, P_s) \quad - \quad - \quad - \quad - \quad (1)$$

And the short-run cost function as

$$C = F(X,T,P_s,K^*) \quad - \quad - \quad - \quad - \quad (2)$$

Where: C = Total cost; X = Output; T = Technology; P_s= prices of factors; K* = fixed factors

2.12 Analytical Framework

The nature and purpose of a study determines the type of analysis and analytical techniques to be employed, therefore each researcher must develop an appropriate approach, though general principles apply. Also, the choice of techniques depends on a host of factors in particular the objectives of the study, the availability of data, time and budget (McNally and Othman, 2002). Different approaches could be used to analyze data. The first step of simple but important analytical tool used in data analysis is the descriptive statistical tools. For exploratory studies, rates, mean, percentages tables, graphs, charts, standard deviation and frequency distribution among others may be adequate. In addition to the descriptive statistical tools, some specific objectives and quantitative data require in-depth analysis which may need more complex analytical tools than the simple descriptive statistical tools. However, for this study, the following specific models will be employed in addition to descriptive statistical tools: production function analytical model and stochastic frontier production model, budgetary techniques, gross margin and value addition model respectively.

2.12.1 Stochastic Frontier Production Model

The stochastic frontier production model represents an improvement over the traditional average production function and over the deterministic functions, which use mathematical programming to construct production frontiers. The notion of a deterministic frontiers shared by all firms ignores the possibility that a firm's performance may be affected by factors entirely outside its control such as bad weather and input supply breakdown as well as by factors under its control (i.e. technical efficiency). To lump up the effects of exogenous shocks, both favourable and unfavourable, together with the effects of measurement errors and inefficiency into a single one-sided error term, and to label the mixture inefficiency is a problem with the deterministic frontiers.

According to Forsund, Lovell and Schmidt (1980), this conclusion is reinforced if one considers also the statistical noise that every empirical interpretation is that first, there as well may be measurement errors in the dependent variables. Second, the equation may not be completely specified with the omitted variables individually unimportant. Both of these arguments hold just for production functions as for any other kind of equation, and it is dubious at best not to distinguish this noise from inefficiency, or to assume that noise is one-sided. These argument lies behind the stochastic frontier (also called composed error) model developed independently by Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977). The essential idea behind the stochastic frontier model is that error term is composed of two parts. A symmetric component permits random variation of the frontier across firms and captures the effect of measurement error, other statistical noise and random stocks outside the firm's control. A one-sided component captures the efforts of inefficiency relative to the stochastic frontier. The model that was used in this study is based on the one proposed by Battese and Coelli (1995) in which the stochastic frontier specification incorporates models for the technical inefficiencies effects and simultaneously estimate all the parameters involved in the production and most cost function models. The stochastic frontier production function model is specified as follows:

$$Y_i = f(X_i; ß) + v_i - \mu_i \qquad ....(3)$$

Where Y_i measures the quantity of output, X_i is a vector of the input quantities, ß is a vector of parameters to be estimated; $f(X_i; ß)$ is a frontier production function; Where v_i is assumed to be independently and identically distributed as $v \sim N(0,\sigma^2 v)$ random error and represents random variability in production that cannot be influenced by farm produce. $\mu_i \sim N(0,\sigma^2\mu)$. The frontier production function $f(X_i; ß)$ measures the maximum potential output for a given output vector, X_i. Both v_i and μ_i cause actual production to deviate from the frontier.

Using a Cobb-Douglas functional specification to model crop production technology, the frontier production function in equation (4) is estimated using maximum likelihood estimation procedures which provides estimators for ß and variance parameters, $\sigma^2 = \sigma^2 v + \sigma^2\mu$ and $Y = \sigma^2\mu / \sigma^2$. To empirically measure efficiency, deviations from the frontier are separated into a random (v) and an inefficiency (μ) component.

2.12.2 Technical Efficiency (TE)

According to Onojah (2004), Ogundari and Ojo (2006) and Okoruwa and Ogundele (2008), technical efficiency (TE) is the ability of a firm to produce a given level of output with a minimum quantity of inputs under a certain technology. Technical efficiency occurs when a firm is utilizing all of its resources and operating at its production possibility frontier (PPF). This happens when the production of one good is achieved at the lowest cost possible given the production of other goods. Productive or technical efficiency requires that all firms operate using their best practice technological and managerial processes. By improving these processes, a firm can extend its production possibility frontier outwards and increase efficiency further. Technical efficiency is a situation where it is possible for a firm to produce with the given technology (know-how): (i) a large amount from the same inputs; and (ii) the same output with less of one or more inputs without increasing the amounts of other inputs. Yusuf and Adenegan (2008) maintained that a technically efficient firm operates on the production frontier while an inefficient firm operates below the frontier. An inefficient firm could however operate on the frontier either by increasing output with the same inputs bundle or by using fewer inputs to produce the same output. They observed that the more a firm gets to the frontier, the more efficient it becomes and vice versa. Production efficiency occurs where production takes place at the lowest average cost. Omotosho, Muhammed and Falola (2008) are of the opinion that production efficiency is the pre-requisite for allocative or economic efficiency.

The estimation techniques of relative TE of firms (frontier approaches) can be generally categorized into two, viz, Data Envelopment Analysis (DEA), a non-parametric mathematical programming approach to frontier estimation; and the stochastic frontiers which involve an econometric estimation (Seiford and Thrall, 1990). The emergence of these two estimation techniques was based on Farrell's suggestion to estimate the TE of firms from the sample data using either a non-parametric piecewise-linear programming or a parametric function such as the Cobb-Douglas form. Charnes, Copper and friends took up the first suggestion, resulting in the development of the DEA approach while the parametric suggestion was tackled by Aigner and others, resulting in the development of the stochastic frontier approach (CEPA, 2000). Detailed discussions of the DEA methodology are presented by Farel, Gosskopt and Lovell (1985 and 1994), Seiford and Thrall (1990), and Ali and Seiford (1993).

Presently, the stochastic frontier approach has been widely adopted. This is because of the pit falls of the DEA. The DEA assumes that all deviations from the frontier are as the result of inefficiency in production. Thus, the measurement error and other noise not captured by the model may influence the shape and position of the frontier. This may also give misleading indications of relative managerial competence. In addition, one cannot test hypotheses regarding the existence of inefficiency and also regarding the structure of the production technology in the DEA. These problems are adequately addressed by the stochastic frontier analysis (CEPA, 2000). To estimate a production function, information on output and input quantities are required, while the estimation of a cost function normally require information on output, total cost and input prices (CEPA, 2000). In an attempt to formulate the stochastic frontier production model to measure the TE of firms, scholars at various times proposed different deterministic frontier estimation functions which have attracted wide criticism. Aigner and Chu (1968) considered the estimation of a parametric frontier production function by specifying Cobb-Douglas production function (in log form) for a sample of N firms as:

$$\text{In}Y_i = \text{In}X_i^1 B - U_i, \qquad i = 1, 2, \ldots, N \qquad (5)$$

Where:

$\text{In}Y_i$ = the log of the (scalar) output of the ith firm

InX_i = (k+1) X1 vector where the first element is "1" and the remaining elements are the log of the K input quantities used by the ith firm

β (β_0, β_1 ….. β_k) = (K + 1) X1 vector of unknown parameters to be estimated

U_i = the non- negative variable representing inefficiency in production.

The parameters of the model were estimated using linear programming where

$\sum_{i=1}^{N} U_i$ is minimized subject to the constraints that $U_i \geq 0$, i = 1, 2, …., N.

Further suggestions points to the use of quadratic programming methods. Using the output oriented measure, Aigner and Chu (1968) suggested the TE of the ith firm to be the ratio of observed output of the ith firm relative to the potential output defined by the estimated frontier, given the input vector X_i. This is mathematically expressed as:

$$TE_1 = Y_i = \frac{\exp(InX^1\beta - U_i)}{\exp(InX_i^1\beta)} = \frac{\exp(-U_i)}{\exp(InX_i^1\beta)} \quad (6)$$

Afriat (1972) specified a model to measure the TE of the ith firm similar to that specified by Aigner and Chu (1968) except that the U_i were assumed to have a gamma distribution and the parameters of the model were estimated using the maximum likelihood (ML) method. Richmond (1974) asserted that a method known as corrected ordinary least squares (COLS) could also be used to estimate the parameters of Afriat's model. In this method of COLS, the ordinary least squares (OLS) method provides unbiased estimates of the slope parameters and the downward biased OLS estimator of the intercept parameter is adjusted up by the sample moments of the error distribution obtained from the OLS residuals. Schmidt (1976) observed that the linear and quadratic programming estimators proposed by Aigner and Chu (1968) are ML estimators if the U_i were assumed to be distributed as exponential or half-normal random variables respectively.

All the deterministic frontier estimators discussed above have been widely criticized. The major drawback is that no account is taken of the possible influence of measurement errors and other noise upon the shape and positioning of the estimated frontier, since all observed deviations from the estimated frontier are assumed to be the result of technical inefficiency. An alternative stochastic frontier approach which addressed this problem and adequately captures the errors in production due to both noise and inefficiency was that proposed by Aigner, Meeusen and others. The stochastic frontier production function was independently proposed by Aigner, Lovell and Schmidt (1977), and Meeusen and Van den Broeck (1977) to estimate the TE of the firms. This function has two error components: the symmetric error term (V_i) which accounts for noise (factors beyond the control of the farmers in production such as weather, topography, disease outbreak, strike and government policy); and the non-negative asymmetric error (U_i) accounting for the technical inefficiency of the farmers in production. Many researchers have applied and adopted the use of this model (Bauer, 1990; Battese and Coelli, 1992 and 1995; Greene, 1993; CEPA, 2000; Onyenweaku and Nwaru, 2005; Emokaro and Erhabor, 2006; Erhabor and Emokaro, 2007; Ehirim and Korie, 2008; and Onoja and Achike, 2008). The model (in log form) using the Cobb-Douglas function is implicitly expressed as:

$In\ Y_i = InX_i^1\beta + V_i - U_i, \quad i = 1, 2, \dots n$ (7)

Where:

$In\ Y_i$ = the log of the (scalar) output of the í-th firm;

InX_i = (k + 1) x 1 vector where the first element is "1" and the remaining elements are the logs of the k input quantities used by the í-th firm;

$\beta = (\beta_o, \beta_{1\dots}\ \beta_k)$ is a (k + 1) x 1 vector, the unknown parameter to be estimated;

V_i = non- negative asymmetric error accounting for technical inefficiency of the farmers; and

U_i = Symmetric error term accounting for noise.

The parameters of this model are estimated by Maximum Likelihood (ML), given suitable distributional assumptions for the error terms. The V_i is assumed to be independent of U_i; identically and normally distributed with zero mean and constant variance {N~ (O, δ^2v)}. The U_i is assumed to have a distribution that is either half normal, exponential or truncation of a normal distribution. If U_i=0, no technical inefficiency occurs, the production lies on the stochastic frontier. If U_i>0, production lies beneath the frontier and is said to be inefficient. The non-negativity of U_i implies that no farmer can perform better than the best practiced frontier. The independent distribution of U_i and V_i allows for separation of technical inefficiency and "noise" (Bauer, 1990; Battese and Coelli, 1995; and Ehirim and Korie, 2008).

The firm specific measure of technical inefficiency can be determined from the conditional expectation of U_i given ε_i, the composite error term (Jondrow, Lovell, Materov and Schmidt, 1982). The level of TE of the í-th farmer is then given as the ratio of the observed output (Y_i) to the corresponding frontier output (Y_i^*).

2.12.3 Budgetary Technique

The budgetary technique is used to calculate cost and return analysis of a firm. It was used to determine the profitability of fish farming in the work of Adewuyi, Phillip, Ayinde and Akerele (2010) "Analysis of Profitability of Fish Farming in Ogun State, Nigeria", stating the following models as:

Π = TR- TC……………………….. (8)

TR= PQ…………………………..…. (9)

Where: Π = Total Profit (N); TR=Total revenue (N); TC= total Cost (N); P= Unit price of output (N); Q= Total quantity of output (N). Also, According to Olukosi and Erhabor (1989); Kudi, Bako and Atala (2008), Net Farm Income (NFI) gives an overall level of profitability of an enterprise by putting both fixed and variable costs into consideration and subtracting the cost from the total revenue at each stage in pisciculture value chain enterprise. The difference between the gross revenue (GR) and total cost (TC) gives the net revenue (NR), Therefore: Net farm income (NFI) is expressed as:

NFI = GR – TC …………………………..(10)

Where: NFI = Net Farm Income

TC = (TVC + TFC) = Px. X

GR = Py. Y

GR = Gross Return / ha

Py = Unit Price of Output

Y = Quantity of Output

Px = Unit Price of Input

X = Quantity of Input

TC = Total Cost (N)

TFC = Total Fixed Cost (N)

TVC = Total Variable Cost (N)

2.13.4 Value Chain Analysis

A typical value chain analysis can be performed in the following steps according to Dagmar (2001):

1. Analysis of own value chain –which costs are related to every single activity
2. Analysis of customers value chains –how does our product fit into their value chain
3. Identification of potential cost advantages in comparison with competitors
4. Identification of potential value added for the customer –how can our product add value to the customers value chain (e.g. lower costs or higher performance) –where does the customer see such potential

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study Area

The study was carried out in Lagos state, Southwestern region of Nigeria. This state was chosen because of the abundance of pisciculture enterprises and endowment of the region with water bodies which facilitated the operational existence of fish farms as the major agricultural activity in this region. It is also very familiar to the researcher as it increased the ease of data collection. Lagos State was created on May 27, 1967 by virtue of State (Creation and Transitional Provisions) Decree No. 14 of 1967, which restructured Nigeria's Federation into 12 states *(Lagos State official website, 2013* - lagosstate.gov.ng). Lagos State is an administrative division of Nigeria, located in the Southwestern part of the country; with a land mass spanning over 3345 sq km/1292 sq m (Encarta, 2009), lies between Latitudes 6°35′N of Equator and Longitude 3°45′E of Greenwich Meridian (C-GIDD (Canback Global Income Distribution Database), 2008) possesses a population of 9,013,534 million people (NPC, 2006).

Lagos state is located on four principal islands and adjacent parts of the Nigerian mainland. The islands are connected to each other and to the mainland by bridges and landfills (Encarta, 2009). Equally, the metropolitan areas (Colony Province) of Ikeja, Agege, Mushin, Ikorodu, Epe and Badagry were administered by the Western Region (Lagos State Population, 2006). The climatic weather condition of this region has made it favourable for fish farming to take place. It has also allowed for survival and multiplications of various fish species found in this environment (Encarta, 2009). Geographically, the state is located on the Bight of Benin (an arm of the Atlantic Ocean) (Encarta, 2009), which had made the people of Lagos state to engage mostly in fishing enterprises. It is a semi-tropical rainforest vegetation, and has a humid climate with a temperature of about 27^0C *(Lagos State official website, 2013* - lagosstate.gov.ng).

Though, considered as the smallest in terms of area amongst Nigeria's states, Lagos State is arguably the most economically important state of the country, as well as it is the nation's largest urban area (C-GIDD, 2008) and most populated urban area in the whole of Africa (UNDP, 2003). Till date, it remains the center of commerce for the country. Lagos State is divided into five Administrative Divisions, which is then further divided into 20 Local Government Areas (C-GIDD, 2008). The first 16 of the LGAs are the Metropolitan Lagos while the remaining four LGAs (Badagry, Ikorodu, Ibeju-Lekki and Epe) are within Lagos State but are not part of the Metropolitan Lagos. In 2003, many of the existing 20 LGAs were split for administrative purposes into Local Council Development Areas (LCDAs). These lower-tier administrative units now number 56 (see table 3.1 below).

Table 3.1: Administrative Divisions and Local Government Areas of Lagos State

LGA Name	Area (km^2)	Census 2006 population	Administrative capital
Agege	11	459,939	Agege
Alimosho	185	1,277,714	Ikotun
Ifako-Ijaye	27	427,878	Ifako
Ikeja	46	313,196	Ikeja
Kosofe	81	665,393	Kosofe
Mushin	17	633,009	Mushin
Oshodi-Isolo	45	621,509	Oshodi/Isolo
Shomolu	12	402,673	Shomolu
Ikeja Division	*424*	*4,801,311*	
Apapa	27	217,362	Apapa
Eti-Osa	192	287,785	Ikoyi
Lagos Island	9	209,437	Lagos Island
Lagos Mainland	19	317,720	Lagos Mainland
Surulere	23	503,975	Surulere
Lagos Division	*270*	*1,542,279*	
Ajeromi-Ifelodun	12	684,105	Ajeromi/Ifelodun
Amuwo-Odofin	135	318,166	Festac Town
Ojo	158	598,071	Ojo
Badagry	441	241,093	Badagry
Badagry Division	*746*	*1,841,435*	
Ikorodu	394	535,619	Ikorodu
Ikorodu Division	*394*	*535,619*	
Ibeju-Lekki	455	117,481	Akodo
Epe	1,185	181,409	Epe
Epe Division	*1,640*	*298,890*	

*Source**: (Lagos State official website -*** **lagosstate.gov.ng**)

3.2 Sample Techniques

A multi-stage sampling technique was adopted for this study. Firstly, four (4) Administrative Divisions out of the five (5) in the state were purposively selected; and these include Ikeja, Lagos, Badagry and Epe division. This was due to the predominance of fish farmers in these zones. The second stage involved the purposive selection of two (2) Local Government Areas each from the above selected four (4) Administrative Divisions of the state, they are as follows: Alimosho, Kosofe, Eti-Osa, Lagos Island, Ojo, Amuwo-Odofin, Epe and Ibeju-Lekki Local Government Area. This is also mainly due to the predominance of fish farmers in this areas. The third stage involved random selection of three (3) communities from each of the eight (8) LGAs selected above. Lastly, the fourth stage randomly sampled five (5) fish farmers from each of the twenty-four (24) communities selected above. This gave a total of 120 respondents to be sampled. The researcher administered this questionnaire himself although sorted the help of extension workers in the state whenever the need arose.

The questionnaires was divided into six (6) sections: **A** contained the socio-economic characteristics of fish farmers as well as analyze the influence of these socio-economic characteristics on their technical efficiency; **B** gathered information on the various steps involved in pisciculture value chain; **C** evaluated the factor-product use efficiency as well as analyze factor-product relationships in pisciculture value chain; **D** estimated the cost and returns of pisciculture value chain in the study area; **E** identified the various constraints facing pisciculture value chain; finally, **F** gathered suggestions and recommendations from all the parties involved.

3.3 Data collection

A structured questionnaire was used for primary data collection. The population for this study was made up of all the pond fish farmers in this area. A total of one hundred and twenty (120) fish farmers who practice pisciculture and owned fish ponds in the area were sampled. Primary data was solely used for this study. This was gathered from the responses of those who practice pisciculture and own fish pond via interview and administration of structured questionnaire as well as informal discussion with fish farmers during the field survey.

3.4 Data Analysis

Various analytical tools were used to achieve the objectives of the study. Objective II, III and the first part of Objective I were achieved using simple descriptive statistics such as frequency distribution tables, percentages, averages (mean) while stochastic production frontier model was used to achieve the remaining part of Objective I as well as Objective III in order to analyze the technical efficiency and technical inefficiencies. Budgetary technique (Net Farm Income, Return on Investment (ROI)) as well as value chain analysis were adopted collectively to achieve objective IV. Finally, Objective V was achieved using 4-point Likert Scale rating. Test of significance was revealed from stochastic frontier model utilized.

Model Specifications

3.4.1 Cobb-Douglas Functional form of the Stochastic Frontier Analysis

The Cobb-Douglas functional form of the stochastic frontier was used to determine the technical efficiency of fish farmers in study area. This will enable us to measure the technical efficiency and the relationship between factor-product in pisciculture value chain in this area (in achieving objectives I & III). A Cobb-Douglas Functional form of the Stochastic Frontier Analysis as already been discussed in the analytical framework (See section 2.12.1). Therefore, the stochastic frontier model to be adopted was the one used by Coelli and Battese (1996) and Bravo, Ureta and Rieger (1991). In the model, it was assumed that the farm frontier production function can be written as:

$$Y = f(Xi; ß) + Vi - Ui \qquad ....(5)$$

Where Y is the quantity of fish output, Xi is a vector of input quantities, and ß is a vector parameter, Vi = random error term and Ui = non-negative one sided error term that measures inefficiency. The empirical model of the stochastic production function frontier applied in the analysis of efficiency of the production system of pisciculture farmers is specified as:

$$\ln Y_{ij} = \ln b_0 + b_1 \ln X_{1ij} + b_2 \ln X_{2ij} + b_3 \ln X_{3ij} + b_4 \ln X_{4ij} + b_5 \ln X_{5ij} + b_6 \ln X_{6ij} \qquad ....(6)$$

Where: Y = total output (Kg)

X_1 = farm size measured in Hectares (Ha)

X_2 = labour used in fish production (man/days)

X_3 = feed measured in Naira (N)

X_4 = fertilizer in Naira (N)

X_5 = Stocking capacity (no of fingerlings)

X_6 = depreciation value of fixed inputs in naira (₦)

Ln = Natural logarithm

$ß_0$ = intercept showing value of Y when each of the independent variables are zero. That is, the value dependent in each of the equations is predicted to have when all the independent variables are equal to zero.

$ß_1$ - $ß_6$ = the coefficients or multipliers that describe the size of the effect of the independent variables are having on the dependent variable Y.

ij are subscripts I and J and they refer to the i^{th} farm produce and the j^{th} input respectively.

The efficiency function is specified as:

$$T.E = \tilde{\bar{O}}_0 + \tilde{\bar{O}}_1 Z_1 + \tilde{\bar{O}}_2 Z_2 + \tilde{\bar{O}}_3 Z_3 + \tilde{\bar{O}}_4 Z_4 + \tilde{\bar{O}}_5 Z_5 + \tilde{\bar{O}}_6 Z_6 + \tilde{\bar{O}}_7 Z_7 + \tilde{\bar{O}}_8 Z_8 + \tilde{\bar{O}}_9 Z_9 + \tilde{\bar{O}}_{10} Z_{10} + \tilde{\bar{O}}_{11} Z_{11} + e$$

Where: T.E = Technical Efficiency

Z_1 = Year of schooling (education)

Z_2 = Age of fish pond (in years)

Z_3 = Age of farmer (in years)

Z_4 = Farming experience (in years)

Z_5 = Household size (numbers)

Z_6 = Membership of cooperative / farmers organization (dummy, 1 = member, 0 = non member)

Z_7 = credit access (dummy, 1 = Access, 0 = no access)

Z_8 = Sex (dummy, 1 male, 0 = female)

Z_9 = extension (dummy, 1 = contact, 0 = no contact)

3.4.2 Budgetary Techniques

For objective iv, budgetary techniques and value addition analysis were used to achieve it respectively. According to Olukosi and Erhabor (1989); Kudi, Bako and Atala (2008), Net Farm Income (NFI) gives an overall level of profitability of an enterprise by putting both fixed and variable costs into consideration and subtracting the cost from the total revenue at each stage in pisciculture value chain. The difference between the gross revenue (GR) and total cost (TC) gives the net revenue (NR), Therefore Net farm income (NFI) is expressed as:

$$NFI = GR - TC \quad ...(7)$$

Where: NFI = Net Farm Income

TC = (TVC + TFC) = Px. X

GR = Py. Y

GR = Gross Return / Pond

Py = Unit Price of Output

Y = Quantity of Output

Px = Unit Price of Input

X = Quantity of Input

TC = Total Cost (N)

TFC = Total Fixed Cost (N)

TVC = Total Variable Cost (N)

3.4.3 Value Chain Analysis

A typical value chain analysis can be performed in the following steps according to Dagmar (2001):

1. Analysis of own value chain –which costs are related to every single activity

2. Analysis of customers value chains –how does our product fit into their value chain
3. Identification of potential cost advantages in comparison with competitors
4. Identification of potential value added for the customer –how can our product add value to the customers value chain (e.g. lower costs or higher performance) –where does the customer see such potential

For the purpose of this study, two tools from the above listed analytical methods which are: (1) analysis of own value chain – which costs are related to every single activity and (4) identification of potential value added for the customer will be collectively adopted in order to achieve the objective of this study.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Socio-economic Characteristics of Respondents

The socio-economic characteristics of respondents discussed in this chapter includes age, sex, marital status, educational level, major occupation, farming experience, farm size, labour type and house size.

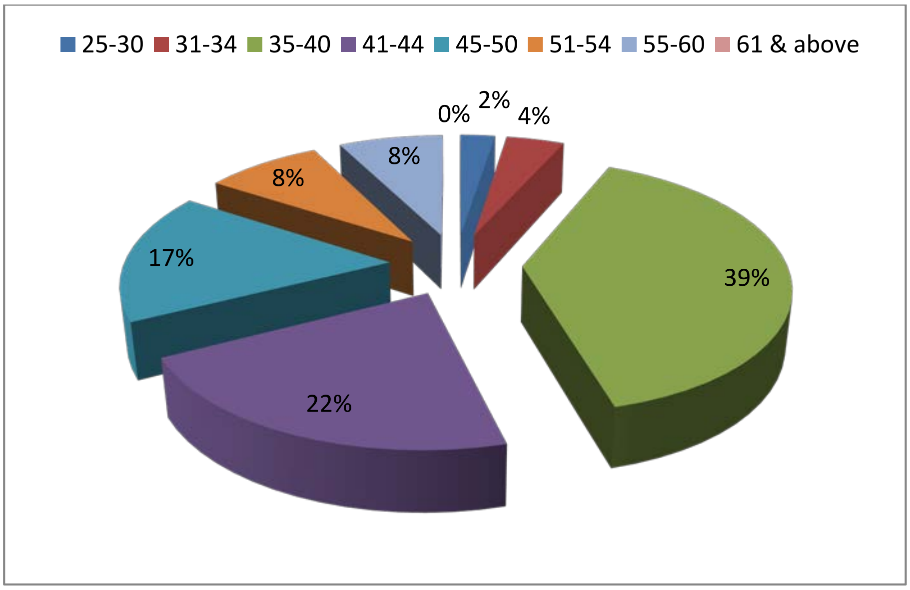
4.1.1 Age Distribution of Respondents

Table 4.1: Distribution of Respondents by Age

Age intervals	Frequency	%
25-30	3	3
31-34	5	4
35-40	47	39
41-44	26	22
45-50	20	17
51-54	10	8
55-60	9	7
61 & above	0	0
Total	120	100

Source: Field survey (2014)

From the table above (Table 4.1), it can be observed that majority (39%) of the fish farmers falls within the age of 35-40years, followed by respondents within ages 41-45years with 22%. On the other hand, only a handful (3%) of the respondents belongs to the age bracket of 25-30years. This is in agreement with the observation of Banjo, Nosiru, Ayorinde and Odusina (2009) who stated that the highest population of 35-40years signifies the productive age which portends better future for fish production. From the above table, the result suggests that the farmers' falls within the economically active age (below 60years). With the current high rate of unemployment in the country, most young people have been reported to resort into fish farming. The figure below (Fig 4.1) clearly depicts the age distribution of fish farmers in this area.



Source: Field survey (2014)

Fig 4.1: Depicts Respondent Age Distribution

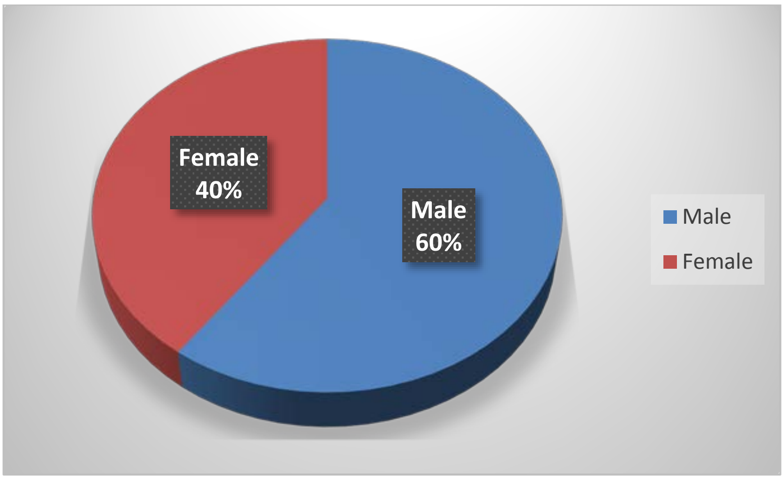
4.1.2 Sex Distribution of Fish Farmers

Table 4.2 Sex Distribution of Respondents

Gender	Frequency	%
Male	72	60
Female	48	40
Total	120	100

Source: Field survey (2014)

Table 4.2 above showed that from a total of 120 pisciculturist sampled in this area, majority (60%) were males while the remaining (40%) were females. This is consistent with earlier studies of Omolike, 2005; Ighere, 2005 and Banjo et. al. (2009), who noted that the dominance of males in fish farming enterprise conforms to the fact that fish farming is highly laborious and technically demanding. Also in concordance to this is the report of Agboola (2011) who stated that the higher number of male participation in fish farming indicated the extent of gender sensitivity on occupation like farming, which could be attributed to the fact that agricultural production is faced with a lot of risk and uncertainties and women are risk averse, so also is the result of drudgery that aquaculture business is involved in. Further below is a figure (Fig 4.2) which clearly depicts the distributions of respondents in this enterprise.



Source: Field survey (2014)

Fig 4.2: Depicts Sex Distribution of Respondents

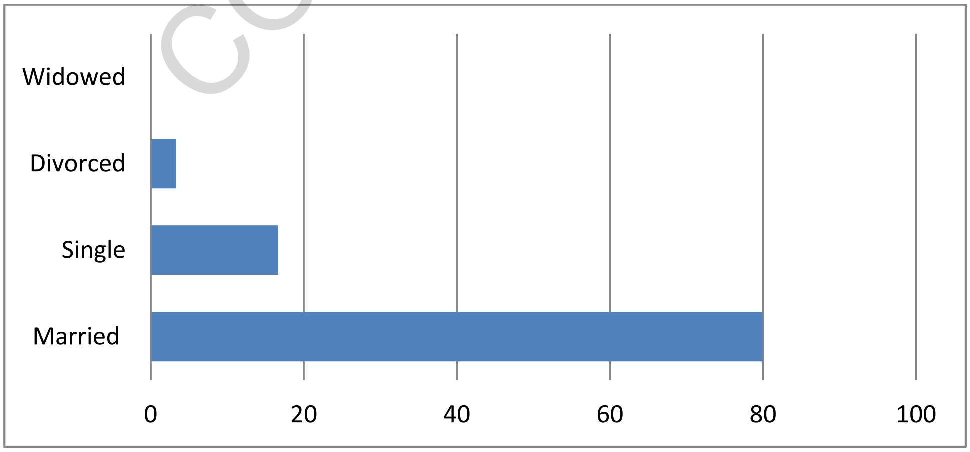
4.1.3 Marital Status of Respondents

Table 4.3 Distribution of Respondents by Marital Status

Marital distribution	Frequency	%
Married	96	80
Single	20	17
Divorced	4	3
Widowed	0	0
Total	120	100

Source: Field survey (2014)

From the above table 4.3, 80% of the respondents were married while only 17% were single and 3% divorced. This could be attributed to the western culture and tradition of this area where people are encouraged to marry at an early stage in life. The figure below (Fig 4.3) clearly depicts the distribution of respondents according to their marital status.



Source: Field survey (2014)

Figure 4.3: Depicts Marital Distribution of Respondents

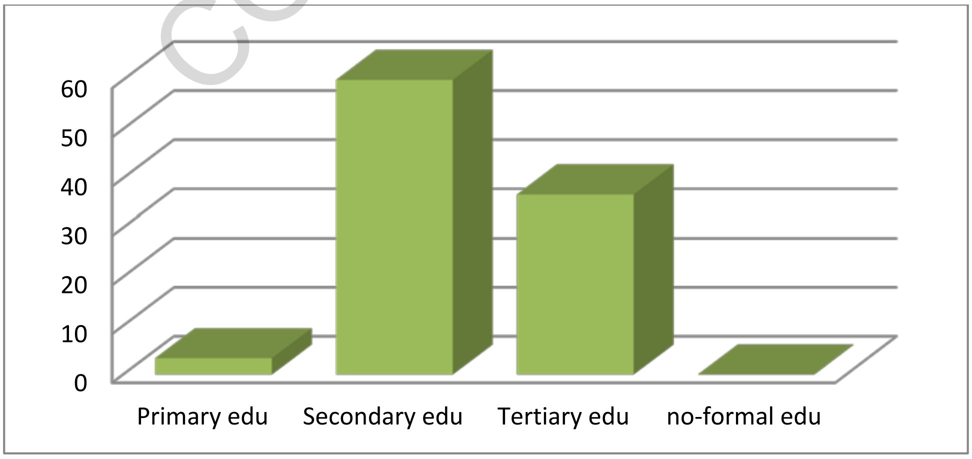
4.1.4 Educational status of respondents

Table 4.4 Educational status of respondents

Educational status	Frequency	%
Primary	4	3
Secondary	72	60
Tertiary	44	37
no-formal	0	0
Total	120	100

Source: Field survey (2014)

Education is an important factor influencing management and the adoption of any technology. The table above (Table 4.4) shows that the respondents were found to be distributed over a wide range of educational backgrounds with majority (60%) of the respondents possessing secondary education and 44 respondents (37%) were found to possess tertiary education with only very few (3%) respondents indicating to have only completed primary education. It was also noted that none of the respondent indicated not possessing any form of education. This can be adjudged from the fact fish farming requires a lot of technicalities which would at least require the fish farmer to be enlightened in order to understand the requirements of this livestock such as feed type, feeding rate, feed quality, fertilizer requirement/measurement, treatment and measurement of fish weight gain versus feed intake and so on. The result from the table above (Table 4.4) is in agreement with an earlier study by Yusuf, Ashiru and Adewuyi (2002) and Agboola (2011) which stated that this is an indication of high literacy level which may be required for effective management of fish farms. Also, the positive influence of education on farmers' acceptance of improved farm practices has been established by several studies (Onemolease et al, 2000; Tshiunza, Lemchi and Uloma, 2001). The figure below (figure 4.4) is a clearer picture of this illustration.



Source: Field survey (2014)

Fig 4.4: Depicts the Educational Status of Respondents

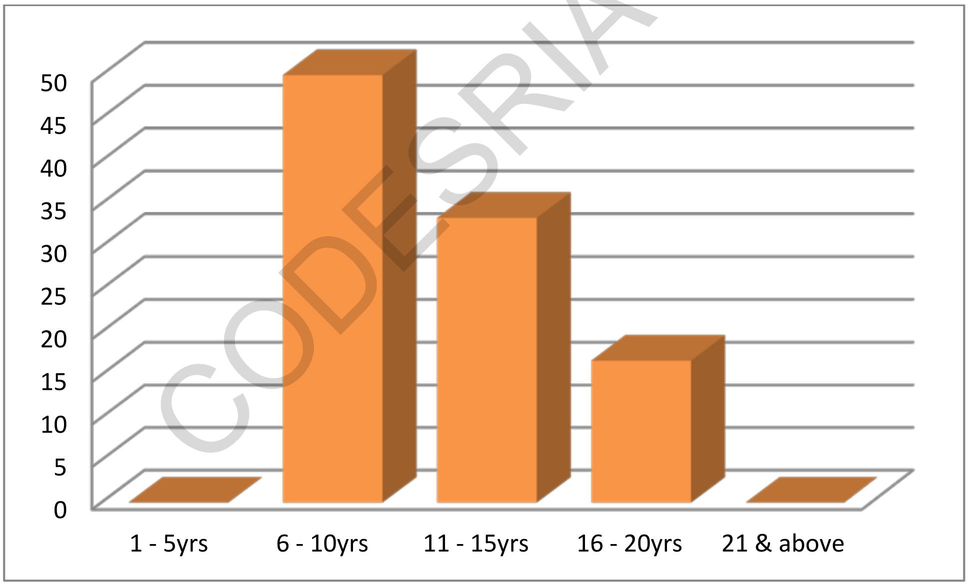
4.1.5 Farming Experience of Respondents

Table 4.5: Farming Experience of Respondents

Farming experience	Frequency	%
1 - 5yrs	0	0
6 - 10yrs	60	50
11 - 15yrs	40	33
16 - 20yrs	20	17
21 & above	0	0
total	120	100

Source: Field survey (2014)

Farming experience is an important aspect in fish farming and agriculture at large. In the table above (Table 4.5), it was observed that majority (50%) of the respondents had experience between 6 – 10years followed by 40 respondents who had their experience between 11-15years (33%) and the remaining respondents having theirs in the range of 16-20years (17%). An average experience age of 15years exists among the fish farmers in this area. This is in line with opinion of Onemolease, and Oriakhi (2011) who noted that experience is highly needed in the enterprise of fish farming. Further below is a figure (Fig 4.5) which clearly illustrate this discussion.



Source: Field survey (2014)

Figure 4. 5: Depicts Farming Experience of Respondents

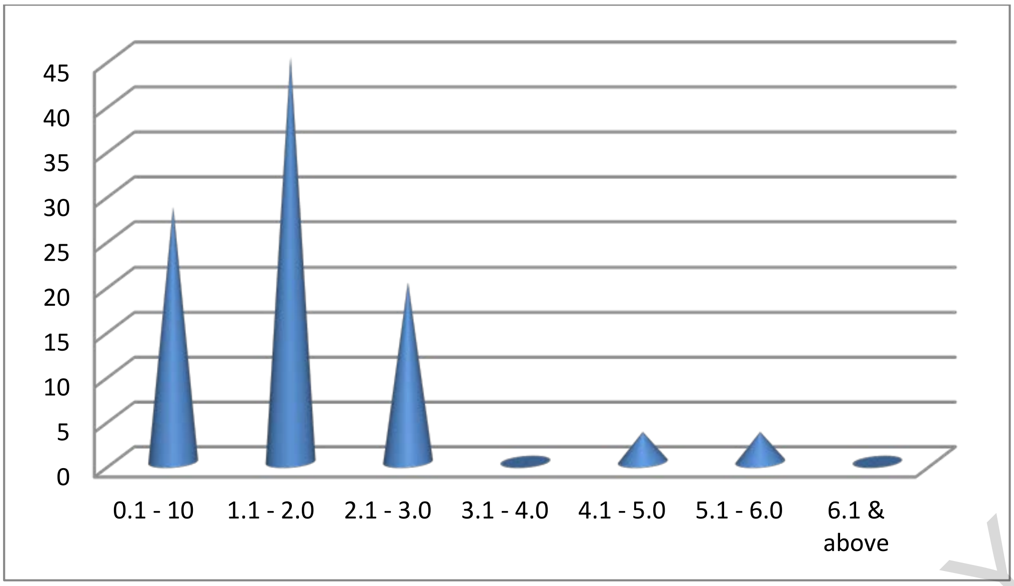
4.1.6 Farm Size

Table 4.6 Farm Size of Respondents

Farm Size (ha)	Frequency	%
0.1 – 1.0	34	29
1.1 - 2.0	54	45
2.1 - 3.0	24	20
3.1 - 4.0	0	0
4.1 - 5.0	4	3
5.1 - 6.0	4	3
6.1 & above	0	0
Total	120	100

Source: Field survey (2014)

Land is a fixed asset and a scarce one at that, which constitutes one of the major factors of production in farming and agriculture at large. The table above (Table 4.6) shows that majority of the fish farmers own a farm holding in the range of 1.1ha to 2.0ha (45%) while closely followed by farmers with holdings in the range of 0.1ha to 1.0ha (29%) and 2.1ha to 3.0ha (20%). Only few farmers (3%) indicated a farm holding in the range of 4.1ha to 5.0ha and 5.1ha to 6.0ha respectively. This is in line with the result obtained from the survey carried out in 1973/74 by the Federal Office of Statistics as reported by Olayide (1980), which noted that small-scale farms were classified to range between 0.1ha and 5.99ha and they constitute about 80.78% of all farm holdings, the medium scale farms range from 6.0 to 9.99ha and constituted about 13.59% of all farm holdings while large farms range from 10.0ha and above and constituted about 5.63% of all farm holdings. Furthermore, this also agrees with PIND (2011) who observed that a considerable large population of the fish farmers are small farmer holders and are fragmented despite the vast opportunities in this enterprise. Therefore, making it so difficult to harmonize the opportunities and integrate these farmers to work together. The implication of the above result is that most of the population in this fish farming enterprise is only operating solely and not as a team which makes development very hard to achieve. The figure (fig.4.6) below depicts clearly these illustrations.



Source: Field survey (2014)

Figure 4.6: Depicts farm size of respondents

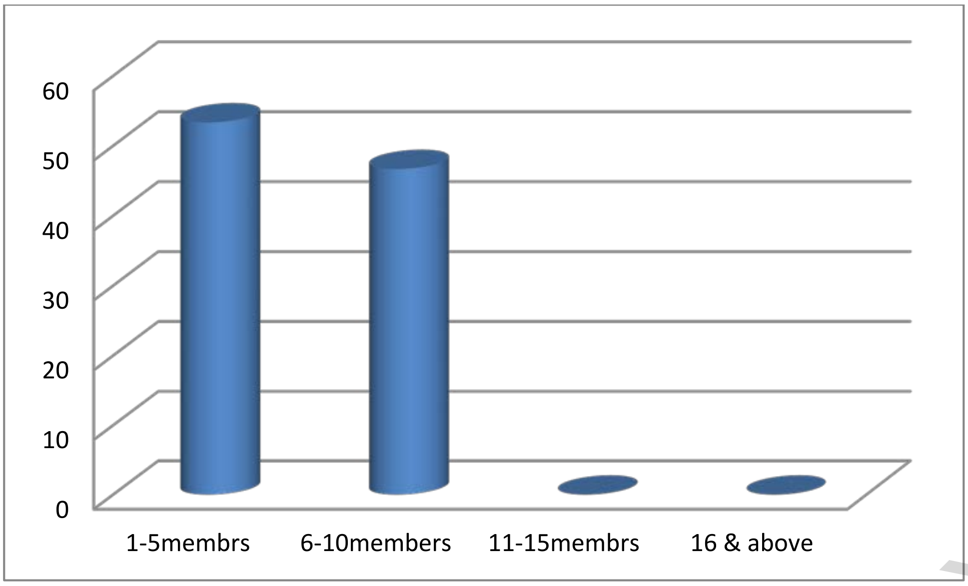
4.1.7 Household Size

Table 4.7 Distribution of Household Size of Respondents

Household Size	Frequency	%
1-5membrs	64	53
6-10members	56	47
11-15membrs	0	0
16 & above	0	0
Total	120	100

Source: Field survey (2014)

In most farm families, household size actually means more labour, this is why most African and developing countries household size tend to consist of an average number of 5 to 6 members. From the table above (Table 4.7), it is seen that the majority (53%) of the respondents possess between 1-5 household members closely (47%) followed by respondents with 6 to 10 household members. No respondent indicated more than 11 household members or above 16 household members. On the average, there exist an average household size of 6.5, which is in agreement with above stated observation as well as the observations of Onemolease et al., (2000; 2011) as they imply that pisciculture farmers have large household which is believed to constitute an important labour source for them. Figure 4.7 below depicts clearly this illustration.



Source: Field survey (2014)

Figure 4.7: Depicts Household Size of Respondents

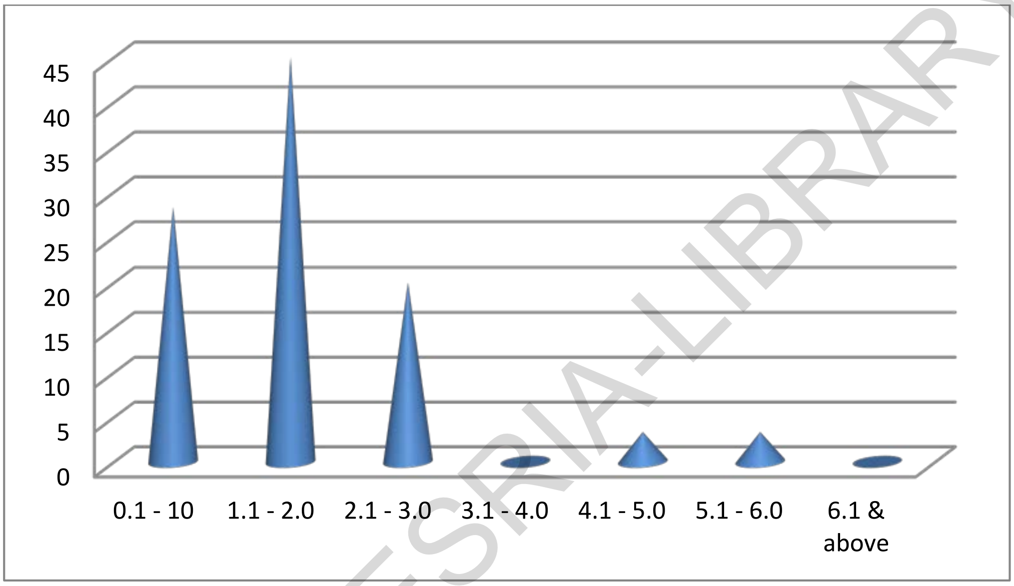
4.1.8 Distance of Farm to the Market (km)

Table 4.8: Frequency Distribution of Respondents According to Farm Distance

Farm Distance (Km)	Frequency	%
0.1 – 1.0	34	29
1.1 - 2.0	54	45
2.1 - 3.0	24	20
3.1 - 4.0	0	0
4.1 - 5.0	4	3
5.1 - 6.0	4	3
6.1 & above	0	0
Total	120	100

Source: Field survey (2014)

Farming distance is also a factor worth considering in terms of volume of production in fish farming and agriculture at large. This is due to the fact that a lot of factors must be considered before and after production of agricultural products such as market, demand of the product, competition, mode and type of transportation, access to the market and so on. Therefore, the table above (Table 4.8) showed that majority (45%) of the farmers live between a range of 1.1km to 2.0km away from the market while 29% of the respondents live between the range of 0.1km to 1.0km to the market and only 20% of the respondent claim to live between a range of 2.1km and 3.0km from the market. Only few (8%) respondent indicated living between 4.1km and 6.0km away from their point of sales. The implication of this result is that most farmers living very far apart from the point of sale might be discouraged from producing more due the fact that they will have to spend more to transport their produce to the point of sale, also the aspect of poor transportation means also needs consideration not to mention the poor mode of conveying this produce to the market. This is in agreement with the opinion of Ali, et al. (2010), as they observed that transportation of fry and fingerlings was a problem in the study area. Not only that the transportation system as a whole was unsatisfactory here; the mode of conveying the fries and fingerlings also leaves much to be desired. The prevailing fry transportation system is traditional as described by Saha and Chowdhury (1956), and results in lowering of vitality of the fry and resultant mortality. Ali et al (2010), further noted that transportation problems had been reportedly noted to cause about 20-30% mortality of fry. This eventually forces most fish farmers to sell at the farm gate therefore reducing any additional margin they could have gained. The figure below (Fig.4.8) depicts a clearer picture of this illustration.



Source: Field survey (2014)

Figure 4.8: Depicts respondents' farm distance to market (km)

4.2 Steps in Pisciculture Enterprise

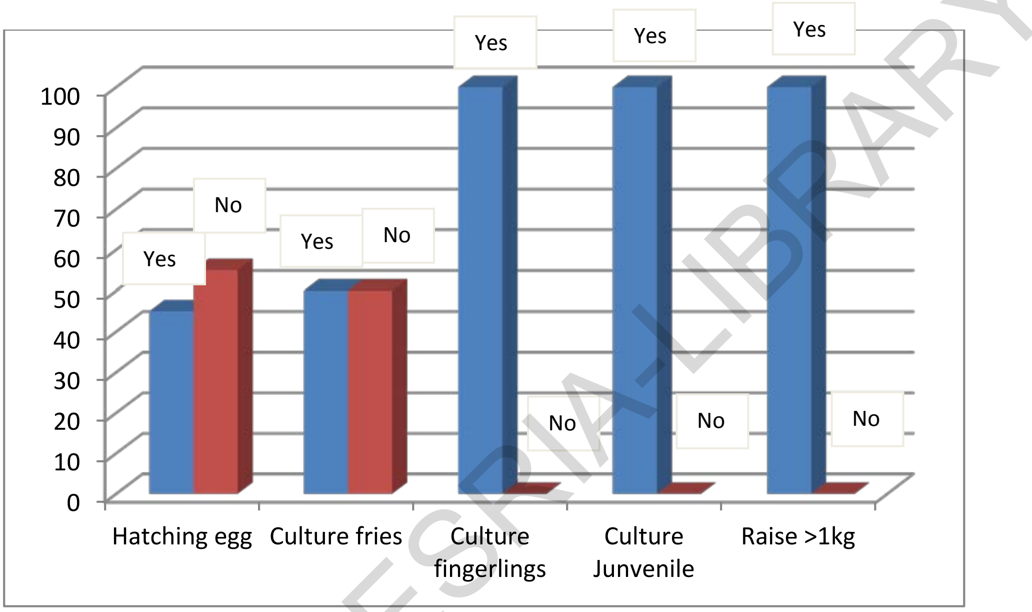
Table 4.9 Steps of respondents in pisciculture enterprise

Value Chain Steps	Yes	Yes (%)	No	No (%)
Hatching egg	54	45	66	55
Culture fries	60	50	60	50
Culture fingerlings	120	100	0	0
Culture Juvenile	120	100	0	0
Raise >1kg	120	100	0	0

Source: Field survey (2014)

The guiding principle in the selection of cultured fish species as well as what stage to begin and end culturing of fish species include: growth rate of the fish, duration of production, cost of production, short food chain of the species, good table quality as well as readily available market which is a function of their demand. From the table above (Table 4.9), it can be noted that all (100%) respondents sampled culture fish from fingerlings to the acceptable market size of (>1kg). Only a few (45%) respondents engage in hatching eggs while the remaining few respondents (50%) begin production from culturing fries on their farms. Some of the reasons indicated by most of the respondents for not hatching eggs and culturing fries ranges from lack of water, lack of technical-know-how, poor handling methods and poor management skills amongst other factors. They also indicated that most (50%) of them would rather buy fries from other hatchers and start their production from there, as they believed that other stages are safer, less demanding and requires little or no technicality to survive. This is in line with the observation of Ali, Rahman, Roy, Haque and Islam (2009) who stated that the fry nursery trade in Jessore region has been developed based on the increasing seed demand all over the country as well as having an ultimate goal of meeting the seed supply for pond fish culture all over the country, also to solve the employment problems and improve socio economic condition of fish fry trade community. From the aforementioned statement, it is obvious that although fish fry culture is highly profitable, it must also be acknowledged here that it is also laborious and technically demanding, which dissuade unskilled fish farmers from delving into the business. The consequence for this is that most fish farmers will continually depend on the very few fish fry farmers who can only serve a very slim population in the larger population of fish farmers in the area. In line with Adewumi and Olaleye (2010), who quoted the *Federal Department of Fisheries statistical report of 2007*, stated that the minimum fish fingerling requirement in Nigeria is 4.3 billion while the total fingerling supply from all sources is 55.8 million, which is not enough to meet the fish farmers' demand. This result therefore leads to scarcity of fish fry, inflated or unstable prices for the product as well as unhealthy competition for the products amongst fish farmers who desperately need the product for their own production. Adewumi and Olaleye (2010) therefore concluded that 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 fish.

On the other hand, the table (Table 4.9) further showed that all (100%) respondents participate in other stages of fish farming which includes culturing fingerlings, juveniles as well as culturing to market sizes (depending on the consumer preferences). This is in agreement with the observations of Oguoma, Ohajianya, and Nwosu (2010) and Agboola (2011) who stated that fish farming is a highly profitable venture as well as the level of profit did not significantly differ between the different areas. The is a good sign as many fish farmers get involve in fish production although many set their sight on profit alone, but there is more to the contribution of fish farming in this area as it contributes immensely to combating food insecurity, provide financial insurance and stability for fish farmers while other people involved in the chain of this enterprise get income via employment during the process of production. Furthermore, figure 4.9 below clearly depicts the standings of fish farmers sampled on the particular stages they involve themselves within their enterprise. On a final note, this improvement in local production of fish in the country shows a good sign that the industry is moving away from subsistence level of production and now moving into commercial level, albeit small scale, production that is mostly prevalent in the country.



Source: Field survey (2014)

Figure 4.9: Depicts Steps in Pisciculture Enterprises

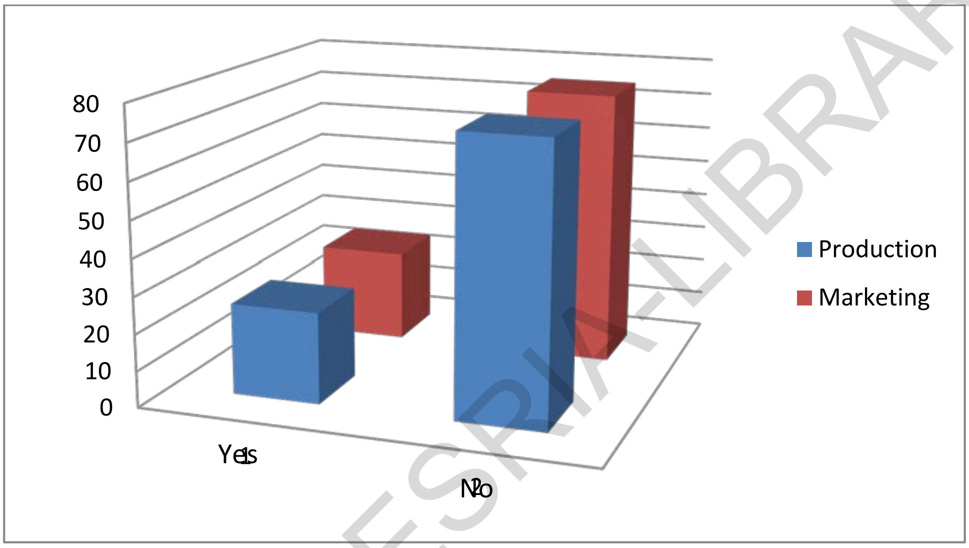
4.2.1 Value Chain in Pisciculture Enterprise

Table 4.10: Distribution of respondents participating in value chain

Value addition	Yes (%)	No (%)	Frequency (Yes)	Frequency (No)
Production	25	75	30	90
Marketing	25	75	30	90

Source: Field survey (2014)

From the table above (Table 4.10), it indicated that majority (75%) of the respondents do not inculcate either of production or marketing value chain in their fish farming enterprise while only few (25%) do. Some of the fish farmers who do not practice value chain indicated some reasons such as lack of skills, time constraints and cost of labour amongst other things as their major reasons for not inculcating value chain in their enterprise. The figure below (Fig 11) further depicts the categorization of respondents according to value chain inculcation in their fish farming enterprise. This result has a major effect on improvement of farmers average income, if farmers would continually resist the obvious importance of inculcating value chain in their business, the farmers will definitely continually and persistently loose a lot of their margin to marketers and food processors who buys at the farm gate at ridiculous prices that can barely cover the production cost of these fish farmers. Not only is profit been lost, extra jobs will also be lost along the line and in addition to these losses, the fish products coming from the farmers will lack quality and barely meet the demands of numerous consumers in this area and beyond. The figure below (Fig 4.10) further depicts a clearer picture on the categories of fish farmers that inculcate value chain in their enterprise and those that do not.



Source: Field survey (2014)

Figure 4.10: Depicts respondents' status on value chain

4.2.2 Production Value Chain in Pisciculture Enterprise

Table 4.11 Type of Production value added by respondents in Pisciculture Enterprise

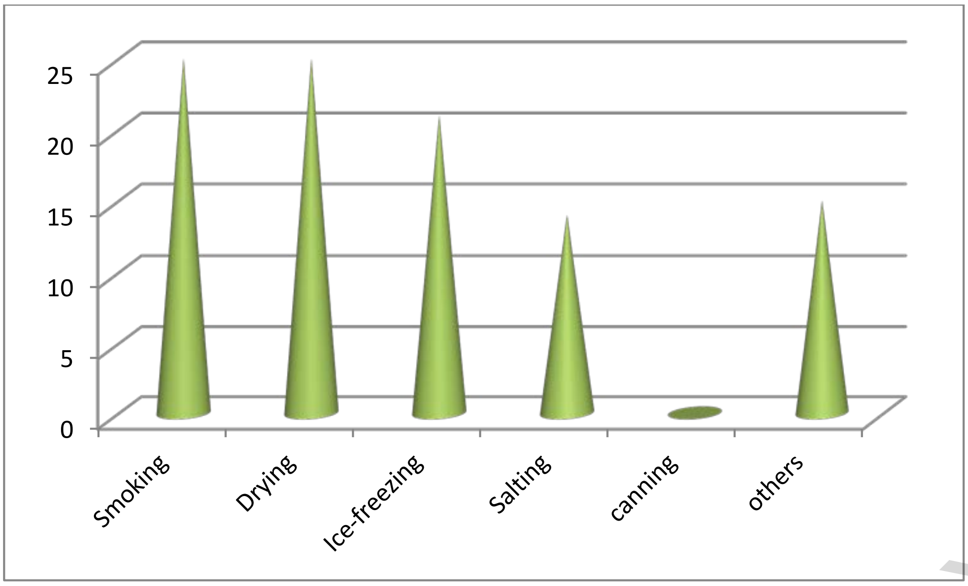
Production Value chain	%	Frequency
Smoking	25	19
Drying	25	19
Ice-freezing	21	16
Salting	14	11
Canning	0	0
Others	15	11
Total	**100**	**76***

**Multiple Responses
Source: Field survey (2014)

Production value chain in pisciculture ranges from smoking to fish barbeque, but various farmers have different reasons for choosing a particular value chain. Market factors, costs of production and consumer preference are top of the reasons producers engage in various forms of value chain. Earlier in table 4.10, it was indicated that only 30 (25%) respondents inculcated both production and marketing value chain in their fish farming enterprise while the majority (75%) of the respondents do not. Therefore, the table above (Table 4.11) indicated that out of the total 30 respondents that inculcate production value chain to their fish farming enterprise, majority of the production value chain inculcated in pisciculture still remains smoking (25%), drying (25%), ice-freezing (21%) and closely followed by salting (14%) but other noted activities such as fish pepper soup, fish barbeque amongst others as alternative ways to add value to their fish products which mainly depends on the consumer demand.

This is in line with the observation of PIND (2011) when it stated that domestic smoked fish demand in Nigeria is estimated to be as large as the fresh fish market, and increasing in markets far away from the coast. This is due to the fact that marketing/trading and smoking fish require low investment and basic technology, both attract large numbers of participants. Also, the huge market share controlled by both smoked fish and ice-freeze fish has led to their continuous attraction of more investors into this venture amongst other types of fish processing methods.

The result shown therefore agrees with the USAID report in the Cambodia MSME 2/BEE project (2010) which observed that processed products are still majorly limited to the traditional smoked fish, dried fish, Prahoc and Pa'orc. There is therefore potential in this value chain to develop markets for fillet and breaded fish products, which may be supplied by medium and large scale producers especially in this area. What this means is that value chain is yet to be widely accepted by majority of the fish farmers which has a negative influence on the quality of fish products available to the consumers as well as negatively influencing the amount of income and other margins that this enterprise brings along with it. Figure 12 below further depicts a clearer picture of the status of fish farmers on value chain inculcation in their enterprise in this area.



Source: Field survey (2014)

Figure 4.11: Depicts type of Production Value Chain Respondents Adopts in their Enterprise

4.2.3 Marketing Value Chain in Pisciculture Enterprise

Table 4.12 Type of market value added by respondents in Pisciculture Enterprise

Marketing Value chain	%	Frequency
Transportation	0	0
Packaging	31	20
Advertisement	23	15
Contract sales	46	30
Others	0	0
Total	100	65*

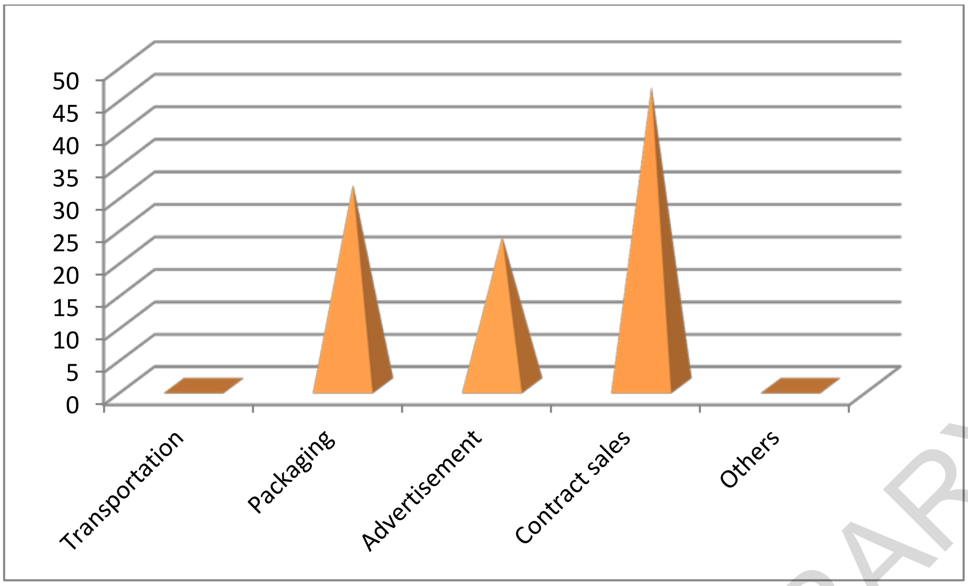
**Multiple response
Source: Field survey (2014)

As table 4.10 indicated above, only 30 (25%) respondents inculcated both production and marketing value chain in their fish farming enterprise while the majority (75%) of the respondents do not. Therefore, the table above (Table 4.12) indicated that out of the total 30 respondents that inculcate marketing value chain to their fish farming enterprise, majority of the marketing value chain inculcated in pisciculture still remains contract sale (41%), packaging (31%) and closely followed by advertisement (23%). Worthy of note is that none of the respondents indicate utilizing other marketing pattern such as transportation or any other means outside the abovementioned methods. This is due to major concerns involved with transportation in terms of mode of transportation of fries and fingerlings which mostly contributes to about 20-30% mortality if the process is not properly carried out. Other issue with transportation is the bad road that is practically the same problem shared with other agricultural products in this area. As rightly put by Ali, et al. (2010), they observed that transportation of fry and fingerlings was a problem in the study area. Not only that the transportation system as a whole was unsatisfactory here; the mode of conveying the fries and fingerlings also leaves much to be desired. The prevailing fry transportation system is traditional as described by Saha and Chowdhury (1956), and results in lowering of vitality of the fry and resultant mortality. Ali et al (2010), further noted that transportation problems had been reportedly noted to cause about 20-30% mortality of fry.

Furthermore, the result from table 4.12 therefore agrees with PIND report (2011), which stated that the prevailing marketing dynamics have not helped the fish farmers' either. This is because small-scale production yields are low, in many parts of the country, small-scale farmers have been unable to assemble sufficient volume to attract serious, stable buyers. Instead, small-scale fish-farmers generally rely on a multitude of roving wholesalers and traders, who are opportunistic and purchase with little regard for quality or long-term partnership. PIND (2011) further noted that given that marketing/trading and smoking fish require low investment and basic technology, both attract large numbers of participants. The atomistic nature of the sector and fragmented marketing carried out by a mass of mostly small to medium traders/wholesalers has challenged the sector. Challenges resulting from the structure of the industry involve not only the inability to consolidate sufficient volume, but also erosion of effective marketing strategies and prevention of the development of a common set of quality standards since everyone is off doing their own thing, without coordination, strategy or vision for the future. This has discouraged serious investment to grow the sector.

The prevailing marketing channels though short is fragmented, for both fresh and smoked fish, and its fragmented nature has also undermined sector growth by contributing to increased risk and uncertainty, whether perceived or real, for the subsistence producers. Such that small-scale producers, despite strong consumer demand for fish, remain conservative and unwilling to invest and grow their production possibilities. Consequently, a large percentage of the participants remain small and semi-subsistent or if commercial, they remain stagnant. The fragmented marketing channels are another serious constraint inhibiting the aquaculture sector.

This is therefore in support of the USAID report in the Cambodia MSME 2/BEE project (2010), which stated that there exist potential in pisciculture value chain to develop markets for fillet and breaded fish products, which may be supplied by medium and large scale producers especially in this area. What this means is that value chain is yet to be widely accepted by majority of the fish farmers which has a negative influence on the quality of fish products available to the consumers as well as negatively influencing the amount of income and other margins that this enterprise brings along with it. Figure 4.12 below further depicts a clearer picture of the status of fish farmers on value chain inculcation in their enterprise in this area.



Source: Field survey (2014)

Fig 4.12: Depicts type of Marketing Value Chain Respondents adopts in their Enterprise

4.3 Factor-Product Relationship in value chain pisciculture

Table 4.13: Summary Statistics of Output and Explanatory Variables

Description	Unit	Mean value	Std. Deviation	Max. value	Min. Value
Output	Kg	14,000	4,792.08	20,000.00	6,000.00
Labour	Man-days	748.33	31,264.32	1200	500
Land	Hectares	1.97	1.15	6.00	0.50
Fertilizers	Naira	4,916.67	2,875.81	15,000.00	1,250.00
Feed	Naira	1,618,666.67	1,024,830.33	5,000,000.00	400,000.00
Household size	Number	5.12	1.90	9.0	2.0
Farming Experience	Years	11.7	4.18	20.0	6.0
Education	Years	14.4	3.12	20.0	6.0
Age	Years	42.5	7.21	59.0	30.0
Depreciation cost	Naira	59,000	34,509.77	180,000.00	15,000.00

Source: Field survey (2014)

The summary statistics of the variables used for the stochastic frontier production function is shown in the table 4.13 above. Average output per farmer per production cycle is 14,000kg while the analysis of inputs revealed an average farm size of 1.97ha per farmer, an indication that the study covered small-scale family-managed farm units. The average labour used of 748.33 man-days per hectare per cycle shows that fish farmers still depend heavily on human labour to do most of the farm operations. With relatively available cheap labour in Nigeria, extensive use of human labour for farming has been shown to make fish farming, especially in the urban areas, profitable (as cited in Enete and Okon 2008). The summary further revealed that fish farmers were experienced (11.7years) and educated with about 14.4years of schooling. Both experience and education could equip the farmers with relevant skills for enhanced farm management and hence productivity. The farmers were young as indicated by a mean age of 42.5 years. The maximum likelihood (ML) estimates of the parameters of the stochastic production frontier were obtained using the sigma squared (0.0058) is statistically significant and different from zero at $\alpha = 0.01$. This indicates a good fit and the correctness of the distributional form assumed for the composite error term. The variance ratio, known as gamma (γ) = 9.99, indicates that systematic influences that are unexplained by the production function are the dominant sources of random error. This means that 85.7% of the variation in output among the fish farmers was due to disparities in technical efficiency. The presence of one sided error components in the specified model is thus confirmed, implying that ordinary least square estimations would have provided an inadequate representation of the data. The generalized likelihood ratio test ($\lambda^2 = 0.6342$) is significant. The result of the judgment statistics does confirm that the stochastic frontier model appears to be a significant improvement over an average (OLS) production function.

The estimated ML coefficients of all the variables in the production function were all positive and conformed with the a priori expectation, indicating that the estimated production function is an increasing function. The coefficient of land size was positive and significant with a production elasticity value of 0.158. Therefore, a 10% increment in land size will increase output of fish by 1.58%. This means that there is scope for increasing output by expanding farmland. The coefficient of labour was positive and significant at a 5% level of probability, showing the importance of labour in fish production in the area. This might be because all agronomic practices involved in fish production are done manually, thus confirming the labour intensity of the livestock farming. Several other studies (Umoh, 2006; Okezie and Okoye, 2006; Udoh & Etim, 2008 and Okon & Enete, 2010) also had similar findings.

The production elasticity value of output with respect to quantity of fertilizer applied was 0.4296. The coefficient was statistically significant at 5% probability level. This means that if the quantity of fertilizer was increased by 10%, output will be improved by a margin of 4.296%. The aquatic nature of fish should make its output heavily dependent on water fertility, and under commercialized fish farming, water fertility maintenance is very crucial for sustenance. The coefficient of organic fertilizer was positive and significant at a 1% level of probability. The production elasticity of manure (0.4543) shows that if the quantity of manure was increased by 10%, output will be increased by 4.5%. The farmers usually augment their inorganic fertilizer application with that of poultry manure, which is usually cheaper and environmentally friendlier.

Table 4.14: Maximum Likelihood Estimation of the Cobb-Stochastic Production function

Production factors	Parameters	Coefficient	Standard Error	T-value
Constant term	β_0	3.2121	0.3094	0.1038
Pond size	β_1	-0.0222	-0.5144	-0.4308
Labour	β_2	0.2756	0.1019	2.7049**
Feed	β_3	-0.0031	0.0260	-0.1197
Fertilizer	β_4	0.0430	0.0097	4.4424***
Stocking capacity	β_5	0.3990	0.0987	4.0419***
Depreciation value	β_6	0.1947	0.0864	2.2522**
Efficiency factors				
Constant term	δ_0	-0.3489	0.9763	-0.3573
Years of schooling	δ_1	-0.0527	0.0778	-0.6774
Age of fish pond	δ_2	-0.1685	0.1464	-1.1510
Age of farmer	δ_3	-0.1475	0.2898	-0.5090
Farming experience	δ_4	0.0180	0.0612	0.2898
Household size	δ_5	0.3018	0.2142	1.4084
Membership cooperative	δ_6	0.1217	0.0582	2.0928**
Credit access	δ_7	-0.0246	0.0528	-0.4655
Sex	δ_8	-0.0246	0.0528	-0.4655**
Extension contacts	δ_9	0.1923	0.1360	1.4142
Variance parameters				
Sigma squared	$\sigma^2 = \sigma^2 v + \sigma^2 v$	0.2253		
Gamma	$\Upsilon = \sigma^2 v / \sigma^2$	9.9999		
Log likelihood function		63.4199		
LR test		34.1319		
No. of observations	120			

Source: Computer Printout of FRONTIER 4.1c, using field survey data, 2013/14
Note: ***=significant at 1%, **=significant at 5% level of probability

From table 4.14 above, the sigma squared (0.225) is statistically significant and different from zero at α = 0.01. This indicates a good fit and the correctness of the distributional form assumed for the composite error term. The variance ratio, known as gamma (γ) = 9.99, indicates that systematic influences that are unexplained by the production function are the dominant sources of random error. This means that 99.9% of the variation in output among the fish farmers was due to disparities in technical efficiency. The presence of one sided error components in the specified model is thus confirmed, implying that ordinary least square estimations would have provided an inadequate representation of the data. The generalized likelihood ratio test (λ^2 = 0.4765) is significant. The result of the judgment statistics does confirm that the stochastic frontier model appears to be a significant improvement over an average (OLS) production function.

The estimated ML coefficients of all the variables in the production function were all positive except pond size and feed cost which conformed to the *apriori* expectation, indicating that the estimated production function is an increasing function. The coefficient of stocking capacity was positive and significant with a production elasticity value of 0.3990. Therefore, a 10% increment in stocking capacity will increase output of fish by 3.99%. This means that there is scope for increasing output by expanding farmland. The coefficient of labour was positive and significant at a 5% level of probability, showing the importance of labour in fish production in the area. This might be because all agronomic practices involved in fish production are done manually with hand tools, thus confirming the labour intensity of livestock. Several other studies (Umoh, 2006; Okezie and Okoye, 2006; Udoh and Etim, 2008; and Okon, Enete and Bassey, 2010) also had similar findings.

The production elasticity value of output with respect to quantity of fertilizer applied was 0.4296. The coefficient was statistically significant at 5% probability level. This means that if the quantity of fertilizer was increased by 10%, output will be improved by a margin of 4.296%. The development nature of fish should make its output heavily dependent on fertility of water, and under intensive system of fish farming, water fertility and maintenance is very crucial for sustenance. The coefficient of depreciation of fixed asset used was positive and significant at a 5% level of probability. The production elasticity of depreciation of fixed asset (0.1947) shows that if the fixed asset in increased by 10%, output will be increased by 1.95%. This could translate to a higher density of fish produced per pond and perhaps a higher output. This finding is similar to those of Ajibefun, Battese, and Daramola (2002); Udoh (2006) and Okon and Enete (2010).

In the efficiency model as shown in the table 4.2 above, educational level, household size, and farming experience were all positive but not statistically significant. The age of the farmer had a negative coefficient but was also not significant. Pond size was, however, negative and significant in the efficiency model. This suggests that smaller ponds are more efficient than larger ponds. Considering the small scale nature of fish farming in the area, this result further supports Schultz's (1964) hypothesis that small farm households in developing countries are "poor but efficient". Also, Mkhabela (2005), in comparing the efficiency level between small and large scale farmers, noted that small scale farmers (those who have below 1ha of vegetable farm) were more efficient than large scale farmers (those who have above 1ha of vegetable farm).

Table 4.15: Frequency distribution of Technical Efficiency of fish farmers

Efficiency level	Frequency	Percentage
0.50 - 0.59	1	1.2
0.60 – 0.69	7	8.4
0.70 – 0.79	8	9.6
0.80 – 0.89	33	39.6
0.90 – 0.99	69	44.2
Total	**120**	**100**
Maximum value = 0.97		
Minimum value = 0.57		
Mean efficiency = 0.88		

Source: Field survey (2014)

Table 4.15 above shows the Frequency of distribution of technical efficiency of fish farmers. There is a variation in the level of efficiency among the farmers, ranging from 0.50- 0.99% with a mean efficiency level of 0.88. However, 93.4% of the farmers had a technical efficiency of 70% and above. This implies that, on the average, farmers are able to obtain 88% of potential output from a given mix of production inputs. In the short run, there is scope for increasing fish output by 12% through the adoption of the techniques and technology employed by the best fish farmers. The implications of the results is that an average farmer could realize a 5.78% cost saving {i.e. 1-(88.0/93.4)*100} to achieve the technical efficiency level of its most efficient counterpart. A similar calculation on the most technically inefficient farmer reveal cost savings of 39.08% {i.e.1-(56.9/93.4)*100}.

4.4 Cost and Returns Associated With Value Chain Pisciculture Enterprise

Table 4.16: Cost and Returns Associated with Value Chain Pisciculture Enterprise

List of Items	Without Value Chain	With Value Chain
Variable Cost (₦)		
Land	309,269.66	295,161.29
Labour	112,331.46	112,016.13
Feed	1,603,595.51	1,661,935.48
Medication	160,359.55	166,193.55
Fingerlings	103,446.07	104158.0645
Maintenance	40,089.89	41,548.39
Fertilizer	4,916.67	4,919.36
Transportation	0	144,419.36
Storage	0	598,322.58
Advertisement	0	3,661.23
Smoking	0	53,951.61
Salting	0	60,425.81
Drying	0	53,951.61
Ice-Freezing	0	120,851.61
Barbeque/pepper soup	0	431,612.90
Total Variable Cost	**2,457,193.00**	**3,853,128.97**
Fixed Cost (₦)		
Depreciation	58,988.76	59,032.26
Tax (20%)	1,941,123.60	2,661,612.90
Total Fixed Cost	**2,000,112.36**	**2,720,645.16**
Total Cost (TVC + TFC)	**₦4,334,120.225**	**₦6,573,774.13**
Gross Revenue (₦)	**₦9,705,617.978**	**₦13,308,064.52**
Net Profit (₦) (GR – TC)	**₦5,371,497.753**	**₦6,734,290.39**
Return on Investment (ROI)	**2.2**	**2.0**

Source: Field survey (2014)

From the table 4.16, there exist two categories of fish farmers (those who inculcate value chain in their enterprise and those who do not). From the table above, it can be deduced that fish farmers who do not inculcate value chain in their enterprise have a total cost of ₦4,334,120.225 per production session per farmer and a total revenue of ₦9,705,617.978 during the same session. This gave rise to a net profit ₦5,371,497.753 per production session per farmer and also an average return on investment of approximately 2.2 for these sects of fish farmers. On the other hand, the table 4.16 above went further to depict a total cost of production for fish farmers that inculcate value chain into their enterprise as ₦6,573,774.13 and also a total revenue of ₦13,308,064.52 per production session per farmer resulting into a gross profit of ₦6,734,290.39 per fish farmer per production session, which definitely means an average return on investment of 2.0. Although this result shows fish production to be profitable in the state, which also agrees with Oguoma, Ohajianya & Nwosu (2010) who noted that fish farming is a profitable venture in Imo state Nigeria. This result further suggest that farmers that inculcated value chain in their enterprise made far more profit than those fish farmers who do not in Lagos state, Nigeria.

Therefore, from the above table (Table 4.4.1), it can be observed that the difference in average profit margin realized per fish farmer in this area boils down to the fact that very few (25%) fish farmers inculcated value chain into their enterprise while the remaining majority (75%) do not. As a result, the former records more margins than their counterpart who do not. Some of the fish farmers who do not practice value chain indicated some reasons such as lack of skills, time constraints and cost of labour amongst other things as their major reasons for inculcating value chain in their enterprise. The obvious issue here is the fact that most of the fish farmers that do not inculcate value chain to their enterprise are already aware of the level of value they lose in not doing so. The formulas used to arrive at the answers shown in table 4.16 above are shown below.

NFI = GR – TC

Where: NFI = Net Farm Income

Average Gross Revenue (without value chain)/ha (₦) = ₦9,705,617.98

Total Cost (without value chain)/ha (₦) = ₦4,334,120.23

Therefore, Net Farm Income (NFI) of pisciculture enterprise without value chain will be:

NFI = ₦9,705,617.978 - ₦4,334,120.23 = ₦5,371,497.753

On the other hand, Net Farm Income (NFI) of pisciculture enterprise with value chain will be:

NFI = GR – TC

Average Gross Revenue (with value chain) (₦) = ₦13,308,064.52

Total Cost (with value chain) (#) = ₦6,573,774.13

Therefore, Net Farm Income (NFI) of fish farm operations with value chain will be:

NFI = ₦13,308,064.52 - ₦6,573,774.13 = ₦6,734,290.39

4.4.1 Return on Investment (ROI)

Return on investment therefore = Revenue / Cost

For Fish farmers that do not add value to their enterprise, Return on investment is therefore

ROI = ₦(9,705,617.978 ÷ 4,334,120.225)

= 2.236

Approximately Return on Investment (without Value chain) = 2.2

While, Return on investment with value chain is therefore, ROI = ₦(13,308,064.52 ÷ 6,573,774.13)

= 2.024417671

Approximately Return on Investment (with value chain) = 2.0

4.5 Value Chain Analysis

Table 4.17: Breakdown of values derived from each steps in fish farming

`Activities	Hatching of eggs	Hatchery – fries stage	Fries – Fingerlings stage	Fingerlings – Post fingerlings stage	Post fingerlings – Juvenile Stage	Juvenile – Market size (>1kg)
Duration in weeks	1week	2weeks	4weeks	4weeks	4weeks	4weeks
Quantity. raised	7.00	14,000.00	14,000.00	14,000.00	14,000.00	14,000.00
Unit cost of fish raised (₦)	2,000	15	30	50	100	350
Cost of fish raised (₦)	14,000.00	210,000.00	420,000.00	700,000.00	1,400,000.00	4,900,000.00
Cost of Feed (₦)	80,933.33	161,866.66	323,733.32	323,733.32	323,733.32	323,733.32
Cost of Labour (₦)	3,740.00	7,480.00	14,960.00	14,960.00	14,960.00	14,960.00
Cost of land used(₦)	29,500.00	59,000.00	118,000.00	118,000.00	118,000.00	118,000.00
Cost of maintenance (₦)	2,023.33	4,046.66	8,093.32	8,093.32	8,093.32	8,093.32
Cost of fertilizer (₦)	245.83	491.66	983.32	983.32	983.32	983.32
Cost of medication (₦)	8,093.33	16,186.66	32,373.32	32,373.32	32,373.32	32,373.32
Cost of processing (₦)	-	-	-	-	-	36,039.68
Cost of storage (₦)	-	-	-	-	-	7,728.33
Cost of transportation (₦)	-	-	-	-	-	1,865.42
Quantity Sold	14,000.00	14,000.00	14,000.00	14,000.00	14,000.00	14,000.00
Unit Selling Price (₦)	15	30	50	100	350	500
Revenue from Sales (₦)	**210,000.00**	**420,000.00**	**1,400,000.00**	**1,400,000.00**	**4,900,000.00**	**7,000,000.00**
Total Cost (₦)	**138,542.82**	**403,071.64**	**932,143.28**	**1,212,143.28**	**1,912,143.28**	**5,457,776.71**
Net profit (₦)	**71,457.18**	**16,928.36**	**467,856.72**	**187,856.72**	**2,987,856.72**	**1,542,223.29**

Source: field Survey, 2014

From the above (Table 4.17), it can be observed a breakdown of values as derived from every steps in pisiciculture enterprise in this area. The above table showed that hatching of eggs requires only one week and it generates an average profit of ₦71,457.18 to the farmers while culturing of fries only generates on the average after two weeks a net profit of N16,928.36, while on the other hand, culturing of fingerlings requires a minimum of four weeks in order to generate an average profit of ₦467,856.72. Post-fingerlings culturing rakes in an average profit of ₦187,856.72 after four weeks while juvenile culture gives an average profit of ₦2,987,856.72 after four weeks while raising fish to market size which takes another four weeks produces on the average a profit of ₦1,542,223.29. It can be deduced that the highest profit in the chain of pisciculture enterprise remains culturing of juvenile and raising to market size respectively. It can therefore be suggested that fish farmers should avoid culturing of fries rather, should begin their production from fingerlings culture at least if they want to record better margins.

4.6 Constraints

4.6.1 Constraints Facing Pisciculture Enterprise

Table 4.18 Constraints Facing Pisciculture Enterprise

Constraints	Strongly Agree (SA)	Agree (A)	Disagree (D)	Strongly Disagree (SD)	Mean
Poor Hatching techniques /skill	80 (320)	20 (60)	8 (16)	12 (12)	3.4 (408)
lack of supply of fry/fingerlings	52 (208)	44 (132)	12 (24)	12 (12)	3.1 (376)
high cost of feeds	96 (384)	22 (66)	2 (4)	-	3.8 (454)
lack of water supply	60 (240)	52 (156)	4 (8)	4 (4)	3.4 (408)
lack of capital/finance	84 (336)	24 (72)	6 (12)	6 (6)	3.6 (426)
Disease and pest	60 (240)	48 (144)	8 (16)	4 (4)	3.4 (404)
Lack of organized market	60 (240)	40 (120)	8 (16)	12 (12)	3.2 (388)
Poor Transportation	44 (176)	68 (204)	4 (8)	4 (4)	3.3 (392)
Poor storage facilities	52 (208)	44 (132)	8 (16)	16 (16)	3.1 (372)
Poor market information	56 (224)	40 (120)	14 (28)	10 (10)	3.2 (382)
High cost of inputs	84 (336)	16 (48)	12 (24)	8 (1)	3.4 (409)
Others, specify	-	-	-	-	-

Source: Field survey (2014)

From the table above (Table 4.18), it was observed that all the constraints identified in this enterprise were accepted using the 4-point Likert scaling, as most of the constraints had above a mean score of 2.5. For the case of this study, major constraints will be identified in order to proffer long lasting solutions to them. It was observed by the entire 120 respondents in a multiple response scenario that cost of feed ranks (3.8) highest on the Likert 4-point rating scale while closely followed by lack of capital/finance (3.6), high cost of inputs (3.4), poor hatching techniques (3.4), pest and diseases (3.4) and lack of water supply (3.4) respectively topped the list major constraints facing fish farming enterprise in this area amongst other constraints identified. This is in agreement with the observations of Adewumi and Olaleye (2010), Agboola (2011), Onemolease, and Oriakhi (2011); the Foundation for Partnership Initiatives in the Niger Delta (PIND) (2011) and finally, Yela, et al., (2011), as they rightly noted that the inability of the aquaculture sector to exploit growth opportunities rests on numerous constraints that hold back the fish sector, nationally and in the other areas as well. Lack of quality, cost-effective fish feed and shortage of quality, fast-growing fingerlings are two key factors that are imposing the biggest brake on the sector. The combined cost of feed and fingerlings contributes to as much as 65% of the cost of production. High cost of available inputs has served as a disincentive to aspiring small-scale producers, dissuading many from creating a stable demand for the inputs. On the other hand, high costs of inputs have also resulted in high priced products, which have restrained the sector's growth opportunities despite a burgeoning demand for fish.

Further effects of high cost of inputs in fish farming as rightly pointed forward by PIND (2011) has led to a continuous increase in the imports of frozen fish by almost 20% per annum to meet demand at a price consumers seem willing to pay; while domestic farmed fresh fish on the other hand are retailed at prices as much as 100% to 120% higher than imported frozen fish, while domestic capture fish are priced far higher, by almost 325%. Consequently, import of frozen fish is nearly as large as domestic production, and rising. Industry experts predict that imports will continue to rise, particularly since domestic production appears to be lagging. What this result means is that if these constraints are not properly tackled, fish farming will continually lag behind imported fish despite the improvement recorded in the past baring in mind our vast potential to improve.

4.6.2 Constraints facing Value Chain Pisciculture

Table 4.19: Constraints facing Value Chain Pisciculture

Constraints	Strongly Agree (SA)	Agree (A)	Disagree (D)	Strongly Disagree (SD)	Mean
Poor/lack of handling skills	20 (80)	7 (21)	2 (4)	1 (1)	3.5 (106)
Lack of market information	18 (72)	12 (36)	- (0)	- (0)	3.6 (108)
Poor storage facilities	24 (96)	5 (15)	1 (2)	- (0)	3.8 (113)
Poor transportation facilities	15 (60)	12 (36)	2 (4)	1 (1)	3.4 (101)
High cost of inputs for value addition	19 (76)	8 (32)	2 (4)	1 (1)	3.8 (113)
Time constraints	10 (40)	10 (30)	8 (16)	2 (2)	2.9 (88)
Market/consumer demand	15 (60)	5 (15)	8 (16)	2 (2)	3.1 (93)
Lack of organized market	18 (72)	10 (30)	1 (2)	1 (1)	3.5 (105)
Others, specify					

Source: Field survey (2014)

As observed in a similar fashion in the table above (Table 4.18), Table 4.19 also indicated in a multiple response scenario that amongst the 30 respondents that inculcate value chain to their enterprise, major constraints faced utilizing a 4-point Likert rating scale are poor storage facilities (3.8), high cost of inputs for value addition (3.8), lack of market information (3.6), poor handling skills (3.5), lack of organized market and poor transportation facilities (3.4) respectively topped the list major constraints facing value chain inculcation in fish farming enterprise in this area amongst other constraints identified. It must be noted here that all the constraints facing value chain inculcation in fish farming indicated in the table above (Table 4.5.2) were all accepted due to the fact that they had an average mean score above 2.5. This is in agreement with the observations of Hampel (2010) and USAID Market (2011), as they rightly noted that the amongst all the constraints facing value chain in pisciculture enterprise, cost of inputs and lack of market information rank highest on the list. These two aspects of the business are the major deciding factors on the success or failure of the enterprise. Furthermore, the high costs of inputs in particular have resulted in high priced products, which have restrained the sector's growth opportunities despite a burgeoning demand for fish.

4.7 Recommendations According to Respondents

Table 4.20 Recommendation of Respondents

S/No	Recommendations	Frequency	%
1.	Provision of credit/finance	58	25
2.	Provision highly developed market structures	24	10
3.	Provision of water facilities	25	11
4.	Provision of good roads	12	5
5.	Improve extension services	18	8
6.	Provision of storage facilities	94	40
7.	Others, Specify	-	-
	Total	**231***	**100**

*Multiple response
Source: Field survey (2014)

From the table above (Table 4.20), most of respondents recommended a multiple solutions to their major constraints both in pisciculture enterprise and value chain. It can be deduced from the table above (Table 4.20) that a total of 231 responses were indicated of which (on a 100% scale), majority (60%) of the respondents recommended provision of storage facilities closely followed by (25%) provision of credit facilities. Only a handful (11%, 8% and 5%) recommended provision of water facilities, improvement on extension service delivery and provision of good roads to the constraints facing their quality performance in value chain and pisciculture enterprise in this area. This result is in line with the observations of Omalese et al (2011), Yela et al (2011) and Agboola (2011), who jointly believed that storage facilities is mostly required in pisciculture enterprise to enable farmers to store their produce in times of gluts as well as to control the market prices. Furthermore, this result agrees with the opinion of Zeller and Sharma (1998) as they rightly noted that Agricultural credits play a vital role in economic transformation and rural development. Agricultural credit is a crucial input required by the smallholder farmers to establish and expand their farms with the aim of increasing agricultural production, enhancing food sufficiency, promoting household and national income. It enables the poor farmers to tap the financial resources and take advantage of the potentially profitable investment opportunities in their immediate environment. In support of the above statement, Kohansal and Mansoori (2009) also opined that the need for credit facilities is necessitated by the limitations of self-financing, uncertainty pertaining to the levels of output, and the time lag between inputs and output. From the above result, the respondents strongly believe that if quality storage facilities and credit facilities are provided for them, they would do better in terms of increasing the quantity and quality of their produce.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

The broad objective of the study was to analyze factor-product relationship in pisciculture value chain in Lagos state, Nigeria. The specific objectives were to: (i) describe the socio-economic characteristics and examine its influence on pisciculture farmers output; (ii) identify the value chain steps in pisciculture enterprise; (iii) determine the factor-product relationship and estimate the technical efficiency in value chain pisciculture enterprise; (iv) estimate the cost and returns of pisciculture value chain in this area and; (v) identify the various constraints facing pisciculture value chain.

This study adopted survey research design. It mainly utilized primary data. A structured close-ended questionnaire was administered in a multi-stage, stratified random sampling procedure on fish farmers who own ponds and culture fish in Lagos state, Nigeria. A total of one hundred and twenty (120) fish farmers were selected for the study. Thirty (30) fish farmers each were randomly selected from four administrative divisions which are: Ikeja, Lagos, Badagry and Epe division. A purposive sampling of two Local Government Areas (LGAs) based on predominance of fish farming activities in these areas from the administrative divisions namely: Alimosho, Kosofe, Eti-Osa, Lagos Island, Ojo, Amuwo-Odofin, Epe and Ibeju-Lekki while three communities and five respondents were randomly selected from the eight LGAs. Price of fish inputs and outputs including cost of value added were monitored and collected for 24weeks. The validity and reliability of instrument were established by three experts in the Department of Agricultural Economics. The questionnaire was pre-tested in Itesiwaju LGA, Oyo state and a correlation r=0.90 was obtained. Data generated were analyzed using the stochastic frontier analysis (SFA), budgetary analysis, rate of return; test of mean and value addition analysis.

Average output of fish per farmer per production cycle was 14,000kg and an average farm size of 1.97ha per farmer. The farmers possess an average farming experience of 11.7years and an average household size of 5.12members as well as an average schooling year of 14.4years. The farmers were young as indicated by $\bar{X}$ age of 43years. It further indicated that pond size ($\bar{X}$=2.22) and feed ($\bar{X}$=3.12) were the most significant in pisciculture enterprise in this area. Six factors namely, pond size, labour, feed, fertilizer, stocking capacity and depreciation value with coefficients of 0.02, 0.28, 0.03, 0.04, 0.40 and 0.20 respectively exerted significant ($p<0.05$) effects on the output of fish. All the production variables analyzed were positive and significant except pond size and feed cost. The implication is that the production function was an increasing function. The major determinants of efficiency were identified to be farm size and stocking capacity. Smaller farms were found to be more efficient than larger ones. The results further indicated that the farmers were not very technically efficient, with a mean ($\bar{X}$) efficiency estimate of 0.88. The $\bar{X}$ efficiency could therefore be improved by 12% through better utilization of available resources. An average profit of N5,371,497.753 was indicated per farmer per farming cycle with a 2.2 return on investment (ROI) for farmers without value chain; while an average profit of N6,734,290.39 and a 2.0 return on investment was indicated for farmers with value chain; indicating an average difference in margin of N1,362,792.64 between these farmers per production cycle. Also, the study revealed that hatching of eggs which only takes place in one week generates an average profit of N71,457.18 to the farmers while culturing of fries only generates on the average after two weeks a net profit of N16,928.36, while on the other hand, culturing of fingerlings which take up to four weeks generates an average profit of N467,856.72. Post-fingerlings culturing rakes in an average profit of N187,856.72 after four weeks while juvenile culture gives an average profit of N2,987,856.72 after four weeks while raising fish to market size which takes another four weeks produces on the average a profit of N1,542,223.29. It was therefore deduced that the highest profit in the chain of pisciculture enterprise remains culturing of juvenile and raising to market size respectively. The study further indicated that all the constraints were accepted ($\bar{X}$>2.5) but topping the list were feed cost ($\bar{X}$>3.8), lack of credit ($\bar{X}$>3.6), cost of inputs ($\bar{X}$>3.4) and poor technical know-how ($\bar{X}$>3.4). Value chain exerted no significant effect on the efficiency level of fish farmers in this area.

5.2 CONCLUSION

The study analyzed factor-product relationship in pisciculture value chain. The summary statistics indicated that farmers were young (with a mean age of 43 years) and educated, having had about 14.4 years of schooling. The result shows that pond fish farmers were not very efficient technically, although the mean efficiency is relatively high (88%) despite their average farming experience of 11.7years. The production factors (land size, labour, stocking capacity, fertilizer and depreciation) were all positive and significant except for pond size and feed cost which were negative but still statistically significant. This implies that it was an increasing function. The major determinants of farm level efficiency were found to be pond size and feed cost. An increase in farm size was found to reduce efficiency. This finding is consistent with "*Schultz's–poor-but-efficient hypothesis*" that peasant farmers in traditional agriculture are efficient in their resource allocation given their operating circumstances (Schultz, 1964). In addition, a huge difference in profit margin was recorded among farmers with value chain and those without it as an average profit of ₦5,371,497.753 was indicated per farmer per farming cycle with a 2.2 return on investment (ROI) for farmers without value chain; while an average profit of ₦6,734,290.39 and a 2.0 return on investment was indicated for farmers with value chain. This result indicated an average difference in margin of ₦1,362,792.64 between these farmers per production cycle. The implication of this result is that much margin is loss due to lack of value chain inculcation in pisciculture enterprise in this area. The efficiency recorded suggests that an average farmer in the sample is efficient technically, although the efficiency level could be improved by 12% through better use of available resources.

These observations suggest an aggressive awareness on the importance and training of farmers on value chain inculcation in their enterprise. Also, provision of market where these fish products could be sold at profitable prices will go a long way to enhance and ensure that farmers are not only food secured but also financially comfortable.

5.3 RECOMMENDATION

Based on the results of this study, the following recommendations are given:

The pond fish farmers should:

- Avoid culturing of fries rather, should begin their production from fingerlings culture at least if they want to record better margins.
- There should be training and skill acquisition for these fish farmers on hatching of eggs and handling of fries to boost the supply of input in the line of production.
- Embark on practices like formation of cooperatives that would enhance procurement of credit facilities and attraction of both government and Non-governmental agencies which would bring along essential inputs required for value chain pisciculture.
- Improve their farm productivity by embarking on practices that would enhance procurement of inorganic fertilizers for their production. This could include organizing themselves into forming a cooperative society within their locality, if there is none; such a cooperative should pool the resources of the members for bulk purchase of inorganic fertilizers, feed and other resources required for efficient production.
- Explore every available credit opportunities within their community, such as commercial banks, credit and thrift societies among others. Government could also place more emphasis on credit facilities toward agricultural production in general and fisheries in particular; such include Agricultural Credit Guaranteed Scheme Fund which enhanced credit availability to the farmers and taking care of tangible proportion of any default so as to encourage the commercial banks to make credit facilities available to farmers. The fish farmers should carefully consider an economic reduction in fertilizer utility in the

study area, thereby reducing the cost of production and raising the profit margin of their respective farms.

The Government should:

Structure and Institutionalize Business Information Outreach and Technical Support for pond fish farmers. This could be achieved by:

- Encouraging Business and Technical Information Services through Developing a Pisciculture Business Training Module for use by Fingerling Producers as an embedded service which could go alongside credit/incentive procurement for pond fish farmers.
- Developing easy to use training materials and help train fingerling producers recognized by ADP to be certified pisciculture business trainers.
- Supporting the on-going dissemination of business and technical training material to a wider network of pisciculture producers through these fingerling producers, by assisting in setting up and providing feedback for the initial training sessions.

Strengthen Retail Market Information Networks by:

- Preparing consumer and retailer awareness materials to include benefits of pisciculture, how to select good pisciculture products, market hygiene, fish handling and storage.
- Facilitating the organization of retailer/trader business membership associations and forums to improve market infrastructure and link with producers.

Improve Media Use in the Dissemination of Technical, Market and Regulatory Information by:

- Training ADP and related institutions on effective media use for regular dissemination of value chain skills acquisition and other related information in pisciculture enterprise.

Strengthen Networks between Producers to Address Business Issues by assisting value chain players to support each other for:

- Improving market perceptions of pisciculture product.
- Improving productivity and quality through increased adherence to technically correct pisciculture methods.
- Access to good quality seed.
- Managing feed prices.
- Developing market supply linkages.
- Securing access to credit through a series of facilitated working group sessions.

Assist the development of business linkages and out-grower schemes among producers through networking by:

- Exploring the possibility of moving low input stunted fish producers to link between fingerling suppliers and medium scale pisciculturists.

- Encourage Dialogue between producers, policy makers and supporting research and development institution by:
- Using provincial and national business forum mechanisms to assist producers, regulators, policy makers and supporting institutions to understand the various constraints involved in the enterprise and how best to practically handle them.

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APPENDIX I

QUESTIONNAIRE

SECTION A: SOCIO-ECONOMIC CHARACTERISTIC

1. Age of farmer ……………….. (a) 20-29yrs (b) 30-39yrs (c) 40-49yrs (d) 50-59yrs (e) 60 and above

2. Sex of farmer ………………… (a) Male (b) Female

3. Marital Status ………………….. (a) Married (b) Single (c) divorced (d) widow

4. Educational status ………………. (a) Primary education (b) Secondary education (c) tertiary education

5. Years of farming experience ………….. (a) 0-5yrs (b) 6-10yrs (c) 11-15yrs (d) 16-20yrs (e) 21yrs and above

6. Household size ……………… (a) 0-4 (b) 5-9 (c) 10-14 (d) 15 and above

7. Labour type ………………… (a) family (b) hired

8. Quantity of family Labour used ……………..(man/days)

9. Quantity of hired Labour used ……………..(man/days)

10. Cost of hired labour ………….. (naira/day)

SECTION B: VALUE CHAIN STEPS IN PISCICULTURE ENTERPRISE

11. Do you hatch your eggs ……………….. (a) Yes (b) No

12. Do you culture your fries …………… (a) Yes (b) No

13. Do you culture fingerlings …………… (a) Yes (b) No

14. Do you culture Juveniles ………………. (a) Yes (b) No

15. Do you raise to market size …………….. (a) Yes (b) No

16. Do you add value at any stage of fish production ……………….. (a) Yes (b) No

17. If yes (to question 16), what type of value do you add? (a) Smoking (b) drying (c) ice-freezing (d) salting (e) canning (f) Others specify………………………

18. Do you add any value to the marketing of your produce? (a) Yes (b) No

19. What marketing value do you add to your produce? (a) Transportation (b) Packaging (c) Advertisement (d) contract sales (e) others, specify ………………………..

SECTION C: FACTOR-PRODUCT RELATIONSHIP IN VALUE CHAIN PISCICULTURE

20. What is your pond size …………………..(m^2)

21. Age of fish pond ……………….(in years)

22. Stocking rate per pond (Unit) ……………….

23. Cost of feeds (in naira/kg) ……………………….

24. Cost of fertilizer (in naira/kg) ……………………..

25. Cost of Medication in Naira ………………………..

26. Cost of fingerlings in Naira ……………………….

27. Do you have access to credit……………………… (a) Yes (b) No

28. Source of credit available to fish farmers ……………. (a) Cooperative /group funds (b) personal (c) commercial banks (d) others, specify

29. Do you have contact with extension agents ………………. (a) Yes (b) No

30. Do you belong to any cooperative / farmers' organization …………….. (a) Yes (b) No

SECTION D: COST AND RETURNS OF PISCICULTURE VALUE CHAIN

31. Cost of fries stock per pond (in Naira) ……………….

32. Cost of fingerlings stock per pond (in Naira) ……………….

33. Cost of juvenile stock per pond (in Naira) ……………….

34. Cost of table sized fish stock per pond (in Naira) ……………….

35. Cost of maintenance (in Naira) …………………….

36. Cost of transportation (in Naira) …………………..

37. Cost of storage (in Naira) ……………………..

38. Cost of advertisement (in Naira) ……………………

39. Cost of water (in Naira/litre)………………………..

40. Depreciation cost on ponds/equipment (in Naira) ………………………..

41. Tax paid (in Naira) …………………..

42. Insurance cost (in Naira) ……………………….

43. Quantity of fish sold (table size) before value addition …………………… (unit)

44. Amount of fish sold (table size) (in Naira) before value addition ………………………..

45. Quantity of fish sold (table size) after value addition …………………… (unit)

46. Amount of fish sold (table size) (in Naira) after value addition ………………………..

SECTION E: CONSTRAINTS FACING PISCICULTURE VALUE CHAIN

47. Please, rank the constraints faced in your enterprise (on the scale below).

Constraints	Strongly Agree (SA)	Agree (A)	Disagree (D)	Strongly Disagree (SD)
Poor Hatching techniques/skill				
lack of supply of fingerlings/juveniles				
high cost of feeds				
lack of water supply				
lack of capital/finance				
Disease and pest				
Lack of organized market				
Poor Transportation				
poor storage facilities				
poor market information				

high cost of inputs	
others, specify	

48. Please, rank the constraints faced in value chain pisciculture (on the scale below).

Constraints	Strongly Agree (SA)	Agree (A)	Disagree (D)	Strongly Disagree (SD)
Poor/lack of handling skills				
Lack of market information				
Poor storage facilities				
Poor transportation facilities				
High cost of inputs for value addition				
Time constraints				
Market/consumer demand				
Lack of organized market				
Poor market information				
others, specify				

SECTION F: RECOMMENDATIONS

49. What are your suggestions on the best ways to tackle these constraints? …………………… (a) Provision of credit/finance (b) provision highly developed market structures (c) provision of water facilities (d) provision of good roads (e) improve extension services (f) provision of storage facilities (g) others, specify

APPENDIX II

STOCHASTIC FRONTIER PRODUCTION MODEL

Output from the program FRONTIER (Version 4.1c)

instruction file = terminal
data file = prod.dat

Tech. Eff. Effects Frontier (see B&C 1993)
The model is a production function
The dependent variable is logged

the ols estimates are :

	coefficient	standard-error	t-ratio
beta 0	0.33853819E+01	0.46985043E+00	0.72052332E+01
beta 1	0.85301210E-02	0.45066384E-01	0.18927902E+00
beta 2	0.97446922E-01	0.12071856E+00	0.80722404E+00
beta 3	0.32683218E-02	0.37678997E-01	0.86741211E-01
beta 4	0.49571610E-01	0.10614335E-01	0.46702509E+01
beta 5	0.36158345E+00	0.12466351E+00	0.29004754E+01
beta 6	0.36360625E+00	0.14469386E+00	0.25129349E+01
sigma-squared	0.23842202E-01		

log likelihood function = 0.47653923E+02

the estimates after the grid search were :

beta 0	0.34885510E+01
beta 1	0.85301210E-02
beta 2	0.97446922E-01
beta 3	0.32683218E-02
beta 4	0.49571610E-01
beta 5	0.36158345E+00
beta 6	0.36360625E+00
delta 0	0.00000000E+00
delta 1	0.00000000E+00
delta 2	0.00000000E+00
delta 3	0.00000000E+00
delta 4	0.00000000E+00
delta 5	0.00000000E+00
delta 6	0.00000000E+00
delta 7	0.00000000E+00
delta 8	0.00000000E+00

```
 sigma-squared  0.32783065E-01
 gamma          0.51000000E+00


iteration =    0  func evals =    20  llf =
0.47789020E+02
   0.34885510E+01 0.85301210E-02 0.97446922E-01
0.32683218E-02
0.49571610E-01
   0.36158345E+00 0.36360625E+00 0.00000000E+00
0.00000000E+00
0.00000000E+00
   0.00000000E+00 0.00000000E+00 0.00000000E+00
0.00000000E+00
0.00000000E+00
 0.00000000E+00 0.32783065E-01 0.51000000E+00
gradient step
iteration =    5  func evals =    44  llf =
0.51130461E+02
0.34890787E+01 0.15058163E-01
0.10390528E+00-0.41965806E-02
0.37726900E-01
 0.36689020E+00

0.36534625E+00-0.80529230E-02-0.16818707E-01-0.21570514E-01
-0.12399791E-01 0.57030047E-01 0.18371263E-02
0.13822728E+00-0.76964033E-02
0.29097234E-01 0.32741517E-01 0.50991788E+00
iteration =    10  func evals =    61  llf =
0.52287280E+02
0.34777861E+01 0.36790206E-02
0.17199556E+00-0.53928467E-02
0.31876018E-01
0.33201295E+00

0.36523948E+00-0.43839297E-01-0.39572452E-01-0.15741545E+00
-0.99643652E-01 0.64991004E-01 0.10134773E+00
0.13818224E+00-0.25532898E-01
0.15005302E+00 0.33312658E-01 0.54702990E+00
iteration =    15  func evals =    81  llf =
0.54803030E+02
0.30566508E+01-0.18701305E-01
0.32801244E+00-0.48141466E-02
0.33652685E-01
0.40139023E+00
```

0.15935125E+00-0.45795940E+00-0.64315790E-01-0.13086467E+00
-0.28384406E+00 0.46988187E-01 0.40195881E+00
0.15234303E+00-0.58151717E-02
0.24823576E+00 0.38450287E-01 0.87985940E+00
iteration = 20 func evals = 113 llf =
0.58541657E+02
0.30802548E+01-0.47145175E-01
0.29588549E+00-0.18799753E-01
0.47586546E-01
0.37630606E+00

0.24881912E+00-0.13765631E+01-0.58808330E-01-0.32838113E+00
0.29641917E-02 0.43575334E-01 0.49854557E+00
0.15347389E+00-0.28236662E-01
0.22673908E+00 0.32223518E-01 0.97853659E+00
iteration = 25 func evals = 170 llf = 0.60066995E+02 0.32541999E+01-0.39732633E-01
0.30933810E+00-0.23598101E-01 0.46732994E-01 0.34917935E+00

0.24165201E+00-0.58240587E+00-0.69197864E-01-0.20066786E+00
-0.15228360E+00 0.33203511E-01 0.39149034E+00
0.12922556E+00-0.14385742E-01 0.20498362E+00 0.25561849E-01 0.99361377E+00
iteration = 30 func evals = 234 llf = 0.61719857E+02
0.32121875E+01-0.22161077E-01
0.27563782E+00-0.31107899E-02
0.42960756E-01
0.39897838E+00

0.19466534E+00-0.34888504E+00-0.52697842E-01-0.16848919E+00
-0.14751395E+00 0.17954709E-01 0.30176058E+00
0.12171152E+00-0.24591934E-01
0.19231613E+00 0.22533709E-01 0.99999999E+00
pt better than entering pt cannot be found
iteration = 31 func eval= 242 llf = 0.61719857E+02 0.32121875E+01-0.22161077E-01
0.27563782E+00-0.31107899E-02 0.42960756E-01 0.39897838E+00
0.19466534E+00-0.34888504E+00-0.52697842E-01-0.16848919E+00
-0.14751395E+00 0.17954709E-01 0.30176058E+00
0.12171152E+00-0.24591934E-01
0.19231613E+00 0.22533709E-01 0.99999999E+00

the final mle estimates are :

	coefficient	standard-error	t-ratio
beta 0	0.32121875E+01	0.30947377E+00	0.10379515E+02
beta 1	-0.22161077E-01	0.51444061E-01	-0.43078008E+00
beta 2	0.27563782E+00	0.10190267E+00	0.27049126E+01

beta 3	-0.31107899E-02	0.25980939E-01	-0.11973354E+00
beta 4	0.42960756E-01	0.96706485E-02	0.44423863E+01
beta 5	0.39897838E+00	0.98709899E-01	0.40419287E+01
beta 6	0.19466534E+00	0.86435804E-01	0.22521378E+01
delta 0	-0.34888504E+00	0.97633095E+00	-0.35734301E+00
delta 1	-0.52697842E-01	0.77792696E-01	-0.67741375E+00
delta 2	-0.16848919E+00	0.14638219E+00	-0.11510225E+01
delta 3	-0.14751395E+00	0.28982916E+00	-0.50896861E+00
delta 4	0.17954709E-01	0.61955083E-01	0.28980204E+00
delta 5	0.30176058E+00	0.21425129E+00	0.14084423E+01
delta 6	0.12171152E+00	0.58157468E-01	0.20927927E+01
delta 7	-0.24591934E-01	0.52828939E-01	-0.46550120E+00
delta 8	-0.24591934E-01	0.52828939E-01	-0.46550120E+00
delta 9	0.19231613E+00	0.13598833E+00	0.14142106E+01
sigma-squared	0.22533709E-01	0.58268074E-02	0.38672479E+01
gamma	0.9999999E+00	0.85669620E-04	0.11672749E+05

log likelihood function = 0.63419857E+02

LR test of the one-sided error = 0.34131869E+02
with number of restrictions = *
[note that this statistic has a mixed chi-square distribution]

number of iterations = 31

(maximum number of iterations set at : 100)

number of cross-sections = 120

number of time periods = 1

total number of observations = 120

thus there are: 0 obsns not in the panel
covariance matrix :
0.95774012E-01 0.79012715E-02 -0.34732853E-02
-0.26667898E-03
0.91835163E-03
-0.17184827E-01 0.10346385E-01 0.29371461E-01
-0.73748111E-03
0.40909062E-02
-0.18305827E-02 -0.52468099E-03 -0.61857043E-02
0.30930605E-03
0.11041558E-02
-0.43332899E-02 0.14922745E-04 0.31946151E-05

0.79012715E-02 0.26464914E-02 -0.36603378E-02
0.31393142E-03
-0.89173178E-04
0.15067573E-02 -0.94294479E-03 -0.84271470E-03
0.13760173E-02
0.65104389E-03
0.17428671E-03 -0.10557844E-02 0.73043159E-04
0.14374184E-03
0.17801796E-03
-0.23736402E-03 -0.10509989E-04 -0.51270093E-06
-0.34732853E-02 -0.36603378E-02 0.10384155E-01
-0.14091971E-03
0.16929431E-05
-0.68480620E-02 0.22650840E-02 -0.25722727E-02
-0.22360189E-02
-0.27332207E-02
-0.83799191E-03 0.20139247E-02 0.24125837E-02
0.63695254E-03
-0.49867396E-03
0.87399057E-03 0.12188164E-04 0.22779199E-05
-0.26667898E-03 0.31393142E-03 -0.14091971E-03
0.67500918E-03
-0.18732422E-03
-0.71406510E-04 0.51223392E-03 0.37331868E-02
0.68880548E-03
0.17354360E-03
-0.69130647E-03 -0.19646290E-03 -0.66122973E-03
0.21268040E-03
-0.20212579E-03
0.18338469E-03 -0.91727103E-05 -0.12707009E-06
0.91835163E-03 -0.89173178E-04 0.16929431E-05
-0.18732422E-03
0.93521442E-04
-0.18916922E-03 0.45092105E-04 -0.18531215E-02
-0.18814327E-03
-0.22659569E-03
0.44448056E-03 0.59096891E-04 0.22848323E-03
0.63029802E-06
0.28720597E-04
-0.58983627E-04 -0.17696491E-05 0.85173103E-07
-0.17184827E-01 0.15067573E-02 -0.68480620E-02
-0.71406510E-04
-0.18916922E-03
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0.12469205E-02
0.81216031E-03

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0.65104389E-03
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0.44448056E-03
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0.84000944E-01 -0.12296925E-03 -0.47451103E-03
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-0.20212579E-03
0.28720597E-04
0.56089554E-04 0.19182187E-03 -0.26774318E-02
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-0.23504894E-05
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  0.85173103E-07
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-0.10743974E-05
-0.38675308E-06
-0.71404483E-06  0.95165595E-06 -0.39282076E-06
 0.13439423E-06  0.96849624E-07
 0.31644672E-06  0.94710096E-07  0.73392838E-08

technical efficiency estimates :
  firm  year        eff.-est.

     1     1        0.90862109E+00
     2     1        0.91442052E+00
     3     1        0.85485974E+00
     4     1        0.95961319E+00
     5     1        0.93830425E+00
     6     1        0.90542369E+00
     7     1        0.91578894E+00
     8     1        0.91142899E+00
     9     1        0.67131325E+00
    10     1        0.97285090E+00
    11     1        0.91973670E+00
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12	1	0.95338075E+00
13	1	0.81645130E+00
14	1	0.87771967E+00
15	1	0.94402575E+00
16	1	0.92231115E+00
17	1	0.88636322E+00
18	1	0.94149445E+00
19	1	0.82977255E+00
20	1	0.91323716E+00
21	1	0.95612812E+00
22	1	0.84906209E+00
23	1	0.91354069E+00
24	1	0.90838617E+00
25	1	0.95463701E+00
26	1	0.82806460E+00
27	1	0.61957028E+00
28	1	0.91651688E+00
29	1	0.91939800E+00
30	1	0.75265372E+00
31	1	0.96707505E+00
32	1	0.92476046E+00
33	1	0.95385428E+00
34	1	0.96856532E+00
35	1	0.90251366E+00
36	1	0.89043801E+00
37	1	0.95136563E+00
38	1	0.94121666E+00
39	1	0.90328211E+00
40	1	0.86415783E+00
41	1	0.86034734E+00
42	1	0.92712890E+00
43	1	0.94939467E+00
44	1	0.88232518E+00
45	1	0.94756589E+00
46	1	0.85864290E+00
47	1	0.86525616E+00
48	1	0.91869436E+00
49	1	0.90885086E+00
50	1	0.96455511E+00
51	1	0.96107299E+00
52	1	0.95293394E+00
53	1	0.91665882E+00
54	1	0.94754711E+00
55	1	0.93756732E+00
56	1	0.90592268E+00
57	1	0.93478761E+00

58	1	0.94256695E+00
59	1	0.87106994E+00
60	1	0.92138511E+00
61	1	0.91501056E+00
62	1	0.86816185E+00
63	1	0.67527539E+00
64	1	0.74203100E+00
65	1	0.82405414E+00
66	1	0.91305256E+00
67	1	0.64481895E+00
68	1	0.92229962E+00
69	1	0.75374072E+00
70	1	0.88596058E+00
71	1	0.90096337E+00
72	1	0.88373949E+00
73	1	0.70324845E+00
74	1	0.93290380E+00
75	1	0.96102012E+00
76	1	0.92600773E+00
77	1	0.97268598E+00
78	1	0.94195261E+00
79	1	0.96988224E+00
80	1	0.91835126E+00
81	1	0.91102383E+00
82	1	0.72460019E+00
83	1	0.95715509E+00
84	1	0.91935672E+00
85	1	0.67260950E+00
86	1	0.95475911E+00
87	1	0.94455451E+00
88	1	0.87842756E+00
89	1	0.93621923E+00
90	1	0.87743465E+00
91	1	0.86186948E+00
92	1	0.90678438E+00
93	1	0.84009454E+00
94	1	0.85526400E+00
95	1	0.82593631E+00
96	1	0.75355392E+00
97	1	0.62310518E+00
98	1	0.76994643E+00
99	1	0.90328211E+00
100	1	0.86415783E+00
101	1	0.86034734E+00
102	1	0.92712890E+00
103	1	0.94939467E+00

104	1	0.88232518E+00
105	1	0.94756589E+00
106	1	0.85864290E+00
107	1	0.86525616E+00
108	1	0.91869436E+00
109	1	0.90885086E+00
110	1	0.56868790E+00
112	1	0.84 906209E+00
113	1	0.95454069E+00
114	1	0.88838617E+00
115	1	0.87463701E+00
116	1	0.652806460E+00
117	1	0.61957028E+00
118	1	0.81651688E+00
119	1	0.75265372E+00
120	1	0.92707505E+00

mean efficiency = 0.877045340E+00