ECONOMIC ANALYSIS OF FISH FARMING AND ITS CONTRIBUTION TO HOUSEHOLD POVERTY ALLEVIATION IN AKURE SOUTH AND OWO LOCAL GOVERNMENT AREAS OF ONDO STATE, NIGERIA

BY

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A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS

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DECLARATION

I hereby declare that this thesis titled **''Economic Analysis of Fish Farming and its Contribution to Household Poverty Alleviation in Akure South and Owo Local Government Areas of Ondo State, Nigeria''** has been written by me and it is a record of my research work. No part of this work has been presented in any previous application for another degree or diploma at any institution. All borrowed ideas have been fully acknowledged in the text and a list of references was provided.

_____ _____

Asiru Monday ABBAS Date

CERTIFICATION

This thesis titled **'Economic Analysis of Fish Farming and its Contribution to Household Poverty Alleviation in Akure South and Owo Local Government Areas of Ondo State, Nigeria'** by Asiru Monday ABBAS meets the regulations governing the award of Master of Science in Agricultural Economics of Ahmadu Bello University, Zaria and is hereby approved for its contribution to knowledge and literary presentation.

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DEDICATION

This thesis is dedicated to the glory of the Almighty God, my Redeemer, my Hope and the One who makes all things beautiful.

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ABSTRACT

The study focused on the economic analysis of fish farming and its contribution to household poverty alleviation in Akure South and Owo Local Government Areas of Ondo State, Nigeria. A multi stage sampling technique was used to select 100 fish farmers for the study during the 2013 production cycle. Data obtained were analyzed using descriptive statistics, net farm income analysis, Tobit regression model, expenditure approach of determining poverty line, Foster, Greer and Thorbecke technique and z-test. Results of the study showed that 63% of the fish farmers were still within the economically active age bracket of 20-49; 80% of the respondents had tertiary education while 70% had an average of 4 years of farming experience. Earthen pond was used by about 78% of the respondents to culture fish; 88% of the farmers practiced monoculture while 12% practiced polyculture. Significant determinants of intensity of fish farming were pond size (0.0004), number of ponds (0.1051), feed (0.6411), start-up capital (-0.6771), labour (-0.0003), years of experience (0.0105) and level of education (0.0169). An average quantity of 3,097.00 kilogram of table size fish was harvested from an average pond size of 353.00m^2 at the end of the production cycle. The net farm income analysis showed that fish farming was profitable in the study area with a profit of ₦2,432.37/m^2 being realized by a farmer at the end of the production cycle. At 0.05 probability level, the calculated z value was statistically significant and thereby ascertained the positive contribution of fish farming to household poverty alleviation. Notable problems facing fish farmers were high cost of fish feed (33.06%), inadequate capital (22.98%) and inadequate market (12.09%). The study recommended that farmers should be trained on how to compound feed used in raising fish. It is also recommended that increased credit facilities toward aquaculture by financial institutions will help farmers to expand their scale of operation and practice modern culture system such as re-circulatory aquaculture system.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Fish farming is the rearing or production of fish in a semi-controlled environment like ponds, cages, tanks, irrigational canals, reservoirs and other types of enclosures (Ayodele and Ajani, 1995). It is a well-established industry in many parts of the world especially in Asia and Africa. Modern-day fish farming is traced to ancient China in Southeast Asia as well as ancient Egypt in North Africa and the Roman Empire in Europe where food fishes were produced in static and limited ponds. The process of production was described as extensive whereby fish were cultured or raised in an environment similar to their natural habitat (Wedemeyer, 1996).

Fish farming as an economic activity was first introduced into Nigeria about 66 years ago with the establishment of a small experimental station at Onikan in Lagos State, Agodi in Ibadan, Oyo State, and an industrial farm (20 hectares) at Panyam in Plateau State by the Federal Government of Nigeria (Ayodele and Ajani, 1995). Since the establishment of fish farms was spear-headed by the Federal Government of Nigeria, fish farming had received some attention from the government through her programmes on agriculture such as the establishment of Aquaculture and Inland Fisheries Project and the Presidential Initiative on Aquaculture in 2005.

Among the different food production systems around the world, fish farming is widely seen as an important weapon in the global fight against poverty, malnutrition and food insecurity, particularly within developing Countries like Nigeria and Ondo State in particular. Fish farming is regarded as an important domestic provider of the much

needed high-quality animal protein and other essential nutrients (generally at affordable prices to the poorer segments of the community) and/or a provider of employment opportunities and cash income. In view of these positive characteristics, it is perhaps not surprising that fish farming has been among the world's fastest-growing food production sectors for nearly two decades (Tacon, 2001). Edwards (1999) reported that fish farming contributes to alleviation of poverty directly through small-scale household farming of aquatic organisms for domestic consumption and/or income; or indirectly through employment of the poor as service providers to aquaculture or as workers on fish farms of wealthier farmers; or indirectly by providing low-cost fish for poor rural and urban consumers.

Fish remains among the most traded food commodities worldwide. The fishery sector is especially important for developing nations, in some cases accounting for more than half of the total value of traded commodities. In 2012, it represented about10 percent of total agricultural exports and 1 percent of world merchandise trade in value terms (Food and Agriculture Organization, 2014). Fishery exports reached a peak of $129.8 billion in 2011 up by 17% from 2010 but declined slightly to $129.2 billion in 2012 following downward pressure on international prices of selected fish and fishery products (FAO, 2014). Aquaculture is still developing in Africa and is mostly concentrated in a few Countries like Egypt, Morocco and Nigeria.

Africa as a Continent increased its contribution to global fish production from 1.2 percent to 2.2 percent in the past ten years, albeit from a very low base (FAO, 2012). The share of freshwater aquaculture in the region also fell from 55.2 percent to 21.8 percent in the 1990s (FAO, 2012). The potential for fish farming to compete at the

economic level on the African continent is very limited compared with the situation in China for example (Delgado *et al*., 2003). In Southeast Asia in general, fish farming is widely practiced and it is strictly an economic enterprise through private investment. In Nigeria, aquaculture expansion has been a slow process as private sector fish farmers have faced major constraints including lack of seed and quality feed (Olagunju *et al*., 2007)

In Nigeria, annual national fish demand stands at about 2.7 million metric tons while domestic fish production is about 800,000 metric tons (Nnodim, 2014). It is particularly interesting to know that less than 30% of the total annual fish consumed by Nigerians are produced locally (Nnodim, 2014). Agbebi (2011) observed that aquaculture in Nigeria is ignored by policy makers and development professionals even though it has huge prospect not only in alleviating poverty and malnutrition but also as a source of foreign exchange earning.

1.2 Problem Statement

The growth of a Country's population is usually accompanied by increases in the demand for basic necessities of life such as food, clothing and shelter. This is the case with the unrestricted increases in the demand for protein rich food item of animal origin like fish. The animal protein consumption in Nigeria and Ondo State in particular is less than 8 grams per person per day, which is far below Food and Agriculture Organization minimum recommendation that an individual takes 35 grams per caput of an animal protein per day for sustainable growth and development (Niang and Jubrin, 2001). This nutritional requirement is particularly crucial in a developing Country such as Nigeria where malnutrition and starvation are the major problems faced by million of rural

dwellers. Emokaro *et al*. (2010) also observed that the current level of fish production is considerably too low to meet the protein requirement of the nation's population.

Nigeria is endowed with many large rivers, man-made lakes, creeks and about 200 nautical miles of marine water under the Exclusive Economic Zone (Bada and Rahji, 2010). The performance of the fishery sub-sector, however, is still far below expectation with inadequate domestic fish supply. The problem is that total domestic fish production is far less than the total domestic demand. According to Nnodim (2014), domestic fish production in Nigeria stands at about 800,000 metric tons while annual demand stands at about 2.7 million metric tons leaving a deficit of 1.9 million metric tons. This is evident in the fact that Nigeria still imports fish into the Country to supplement local fish production. Nnodim (2014) also reported that Nigeria spends about ₦125 billion annually on the importation of fish. The current import dependent situation is deemed to be unfavourable and non-optimal to the Nigerian economy in view of the aquaculture potential of the Country. The continuous importation of fish portends a grave danger to Nigeria in terms of foreign exchange earnings and its drain on the foreign reserves, and the loss of employment opportunities for Nigerians especially the rural people thus aggravating their poverty level.

Inoni (2007) noted that the bulk of domestic fish production in Nigeria is from capture fisheries which are not sufficient to satisfy the ever growing demand for fish. He also observed that there is a decline in yield of natural fish stocks which is an indicator that fish stocks have reached the point of maximum sustainability yield since the number of catch from capture fisheries is declining. Factors implicated in the decline of capture fisheries include climate change, oil spillage and discharge of industrial wastes into

river which results in pollution of river where people fish from, overfishing and rudimentary technology of fishing.

It is saddening and particularly shocking to know that fish farming which started more than six decades ago in Nigeria has not contributed substantially to poverty alleviation (Ayodele and Ajani, 1995). Thorpe *et al*. (2004) reported that the sub sector harbours an above average relative quotient of the poor. Also, Ayodele and Ajani (1995) noted that the investment by Federal, State and some Local Governments in more than fifty fish farms and some feed mills had been abandoned today and none has been able to make fish a cheap source of animal protein on the common man's table. Also, from review of relevant literature, it was observed that only limited studies exist on the poverty alleviation potential of fish farming in Ondo State. The following research questions were raised in this study:

i. What are the socio economic characteristics of fish farmers in the study area?

ii. What are the species of fish being raised and culture systems adopted in the study area?

iii. What are the costs and returns from fish farming business?

iv. What are the factors influencing the intensity of fish farming?

v. What is the poverty status among fish farming households?

vi. Does the profit realized from fish farming contribute to household poverty alleviation?

vii. What are the problems militating against fish farming business in the study area?

1.3 Objectives of the Study

The broad objective of this study was to conduct an economic analysis of fish farming and ascertain its contribution to household poverty alleviation in Akure South and Owo Local Government Areas of Ondo State, Nigeria. The specific objectives were to:

i. describe the socio economic characteristics of fish farmers in the study area;

ii. identify the species of fish and culture systems;

iii. determine the profitability of fish farming;

iv. analyze factors influencing the intensity of fish farming;

v. estimate the poverty status among fish farmers in the study area;

vi. ascertain the contribution of fish farming to household poverty alleviation and

vii. describe problems militating against fish farming in the study area.

1.4 Justification of the Study

The recurring incidence of poverty in rural, peri-urban and urban areas in Nigeria and Ondo State in particular as a result of lack of sustainable livelihood activities by the populace due to non-diversification of the economy, over-reliance on crude oil generated revenue, environmental degradation from oil spills which results in pollution of rivers where people fish from necessitated this research work. Hunger and malnutrition remain amongst the most devastating problems facing the world poor and needy (Food and Agriculture Organization, 2002). About 80 to 90 million people have to be fed yearly and most of them are in developing Countries like Nigeria. Most of these people are without a decent and reliable source of income i.e. a larger percentage of them is unemployed (World Fish Centre, 2003). With the population of Nigeria on the increase, there is a corresponding demand for employment opportunities that can lift people out of poverty. Thus, there is a need for a suitable, non-oil driven,

environmentally friendly agricultural system that can meet this increasing demand for job opportunity that can actually propel a larger chunk of our population out of the dungeon of poverty. In view of this, fish farming fits exactly into this. Fish farming is of paramount importance in the provision of employment opportunities and food for a lot of people.

Small-scale fish farming can also provide a critical safety net for vulnerable households (even those which were not previously poor) when they face a sudden decline in their income. This can happen, for example, when the head of a household loses his or her job; or if farm crops fail; or, on a larger scale, when the local or even national economy deteriorates. Recurrent civil wars or military conflicts, population displacement, and natural disasters also create circumstances where those affected turn to fish farming as additional or alternative sources of income, food, or employment. The reliance on fish farming to provide income for the poorest also applies to processing and trading activities. This aspect adds an important gender dimension to the discussion, given that women are usually the main participants in these related sectors.

According to Ugwumba and Ugwumba (2003), the demand for fish in Nigeria has been on the increase with demand far exceeding supply. Fish production from aquaculture is seen as the only means to bridge the widening gap between domestic fish supply from depleting return from capture fisheries and demand. Nutritionally, fish, which is a product of fish farming, is a rich source of protein, calcium, vitamin A, essential fatty acids as well as other elements relevant to good nutrition. It plays an important strategic role in improving Nigeria's food security and nutritional status. More than 200 million people all over Africa eat fish regularly (World Fish Centre, 2005). Fresh but more

often smoked or dried fish is a critical source of animal protein for many people especially poor households in rural, urban and peri-urban areas in Nigeria and Ondo State in particular.

With the prevalent economic situation in Nigeria, there is a need to engage in a result oriented, economically viable and environmentally friendly agricultural system that can help in alleviating poverty. In order to achieve this much-desired goal, it is only proper to look in the direction of fish farming.

1.5 Test of Hypothesis

The hypothesis of the study is that:

Fish farming business is not profitable in the study area.

CHAPTER TWO

LITERATURE REVIEW

2.1 World Aquaculture and Capture Production

Aquaculture and capture fisheries supplied about 142 million tons of fish across the world in 2008, providing an estimated apparent per capita supply of about 17kg (live weight equivalent), with aquaculture accounting for 46 percent of the total food fish supply (Food and Agriculture Organization, 2010). Aquaculture has mainly been a developing world activity, particularly on the Asian continent. Asia accounts for 87% of the world aquaculture production by weight, while China alone is responsible for about 68% of the global aquaculture production. Also, Southeast Asia and India were responsible for about 15% of aquaculture production in 1997 (Delgado *et al*., 2003). According to United Nations Food and Agriculture Organization (2010), aquaculture continues to be the fastest-growing animal-food-producing sector and to outpace population growth, with per capita supply from aquaculture increasing from 0.7kg in 1970 to 7.8kg in 2008 and an average annual growth rate of 6.6 percent. While production of fish from aquaculture was less than one million ton per year in the early 1950s, production was 52.5 million tons in 2008, with a value of US$ 98.4 billion.

World aquaculture is mainly dominated by the Asia-pacific region, which accounts for 89 percent of production in terms of quantity and 79 percent in terms of value. This dominance is as a result of China's immense production, which accounts for 62 percent of the global production in terms of quantity and 51 percent of the global value. The Caribbean and Latin America showed the highest average annual growth in the period 1970-2008 (21.1 percent), followed by the Near East (14.1 percent) and Africa (12.6 percent). In Europe and North America, the average annual growth in aquaculture

production has reduced significantly to 1.7 percent and 1.2 percent respectively (FAO, 2010).

The fish sector is a viable source of income and livelihood for millions of people around the world. Employment in aquaculture and fisheries has grown significantly in the last thirty years, with an average rate of increase of 3.6 percent per year since 1980. It is estimated that in 2008, 44.9 million people were directly engaged, full time or more frequently, part time in capture fisheries or in aquaculture and at least 12 percent of these were women. This figure represents a 167 percent increase compared with the 16.7 million people in 1980. It has also been estimated that for each person employed in aquaculture production and capture fisheries, about three jobs are produced in secondary activities, including post-harvest for a total of more than 180 million jobs in the whole of fish industry. On the average, each jobholder provides for three dependants. Thus, the primary and secondary sectors support the livelihoods of a total of about 540 million people, or 8.0 percent of the world population (FAO, 2010).

On the African continent, more than 10 million people rely on fisheries as a vital entrepreneurial activity. Over 2.5 million fishers make business opportunities. For most of them, the fishing industry is a good avenue for generating income. Of Africa's more than 800 million people over 200 million are regular fish eaters. To them, fish is an essential part of their nutrition, accounting on the average for 22% of their animal protein intake reaching up to 70% in some countries (World Fish Centre, 2005).

In Nigeria, the actual total domestic fish production in 2005 was about 579,500 metric tons. Annual national demand stands at about 1.5 million metric tons leaving a deficit of

about 920,500 metric tons (Adamu, 2007). According to Omitoyin (2007), Nigeria is blessed with suitable land where both freshwater, brackish and marine fish species can be cultured. If this available land is put into proper use, fish production will increase significantly. Table 2.1 shows fisheries and aquaculture production and utilization around the world from year 2007 to 2012.

Thomas (1994) stated that intensification of fish production from pools in African floodplain, through water management, fertilization and stocking with fingerlings, was technically a success. He found out that fish production per hectare was 171% greater in managed ponds compared with unmanaged ponds and in terms of income derived from labour inputs for pond management, the returns per man hour compared favourably to alternative activities.

Satia (1990) observed that since 1984, there has been a surge of interest in large scale commercial fish farms owned and/or operated by a new breed of influential, wealthy and sometimes knowledgeable or skilled Nigerians, whose interest in the subsector has been kindled by various administration on one hand and by a series of reforms enacted by Government in favour of agricultural development after the oil boom era, on the other hand. In the private sector there were about 2000 rural fish ponds, 3000 homestead ponds and over 50 commercial farms. In the public sector, there were more than 30 fish seed production units and hatcheries, a large pool of trained manpower, as well as training and research facilities for aquaculture. However, most public sector units were operating below capacity as a result of insufficient and unreliable release of funds, inadequate input supplies, management problems and insufficient staff motivation. Progress in the private sector on the other hand, was hampered by

inadequate supply of quality fish seed and feed, painful procedures to have access to land and credit facilities.

Table 2.1: World fisheries and aquaculture production and utilization

Production	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Capture (million tons)						
Inland	10.1	10.3	10.5	11.3	11.1	11.6
Marine	80.7	79.9	79.6	77.8	82.6	79.7
Total capture	90.8	90.2	90.1	89.1	93.7	91.3
Aquaculture (million tons)						
Inland	29.9	32.4	34.3	36.8	38.7	41.9
Marine	20.0	20.5	21.4	22.3	23.3	24.7
Total aquaculture	49.9	52.9	55.7	59.1	62.0	66.6
Total World Fisheries	140.7	143.1	145.8	148.2	155.7	157.9
Utilization						
Human consumption (million tons)	117.3	120.9	123.7	128.2	131.2	136.2
Non-food uses (million tons)	23.4	22.2	22.1	19.9	24.5	21.7
World population (billions)	6.7	6.8	6.8	6.9	7.0	7.1
Per capita food fish supply (kg)	17.6	17.9	18.1	18.5	18.7	19.2

Source: FAO, 2014.

2.2 Fish Farming and Food Security

Food security as defined by FAO (1996) is a condition whereby people everywhere irrespective of their gender, ethnicity, religious or political affiliation, age, social status etc have physical and economic access to safe, sufficient and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Fish farming can be a major player in ensuring food security locally by providing food directly to the producer or to the immediate community especially in many areas of Ondo state and in Nigeria as a whole. This contribution can also be indirect; as an economic activity which is reliable and regular, especially in comparison with traditional capture fisheries,

and as an option for diversification into new opportunities. In many areas of Ondo State, the dependence on fish is high. Fish farming or aquaculture provides a direct supply of fish, either for consumption by fish farmers and their family members or members of the society buying fish from fish farmers for their dietary needs. Fish is one of the cheapest protein sources available in developing Countries and they are processed locally and transported over long distances, providing a cheap protein source for the poor and the middle income earners thereby enriching their diets. With the ever increasing population of Nigeria, the demand for fish also increases.

Of all the different food production supply systems around the world, fish farming or aquaculture is seen as an essential domestic provider of the high premium animal protein and other vital nutrients generally at affordable prices to the poor segments of the society (Tacon, 2001). Increased fish production will help in combating hunger and malnutrition, which remain one of the most devastating problems facing the majority of the poor and the needy in the society. World Health Organization (2000) reported that nearly 30% of humanity, including infants, children, adolescent, adults and the elderly in developing Countries are currently suffering from one or more of the multiple forms of malnutrition, abject poverty and food insecurity. With the decline in capture fisheries as a result of factors such as climate change, oil spillage etc, there is an urgent need to look in the direction of fish farming to meet the ever-increasing demand for fish while recognizing the contribution of fish farming to food security, it is also important to state that it provides a new livelihood of higher income for those who engage in it.

2.2.1 Nutritional benefits of fish

In many developing Countries like Nigeria, fish accounts for a high proportion of animal protein intake of the population. Fagbenro (2002) reported that fish provide at least 40% of dietary animal protein of people living in the developing world. Fish also supply highly digestible protein and is a rich source of minerals, fatty acids and water soluble vitamins. The high value of nutrition in fish is particularly important for lower income groups that might otherwise depend on a cereal-based food to meet their dietary needs. Cereal grains are usually low in lysine and sulphur-containing amino acids; so by supplementing their diets with fish significantly raises the biological value of the diet. According to FAO (2006), fishery products like many other animal products contain nitrogenous compounds, lipids, carbohydrates, minerals and vitamins. Table 2.2 shows the nutrients composition of catfish as an example of nutrient in fishery products consumed by humans as food.

Table 2.2: Nutritional value of catfish

Nutrient	Quantities	Unit
Protein	18.20	g
Iron	0.82	mg
Calcium	9.00	mg
Iodine	0.10	mg
Potassium	321.00	mg
Vitamin A	0.02	mg
Vitamin B2	0.10	mg
Vitamin B6	0.20	mg

Source: United States Department of Agriculture, 2002.

Nutritionally, fish is therefore an extremely essential source of protein and micro nutrients for millions of people in Africa in general but for Nigerians specifically and in

Ondo state in particular. Fresh but more often smoked, dried or even processed in powdered form, fish is a critical source of protein and micro-nutrients for many isolated communities in rural areas. Fish may also be the sole affordable or accessible source of protein for poor households in rural, peri-urban and urban areas. Of Africa's more than 800 million people, more than 200 million eat fish regularly. To them fish is an important part of their diet, accounting on the average for 22% of their animal protein intake reaching up to 70% in some Countries (World Fish Centre, 2005).

In human nutrition, fatty acids such as linolenic and linoleic acids are essential for preventing skin diseases and considered very important as they cannot be produced by humans. However, fish oils contain vital polyunsaturated fatty acids which act in the same way as linoleic and linolenic acids. Members of the linolenic acid (fist double bond in the third position, on w-3 counted from the terminal methyl group) have neurological benefits in growing children. One of these fatty acids, eicosapentaenoic acid (c20:5 w3) has attracted considerable attention since Danish scientists found a significant presence of it in the diet of a group of Greenland Eskimos who proved virtually free from arteriosclerosis. Studies in the United Kingdom and elsewhere have documented that eicosapentaenoic acid in the blood is an extremely potent anti-thrombotic factor (Huss, 1995). Fish also contains Omega III fatty acids that are known to reduce cardiovascular diseases, hypertension and arteriosclerosis, thus becoming a preferred source of animal protein for those nearing 50 years of age and above. Omega III fatty acids are also known to enhance good brain cell development in developing foetus, (thus, a vital diet for pregnant women) and intelligent Quotient (IQ) in developing children (Federal Department of Fisheries, 2005). From the foregoing, it is evident that fish is crucial to the economy and health of the nation.

2.3 Role of Fish Farming in Achieving Millennium Development Goals

Millennium Development Goals (MDGs) are a set of eight goals set by the United Nations (UN) and these goals are targeted at reducing poverty globally. When the UN Millennium Development Goals were first announced in September of 2000, a deadline of 2015 was set to halve global poverty. At that time, 15 years seemed long enough. Today, we are barely 1 year away from the deadline.

Eradication of extreme poverty and hunger is the first goal of the MDGs. The World Bank (2001) put poverty index (Poverty Line Value) at $1 per person per day for extreme poverty and $2 per person per day as general poverty line. For many people in the developed world $1 is pocket change, perhaps used towards buying a cup of coffee or a lottery ticket. Yet for millions of people living in poverty in Nigeria, $1 is more than they have to spend each day on food, shelter, clothing, health and education; it's the mark of absolute poverty. MDGs report of 2009 released by the UN Secretary-General, Ban Ki-moon, indicates that Asia has made gains that put it on track to achieve most of the eight goals but Africa including Nigeria is falling behind. In spite of this bleak report, all hope is not lost as fish farming, a powerful blue revolution, offers a huge ray of hope. Money realized from selling fish provides an important contribution to household spending. Also, government revenue from industrial or large scale fish farming can be used to support economic growth and can be specifically targeted towards pro-poor investments which will go a long way in reducing extreme hunger and poverty. According to FAO (2010), it's estimated that for each person employed in aquaculture production, about three jobs are produced in secondary activities, including post-harvest, for a total of more than 180 million jobs in the whole of fish industry. On the average, each jobholder provides for three dependants. Contribution of aquaculture

industry is not only limited to provision of job opportunities to rural, peri-urban and urban population. It also provides a new livelihood of higher income other than other agricultural activities in many countries. For example, economic return from pond fish culture is usually 4 − 6 times of the return to the same area of crops in China, which significantly contributes to poverty alleviation.

Achieving universal primary education is goal number 2 of the MDGs. Education, the development of the human mind cannot be achieved when there's no financial support either from government or home. Household income supported by money realized from fish farming will go a long way in promoting children's education. The nutritional benefits from fish also help children's development and learning abilities (Fisheries Management Science Programme, 2012). So, fish farming has a greater role to play in achieving primary education not only in Ondo State but throughout the federation.

Gender equality and women empowerment has been an issue of interest all over the world. It won't be surprising to see it as goal number three of the MDGs (Millennium Development Goals). Fish farming has a key role to play here. For women in particular, fish processing and trading provide a very important livelihood support in Ondo state and other parts of the Country. Because fish processing and trading do not require strong physical strength and can be undertaken by unskilled labour, they provide opportunities for a large number of women, many from the lowest strata of the society. For many of these women who are heads of households, fish therefore represent the primary and sometimes, the only source of income. Fish farming can actually help in empowering women (Fisheries Management Science Programme, 2012).

Fish is a vital component of diet in many parts of the world including Nigeria and Ondo state in particular, complementing the carbohydrate-based diet of the poor; and providing an important part of children's nutrition which helps their development. Regular eating of fish reduces malnutrition associated with a lot of infant deaths. In a developing Country like Nigeria, staples such as rice, maize and cassava make up the bulk of food consumed by the people and most of these staples are either lacking in essential nutrients or contain essential nutrients in minute quantity. Fish is an alternative source for the supply of these vital nutrients particularly fatty acids that are important for the development of the brain and the body. According to World Health Organization (2000) nearly 30% of humanity, including infants, children, adolescent, adults and elderly within the developing Countries are currently suffering from one or more of the multiple forms of malnutrition, food insecurity and abject poverty. Fish farming, therefore, can play an effective role in reducing infant mortality which is goal number four of the MDGs.

Income from fish farming and nutritional benefits from fish can improve maternal health and these will go a long way in reducing the menace of maternal death not only in Ondo state but throughout Nigeria. Fish consumption during pregnancy and lactation further improves the nutritional and health status of women, thus reducing vulnerability to diseases. Fish flesh is a valuable source of nutritive elements such as calcium, potassium, iron, phosphorus, selenium and vitamins such as A, B and D which help in promoting the health of women during pregnancy and after child birth (Ward, 1996). Fish protein is vital in improving the overall quality of a mixed diet and thereby, helps in improving maternal health.

Many lives have been lost all over the world as a result of the menace of Human Immuno-deficiency Virus (HIV)/Acquired Immune Deficiency Syndrome (AIDS), malaria and other diseases. Many orphans have been made as a result of HIV/AIDS and malaria is believed to be one of the biggest killers in the world. In an attempt to stem this dangerous tide, the United Nations has made fighting or combating HIV/AIDS, malaria and other diseases a top most priority. This is goal number 6 of the MDGs. According to Ward (1996), fish has been shown to contain a combination of proteins, vitamins and minerals that help to fortify affected persons against vulnerability to secondary diseases (opportunistic infections) since improved nutrition increases the effectiveness of anti-retroviral drugs.

Inoni (2007) observed that there is a decline in yield of natural fish stocks which is an indicator that fish stocks have reached the point of maximum sustainability yield since the number of catch from capture fisheries is declining, it's only proper to consider an eco-friendly agricultural system like fish farming to meet the increasing demand for animal protein. The sustainability of the environment is very important in determining the success of any farming venture. The Broundtland Commission (World Commission on Environment and Development, 1987) defined sustainable development as the ability to meet the needs of the present without compromising the ability of the future generation to meet their own needs. Coastal resources depletion and land degradation are factors that lead to poverty since continuous deterioration of coastal resources results in reduced fish catch and therefore, bring about reduction in fish protein consumption and income of fishers, thus increasing poverty level and perpetuation of its vicious cycle. These and other reasons call for serious attention to be focused on environmentally friendly agriculture system like fish farming. Enlightening,

encouraging and empowering people to practice fish farming will minimize the negative impacts of overfishing and associated environmental problems thereby promoting environmental sustainability which is the seventh goal of the MDGs.

Fish is one of the most highly traded food commodities in the world. Over 40% of all fish cross international borders (World Fish Centre, 2005). Delgado *et al*. (2003) stated that developing countries have more than doubled total fish production since 1973. The shift in fish farming in particular, especially in Thailand and Malaysia has created a major source of export revenue. Developing nations are being transformed from the status of net importers of fisheries products to that of large net exporters. FAO (2002) reported that fisheries products represented a major source of export revenue for developing Countries, amounting to over US$20 billion per annum in the late 1990s. The fishery trade is particularly important for developing nations. FAO (2014) reported that fishery trade in 2012 represented 10% of total agricultural exports and 1% of world merchandise trade in value terms. Import and export of fish between Countries promote partnership for global development which is goal eight of the MDGs.

2.4 Fish Culture Systems

Globally, different techniques of fish culture have been developed from time to time in order to obtain maximum yield of fish. According to Gupta and Gupta (2006), culture practices may be on the basis of habitat (kind of water), economic or commercial considerations, one (monoculture) or multiple organisms (polyculture), operative design of the culturing sites etc.

2.4.1 Economic consideration in fish culture system

System of culturing fishes based on economic or commercial consideration can be grouped into three namely; extensive, intensive and semi-intensive system (Gupta and Gupta, 2006).

Extensive system: - It's the least managed culture practice where there is a modest yield. It adopts the traditional technique of culture which depends on natural productivity of the pond. Some fish obtain their food exclusively from plankton e.g. Silver carp. Others such as Tilapia feed on plankton and also on bottom materials. Common carp is an efficient bottom feeder while others like grass carp consume large quantities of higher plants. Such fishes have been cultured without artificial feed but with pond fertilization.

Intensive system: - This system involves the adoption of full culture techniques including maximum feeding, water quality control, scientific pond design, full measure of stock manipulation, disease control, pond fertilization, scientific harvesting etc. With this system, maximum yield per unit of space and effort is a primary concern and highly nutritional artificial feed are used. The investment is quite huge i.e. it's characterized by high level of inputs and high rate of production. Examples are fish culture in spring-fed raceways, culture in recirculation system and net pens in the sea.

Semi-intensive system: - This system of farming takes full advantage of the natural productivity of the aquatic environment and as well as using prepared feed as supplements to increase yield further. The additional yield of fish resulting from additional feeding is profitable.

2.4.2 Design consideration in fish culture system

Culture practices also vary in magnitude and intensity, ranging from homestead (backyard) units to large scale commercial ventures. They include culture in raceway farms, culture in cage farm, pond culture, flow-through culture, culture in tank etc (Gupta and Gupta, 2006).

Raceway farms: - Raceway farms are farms designed or constructed in a way to have regular and abundant flow of good quality and well-oxygenated water. The main sources of water are springs, streams, deep wells or reservoirs. The raceway may be 'earthen' or made of concrete or cement blocks. The earthen raceways can be lined with plastic material to reduce loss of water through seepage. Raceway farms may be in series or parallel design and the design of a raceway requires the use of the contour of the land. Generally, a slope of 1-2% is suggested. One section of a raceway can be about 30m long, 2.5-3.0m wide at the bottom and 1.0-2.0m deep. A raceway farm may consist of 15 to 20 or more segments. All segments should be straight so as to ensure uniform flow of water and each segment should have a separate feeder channel. Therefore, it is important to have water control structures or weirs to regulate the flow and depth of water. Such structures are reinforced concrete, concrete blocks, culverts and metal sheet. In order to ensure regular water supply to raceway farms, a storage reservoir proves to be beneficial, if it is constructed near the mouth or beginning of a raceway system. Similarly, a suitable suction device is important for cleaning raceway bottoms.

Cage farm: - This culture practice of raising fish is particularly unique in that the fish to be cultured are kept in cages of metal mesh, nylon or bamboo mesh, left in the

flowing water. Generally, floating-type of cages are used but submersible and rigid-walled cages are also used. The floating type consists of a floating unit in the form of a framework and a flexible mesh-net cage-bag suspended under it. The floating unit may consist of empty barrels and Styrofoam polythene pipes. Nylon is commonly used for the net but woven split bamboo or weld-mesh can also be used. Cages of underwater net volume of 200 and 500m^3 are the most preferred ones. It's always advisable to have double netting, the outer one serving as a predator net to protect the inner one where the fish stock is kept. When welded, tubular metal or Poly Vinyl Chloride or fiberglass tubing is used for the framework, there is greater flexibility in shapes and sizes of the cages. There are seven ways of arranging the cages in a cage farm. It is advisable to moor cages to a jetty with easy approach, in order to facilitate work and reduce labour costs. Depending on the local conditions, the cage farms may also be installed farther away from the coast and there will be a floating house for the caretaker and a boat to have an access to the farm.

Pond farms: Ponds are bodies of quiet standing waters with only slight wind action. Most ponds used for fish culture are man-made. Ponds are of different categories e.g. embankment and excavated ponds. Embankment ponds are formed by building up a dam, dike or similar above ground structure to impound water. These are the most common ponds used for fish culture because they can be constructed in a great range or topographic conditions. Excavated ponds on the other hand, are ponds constructed by removing soil from an area to form a hole that is then filled with water. They are constructed in an area with a relatively flat topography and removal of water from such ponds is usually by pumping. The ponds may be rained and may have inlet and outlet systems for water supply. The water supply may be from a stream or from underground

wells. The water retaining ability of the pond depends on soil composition of pond bottom and subsoil water level. The natural biological productivity of such ponds depends on soil and water qualities. The carrying capacity of still-water ponds is enhanced by manuring/fertilization and ensuring water quality control.

Flow-through farms: - The real breakthrough in fish culture came with the construction of the flow-through system after realization that not the size of the water area but the quantity of water flowing through limited the yield. Fish culture in flow-through system is a type of intensive culture where the fishes are densely stocked in a long and narrow tank in which there is continuous and abundant flow of water. The fishes are stocked on the basis of the volume of inflowing water and they are fed pelletized and properly formulated feed. A continuous water flow ensures sufficient oxygen supply and flushes away metabolic wastes. The flow-through culture practice relies upon abundant and continuous water supply. The most intensive common carp production rate of 980 metric tons/hectare has been achieved at the Tanaka Running-water fish farm in Japan where there's plenty supply of running water of high dissolved oxygen content.

Tank farms: - As against the ponds, the tanks are made of concrete, fiberglass, marine plywood, metal or other hard substances. As regards their shape, the tank farms may be circular or rectangular in design.

Concrete cement tanks may be circular or rectangular. Water inlets are arranged on the wall in order to ensure proper circulation of water. Circular tanks used for catfish culture range up to 6m in diameter and 0.8m in depth, with a gradient of approximately 5cm from the circumference to the central drain. Rectangular tanks may be 8.0m long,

1.0m wide and 75cm deep. The bottom may be slopy towards one end or towards the middle for better cleaning and draining.

Fiberglass tanks are generally circular in outline and 'fiberglass' is a popular material for tank construction as it is light and strong.

2.4.3 Fish culture management

Fish growth rate and yields from fish farming enclosures can be immensely increased through emphasizing adequate management techniques, steps or procedure that enhances maximum productivity. This involves manipulating a complex of physical, biological, chemical and environmental factors that promote high stocking rate, growth rate, survival rate, good pond structure and water quality (National Special Programme for Food Security, 2005). National Special Programme for Food Security also identified the following ten commandments of fish culture management for a successful fish farming enterprise:

i. Stock healthy and disease-free fingerlings, preferably obtained from fish hatcheries and not from the wild.

ii. Avoid overcrowding, and stock correct number of fingerlings per unit area.

iii. Maintain good water level and quality always.

iv. Watch out for fish enemies (including human poachers) and eliminate or control undesirable and unwanted organisms inside and around the pond area.

v. Feed fish regularly from the same feeding spot by gradual broadcast.

vi. Avoid excessive feeding in over to prevent pond fouling and pollution.

vii. Replenish water if water colour is too deep, green or when fish begin to gather at the surface to gulp for air.

viii. Watch fish behavior for any abnormalities and immediately remove diseased, dead or dying fish (or any other dead animal found in the pond area).

ix. Maintain pond structures. Routinely check for blockages and damages and repair pond walls, pond bottom, screens, inlet and outlet water supply structures.

x. Keep accurate records of fish farming activities.

2.5 Species of Fish and Selection

To select an appropriate species of fish for culturing, consideration of farmer's knowledge; and previous experiences in fish farming are important. The availability and relatively easy access to seed stocks of appropriate species, when required, is another important consideration. Desirable characteristics for cultured species according to Australian Centre for International Agricultural Research (2006) include:

(a) Fast growing and efficient converters of food enabling them to reach marketable size within a short period of time.

(b) Market demand for that particular species because the ultimate goal of fish farming enterprise is to make profit.

(c) Acceptance as food fish to the surrounding communities; this matters significantly if the cultured fish is different from the conventional food types of that particular geographical region, and if the consumers do not know how to process or cook the species in a suitable way.

(d) Ability to co-exist with other species in a water body in order to maximize the use of available space and productivity; this is commonly known as polyculture. Since there are various forms of natural food items within a water body, different species consuming different food items can be farmed together without any conceivable competition for food and space.

(e) Ability to depend on the available natural food resources within the water body in a short food chain i.e. fish species that depend on phytoplankton, zooplankton and detrital aggregates should be stocked rather than carnivorous species.

Fish seeds can be obtained from fish farms. The average production cycle form rearing egg to fingerling stage (1-5gram) requires six to eight weeks, while for table-size fish; it ranges from 5-9 months (600-1000gram) depending on the type of fish and culture practices. Ajana (1995) asserted that culturable fish species in Ondo state and Nigeria in particular are: *Clarias gariepinus, Gymnarchus niloticus, Lates niloticus, Cyprinus carpio, Chana obscura, Tilapia niloticus, Tilapia galilea, Tilapia zili, Tilapia melanopleura, Labeo coubie, Bargus bagad, Clarotes laticeps, Citharinus spp.*

2.6 Overview of Fish Production in Nigeria

In Nigeria, fish amounts to about one fifth of total animal protein supply and this will rise in about five folds over the next forty years from 20 million metric tons to 98 million metric tons by the year 2010 (FAO, 2000). Ajana (2002) reported that the average annual demand for fish in Nigeria between 1995 and 2000 was established at 1.22 million metric tons and that this might increase to about 1.425 million metric tons by the year 2005. Adamu (2007) reported that the actual total of domestic fish production in Nigeria in 2005 was about 579,500metric tons. Nnodim (2014) reported that domestic fish production in 2014 was about 800,000 metric tons.

Akpan (1973) studied pond fish culture in Western Nigeria and discovered that pond fish culture is a viable enterprise. He stated that a well-built fish dam is a lifetime investment fully capable of paying back its fixed (investment) cost in 5 to 10 years at

maximum. With adequate management, a 4-hectare pond stocked with Tilapia, was according to him, capable of yielding a gross margin of ₦380 as against ₦850 when cultured with carp.

Esobhawan (1986) examined resource use efficiency in 47 fish farms in Ondo and Cross River States. The result of the study showed that resources were efficiently utilised in the two States. The computed elasticity of fish production showed that the fish farmers were operating in stage II of production, which is the rational stage of production. It was also observed that the fish farms enjoyed increasing returns to scale. The study proceeded to identify scarcity of feeds, inadequate training and insufficient supply of fingerlings as the main constraints hampering the development of fish farm in the two States.

Agbebi (2011) studied the impact of fish farming on poverty alleviation in Ekiti State, South-West, Nigeria. The study examined the level of fish production, socio-economic characteristics of fish farmers, fish culture management system and the contribution of fish farming to the livelihood of the poor through food supply, employment and trade. The result of the study indicated that a larger percentage of the fish farms were owned by individuals and average farm size of 28.5m^2 was recorded while the gross margin analysis revealed a profit of ₦63,055.05. The study went further to identify management lapses, disease outbreak, predators, poaching as factors that contributed to low profitability of fish farming. The study concluded by suggesting that there is need to raise awareness of huge potential economic contribution of fish farming as it is currently unappreciated and ignored by policy makers and development professionals. Until fish farming is given the right attention it deserves, only then will its potential to

contribute towards poverty alleviation, entrepreneurship, self sufficiency in fish production and increased animal protein have brighter prospects of being realised.

From the above reviews of related studies, it is clearly seen that some works had been done on fish farming but not specifically on Akure South and Owo Local Government Areas which this study intends to do by carrying out an economic analysis of fish farming and its contributions to household poverty alleviation in the two Local Government Areas.

2.7 Problems militating against Fish Farming in Nigeria

In contrast to the rest of the world, per capita fish consumption in sub-Saharan Africa including Nigeria has declined to almost half of the global average and despite suitable natural conditions; aquaculture provides only 2 percent of the region's supply of fish and little economic growth, employment and foreign exchange (World Bank, 2006). Past aquaculture development efforts have largely failed due to weak institutions, poor access to finance and a heavy reliance on failing government extension services and seed production. The focus on subsistence aquaculture may also have been misguided, as it often lacks the driving force of market demand and impetus provided by commercial reality.

The use of many small production units, mainly earthen ponds of less than 0.04 hectare in size, characterizes fish farming in Nigeria and Ondo State in particular. Other notable constraints to fish farming in the Country are inadequate supply of high quality formulated fish feeds particularly for fingerlings and brood stock, inadequate credit facility, non availability of improved species of fingerlings, the use of rudimentary

technologies, difficulty in accessing land for fish production and inadequate extension services (Tobor,1985). Also, fish farmers get little return for their efforts due to the activities of middlemen. Hence, there are low returns in terms of fish farm income to them. This, therefore, contributes to some forms of poverty among the fish farmers. Esobhawan (1986) identified scarcity of feeds, inadequate training and insufficient supply of fingerlings as the main constraints hampering the development of fish farming in Ondo State.

2.8 Poverty Profile of Nigeria

In spite of the fact that the Nigerian economy is paradoxically growing, the proportion of Nigerians living in poverty is increasing every year. The proportion of the population living below the poverty line increased significantly from 1980 to 2010 (National Bureau of Statistics, 2012) as shown in Table 2.3. NBS (2012) also reported that in terms of absolute poverty, 45.7% of Ondo State population are categorized as poor while 54.3% are classified as non poor.

Table 2. 3: Relative poverty headcount from 1980-2010

Year	Poverty Incidence (%)	Estimated Population (Million)	Population in poverty (Million)
1980	27.2	65.0	17.1
1985	46.3	75.0	34.7
1992	42.7	91.5	39.2
1996	65.6	102.3	67.1
2004	54.4	126.3	68.7
2010	69.0	163.0	112.5

Source: National Bureau of Statistics, 2012.

Figure 2.1 shows the absolute poverty measure in Nigeria in 2010.

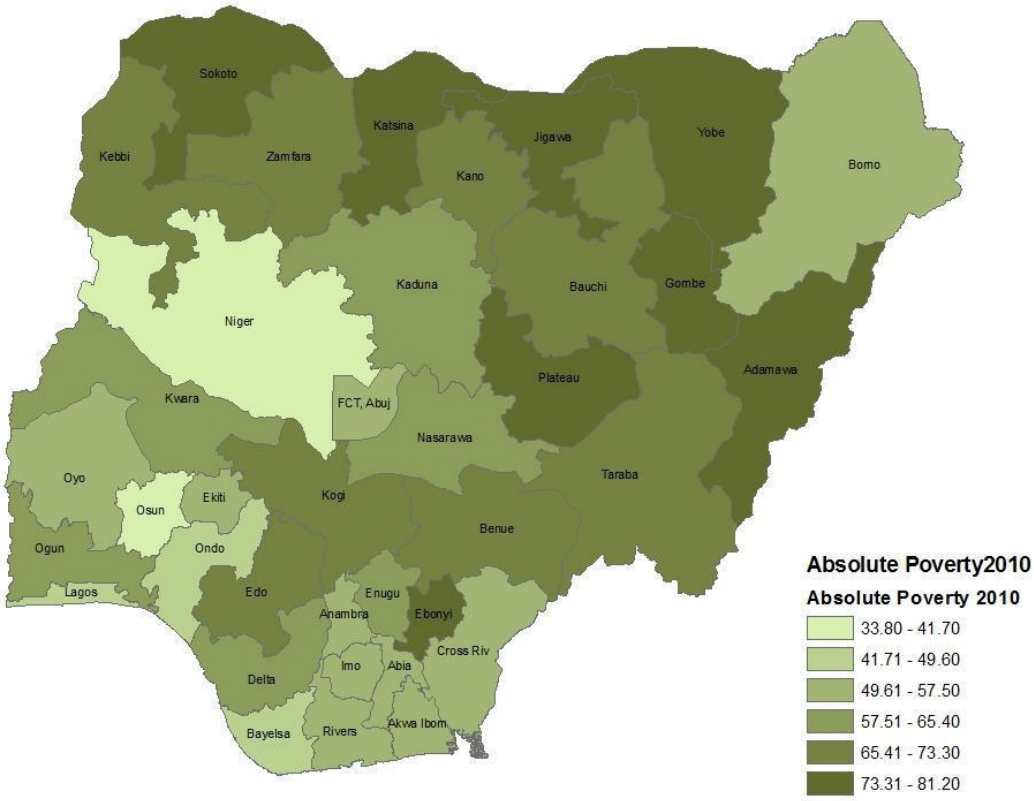


Figure 2.1. Map of Nigeria: Absolute Poverty Measure in 2010.
Source: National Bureau of Statistics, 2012.

2.8.1 Poverty reduction strategies in Nigeria

Concerned by the problems of poverty, various governments in Nigeria at one time or the other instituted various programmes aimed at alleviating or reducing poverty level among the citizenry particularly in the rural areas. Most of the poverty alleviation strategies adopted were well focused on rural areas because poverty in Nigeria is largely a rural phenomenon. However, in many part of the developing world, the numbers of poor people in rural areas exceed the capacity of agriculture to provide sustainable livelihood opportunities (Gordon and Craig, 2001). Adebayo (2014) listed various anti-poverty measures adopted by the Federal Government of Nigeria between 1972 and 2004 to include National Accelerated Food Production Programme, Nigerian

Agricultural and Cooperative Bank, Operation Feed the Nation, Directorate for Food, Roads and Rural Infrastructure, Better Life for Rural Women, National Directorate of Employment, People's Bank of Nigeria, Family Support Programme, Family Economic Advancement Programme, Poverty Alleviation Programme, National Economic Empowerment and Development Strategy. Of all these anti-poverty measures, none was specifically focused on fish farming as a veritable tool through which poverty can be alleviated. This goes to show the extent to which fish farming has largely been ignored and unappreciated by policy makers and development professionals.

2.9 Theoretical Framework

2.9.1 Tobit regression model

The Tobit model, an econometric model that involves an aspect of probit analysis was proposed by Tobin (1958). The concept was first proposed by Tobin in 1958 in the research of the demand for consumer durables. This model has the capability of estimating an equation system inversely so that the probability of an event happening or not can be captured in the dependent variable. The Tobit model is routinely employed when the values of the observed dependent variable are exclusively non-negative and are clustered at zero irrespective of whether any censoring has occurred.

The Tobit model is expressed thus:

$$Y_i^* = \alpha + \Sigma X_i \beta_j + \mu_i, \quad \mu_i \sim N(0\ \sigma^2) \text{.....(1)}$$

$$Y_i = Y_i^* \text{ if } Y_i^* > 0 \text{.....(2)}$$

$$Y_i = 0 \text{ if } Y_i^* \leq 0 \text{.....(3)}$$

Y_i^* = Latent variable

Y_i = Dependent variable

α is a constant term while X_i is a vector of independent variables; β_j is a set of parameters to be estimated and μ_i represents the normally and independently distributed error term with a mean value of zero and constant variance.

2.9.2 Profitability measurement

2.9.2.1 Net farm income analysis

Net farm income is a measure of profitability and is determined based on information derived from a business' or farm operations income statement. The term "profitability" is the difference between the value of what is produced or service provided and the cost of producing that product or providing that service. Net farm income analysis will be used to determine how profitable fish farming business is in Akure South and Owo Local Government Areas of Ondo State. This analytical technique will be used to estimate the profit or the net income which is the difference between the gross farm income and the total costs of production (Olukosi and Erhabor, 1988). The model is specified as follows:

NFI = TR-TC…….....…(4)

Where;

NFI = Net Farm Income,

TR = Total Revenue and

TC = Total Cost (Total Variable Cost + Total Fixed Cost).

2.9.3 Poverty measurement

2.9.3.1 Estimating poverty line through expenditure approach

The poverty line is the value that separates the poor from the non-poor. The World Bank (2001) puts it at $1 per person per day for extreme poverty and $2 per person per

day as general poverty line value. The poverty line value will be calculated from the adult equivalent household expenditure of the sampled fish farmers. Two-thirds of the mean household expenditure of the sampled fish farmers will be used as the poverty line value for the study. This approach has been used by research institute and several researchers (FOS 1999, Omonona 2001, FOS 2004, Kwaghe 2006, Amaza *et al*., 2007). The model is specified as follows:

P = 2/3 x *MAHE*…….....(5)

Where;

P = Poverty Line Value,

MAHE = Mean Adult equivalent Household Expenditure,

Adult equivalent = $1+ 0.7(N_{adults} - 1) + 0.5N_{children}$…….....(6)

Where;

N = Number.

2.9.3.2 Weighted poverty index

The Foster, Greer, and Thorbecke (Foster *et al*., 1984) weighted poverty index is well known for its use in quantitative poverty assessment. The *P-alpha* measures in analyzing poverty relate to different dimensions of the indices of poverty P_0, P_1 and P_2 and are used for head count ratio, depth and severity of poverty. The three measures are all based on a single formula, but each index puts different weights on the degree to which a household or individual falls below the poverty line. This measure is also useful due to its decomposability among subgroups. The poverty index is defined mathematically as follows:

$$P_{\alpha_i} = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{Z - Y_i}{Z}\right]^{\alpha} \quad \text{……...(7)}$$

Where;

α = the FGT (Foster, Greer and Thorbecke) index and takes values 0, 1, 2,

n = total number of households,

q = number of households below the poverty line,

Z = poverty line and

Yi = expenditure of the household in which individual ith lives.

CHAPTER THREE

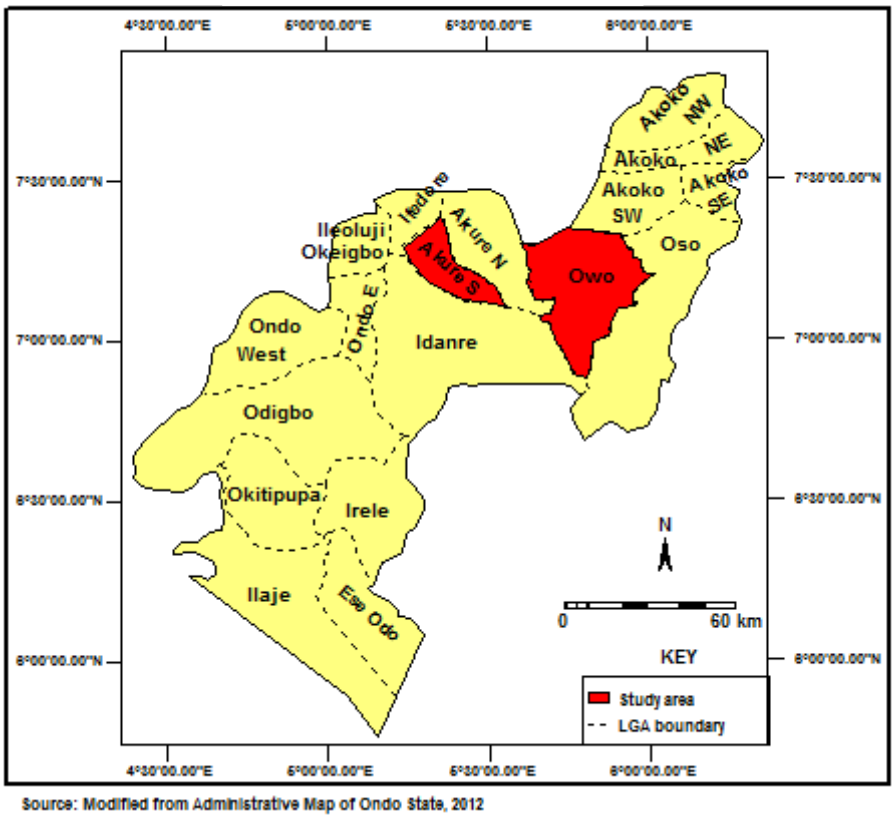
METHODOLOGY

3.1 Description of the Study Area

The study was carried out in Akure South and Owo Local Government Areas (LGAs) of Ondo State. Ondo State was created on 3 February, 1976 from the former Western State. It originally included Ekiti State, which was carved out in 1996.The capital of the State is located in Akure. Total population of the State as at 2006 was put at 3,460,877, with males accounting for 50.42% and females accounting for 49.58% (Federal Government of Nigeria, 2009). With an annual population growth rate of 2.87%, the projected population of the State in year 2015 is put at 4,354,822 (FGN, 2009). The State has a land area of 15,500km^2. The State lies between Latitudes 5^{0}45' and 7^{0}52'N and Longitudes 4^{0}20' and 6^{0}5'E. It is bounded to the East by Edo and Delta States, to the West by Ogun and Osun States, to the North by Ekiti and Kogi States and to the South by the Bight of Benin and the Atlantic Ocean (Sunshine Liberation Forum, 2011).

Akure South LGA has a land area of 331km^2 and a total population of 360,268, as at 2006 with males accounting for 178,672 and females accounting for 181,596 (FGN, 2009). With an annual population growth rate of 2.87%, the projected population of Akure South in year 2015 is put at 453,325. It is also the seat of the State Government and quite a number of the people engage in fish farming. The inhabitants are also cash and food crop farmers. They grow cash crops such as cocoa, coffee, kola nut and food crops such as yam, cocoyam, cassava and maize. Demography of the LGA could be described as both urban and as well as rural because of the population size from place to place. It is where many civil servants and farmers call home (www.ondostate.gov.ng)

Owo Local Government Area is one of the 18 Local Government Areas in Ondo State. The name 'Owo' was derived from the first ruler of the town called Ojugbelu. His pleasant manner and simple way of life earned him the name 'Owo' meaning respect, and the name was passed on to his followers and descendants. Owo traced its origin to the scenic and ancient city of Ile-Ife, the cradle of Yoruba culture. Owo as at 2006 has a total population of 222,262, with males accounting for 112,056 and females accounting for 110,206 (FGN, 2009). The projected population of Owo in year 2015 is put at 279,672. The present-day Owo is an agricultural centre that is involved in fish farming, growing and trading of yams, cassava, maize, peppers, okra, cocoa and cotton. Other commercial activities in the town include lumbering, soya beans processing etc (www.ondostate.gov.ng).



Source: Modified from Administrative Map of Ondo State, 2012

Figure 3.1: Map of Ondo State showing selected LGAs

3.2 Sample Size and Sampling Technique

A multi-stage sampling procedure was adopted for this study. In the first stage, Akure South and Owo LGAs were purposively selected out of the eighteen Local Government Areas in Ondo State for this study because of their prominence among aquaculture producing areas in the State. This prominent aquaculture status was attested to by Ondo State Fisheries Department of 2013 in which Akure South was listed as having 215 registered fish farmers and Owo LGA had 97 registered fish farmers. Simple random sampling technique was then used to select 50 fish farmers from each LGA making a total of 100 fish farmers and this represents 32% of the total fish farmers in the two LGAs.

3.3 Method of Data Collection

Primary data were collected through the use of well structured questionnaires distributed to fish farmers. The information gathered through the use of questionnaires include socio-economic characteristics of fish farmers (age, sex, level of education, household size, farming experience, source of capital), the inputs used (fingerlings, feed, water, fertilizer, lime, drug, labour), the output of the farming exercise (the quantity of table size fish harvested in kilogram) as well as expenditure of fish farmers on food and non-food items and problems militating against fish farming business.

3.4 Analytical Techniques

Data obtained from the study were analysed using descriptive statistics, Tobit regression model, net farm income analysis, expenditure approach of estimating poverty line, Foster Greer and Thorbecke poverty measure technique and z-test.

3.4.1 Descriptive statistics

Descriptive statistics was used to describe and summarize the data. This involves the use of frequency tables and percentages. These tools were used to achieve socio economic characteristics of fish farmers (objective i), species of fish and culture systems (objective ii) and problems militating against fish farming business (objective vii).

3.4.2 Tobit regression model

This analytical tool was used to examine factors such as size of pond, number of ponds, farming experience, capital, feed, labour and level of education which influence the intensity of fish farming. The Tobit regression analysis was used to achieve factors influencing the intensity of fish farming (objective iv). Intensity of fish farming was categorized into small, medium and large scale production of fish. The scale was generated from the number of fingerlings or juveniles stocked; 0 – 5,000 = small scale, > 5000 – 10,000 = medium scale and > 10,000 = large scale. This classification was adapted from the work of Ufoku *et al*. (2006) as the basis for classification of intensity of fish farming into small, medium and large scale based on the population of fingerling or juvenile stocked. The Tobit model is expressed thus:

$$Y_i^* = \alpha + \sum X_i\beta_j + \mu_i, \quad \mu_i \sim N(0\ \sigma^2) \quad \text{.....(8)}$$

$$Y_i = Y_i^* \text{ if } Y_i^* > 0 \quad \text{.....(9)}$$

$$Y_i = 0 \text{ if } Y_i^* \leq 0 \quad \text{.....(10)}$$

Y_i^* = Latent variable

Y_i = Dependent variable

X_i = Vector of explanatory variables

β_j = Parameters to be estimated

μ_i = Error term i.e. random variable which captures factors outside farmer's control

Where,

Y_i = Intensity of fish farming

The independent variables specified as factors influencing the intensity of fish farming were defined as follows:

X_1 = Pond size (m^2),

X_2 = Number of ponds owned (number),

X_3 = Feed (kg),

X_4 = Start-up capital (Naira),

X_5 = Labour (man days),

X_6 = Farming experience (number of years) and

X_7 = Level of education (schooling years)

3.4.2.1 Operational measurement of variables

Intensity of fish farming (Y): This is the scale of production or operation of each fish farmer. Intensity of fish farming was categorized into small, medium and large scale of fish production. The scale was generated from the number of fingerlings or juveniles stocked; 0 – 5,000 = small scale (which was denoted as 1), > 5000 – 10,000 = medium scale (which was denoted as 2) and > 10,000 = large scale (which was denoted as 3). This classification was adapted from the work of Ufoku *et al*. (2006) as the basis for classification of intensity of fish farming into small, medium and large scale based on the population of fingerling or juvenile stocked. This is particularly important because the level of intensification determines the quantity of table size fish that will be harvested at the end of the production cycle.

Pond size (X_1): The size of a pond whether it is concrete or earthen play a significant role in fish farming. The bigger the size of a pond the larger the number of fish it can accommodate and vice versa.

Number of ponds (X_2): The number of adequately managed ponds that a farmer has will go a long way in determining the number of fish he or she is going to harvest at the end of the season as well as the amount of profit, he or she will realize.

Feed (X_3): Feed play an essential role in fish farming. Fish that are given quality feed grow rapidly and reach marketable size within a short period of time while fish that are given poorly formulated feed have stunted growth and are susceptible to diseases.

Capital (X_4): Capital plays a uniquely important role in the success of any business. The amount of capital at the disposal of a farmer will determine how much he or she will use in buying feed, drugs and employing labour.

Labour (X_5): The need for labour in farm operations cannot be over-emphasized. Labour is needed in feeding fish regularly, changing of pond water, checking the activities of poachers and to ward off predators attack.

Farming experience (X_6): It was included in order to find out whether fish farmers who have been in the business of raising fish for years are doing better than new entrants into the business.

Level of education (X_7): This was included in order to know whether fish farmers who are educated are getting better result in terms of fish farming than fish farmers who are not educated.

3.4.3 Net farm income analysis

Net farm income analysis was used to determine how profitable fish farming business is in the study area. It was used to achieve objective iii. The net farm income specifically provides the amount of money that has been returned to the owner of the farm or business for their investment of labor, management and other resources. This analytical technique was used to estimate the profit or the net income which is the difference between the gross farm income and the total costs of production (Olukosi and Erhabor, 1988). The model is specified as follows:

$NFI = TR\text{-}TC$ .....(11)

Where;

NFI = Net Farm Income,

TR = Total Revenue and

TC = Total Cost (Total Variable Cost + Total Fixed Cost)

The fixed inputs were not normally used up in one farming cycle. The fixed inputs were depreciated using the straight line method shown below:

$$D = \frac{P - S}{N} \quad \text{.....(12)}$$

Where;

D = depreciation,

P = purchased value,

S = salvage value and

N = life span of asset

3.4.4 Estimating poverty line through the expenditure approach

This approach was used to determine the poverty line in the study area. The poverty line value was calculated from the household expenditure of the sampled fish farmers. Two-third of the mean per adult equivalent of the household expenditure of the sampled fish farmers was used as the poverty line value for the study. This approach has been used by institute and several researchers (FOS 1999, Omonona 2001, FOS 2004, Kwaghe 2006, Amaza *et al*., 2007).The model is specified as follows:

P = 2/3 x *MAHE*.....(13)

Where;

P = Poverty Line Value,

MAHE = Mean Adult equivalent Household Expenditure,

Adult equivalent = $1+0.7(N_{adults} - 1) + 0.5N_{children}$ .....(14)

N = Number

3.4.5 Weighted poverty index

The Foster, Greer, and Thorbecke (Foster *et al*., 1984) weighted poverty index is well known for its use in quantitative poverty assessment. The *P-alpha* measures in analyzing poverty relate to different dimensions of the indices of poverty P_0, P_1, and P_2 and are used for head count ratio, depth and severity of poverty. The three measures are all based on a single formula, but each index puts different weights on the degree to which a household or individual falls below the poverty line. The Foster, Greer, and Thorbecke weighted poverty index was used to determine the poverty status of fish farmers (objective v). The poverty index is defined mathematically as follows:

$$P_{\alpha_1} = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{Z - Y_i}{Z}\right]^{\alpha} \quad \text{.....(15)}$$

Where;

α = the FGT (Foster, Greer and Thorbecke) index and takes values 0, 1, 2,

n = total number of households,

q = number of households below the poverty line,

Z = poverty line and

Yi = expenditure of the household in which individual ith lives.

3.4.6 Z-test

The Z test was used to ascertain whether the profit realised from fish farming made any significant contribution to household poverty alleviation or not i.e. it was used to achieve objective vi. Z test was calculated thus:

$$Z = \frac{P - P^*}{\sigma / \sqrt{n}} \quad \text{.....(16)}$$

Where;

Z = Calculated Z value,

P = mean profit from fish farming,

P^* = Poverty line value,

σ = Sample Standard Deviation and

n = Sample size

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of Fish Farmers

This section presents the socio-economic characteristics of fish farmers such as age, level of education, gender, family size, farming experience, sources of start-up capital and nature of involvement in fish farming.

4.1.1 Age of fish farmers

Results in Table 4.1 shows that the mean age of fish farmers was 44 years, indicating that majority of the farmers were within the economically active age category (FAO, 1997; Yunusa, 1999). In support of this research finding, Fakoya and Daramola (2005) noted that respondents within this age bracket are innovative and motivated individuals who can cope with challenges that may emanate from farming activities. The age bracket (20 – 49) is an important age category with strength to tackle some of the tasks on the farm. The percentage of fish farmers found to be between the age bracket (20–49) was 63. This age category has the capacity to withstand farm stress and, perhaps explore on how best they can improve their productivities.

Table 4.1: Distribution of fish farmers according to their age

Age	**Frequency**	**Percentage**
20 – 29	14	14
30 – 39	23	23
40 – 49	26	26
50 – 59	22	22
60 – 69	11	11
> 69	4	4
Total	**100**	**100**
Average	**44**	

4.1.2 Level of education of fish farmers

The level of fish farmers' education is presented in Table 4.2. Results revealed that 1 percentage of the farmers had no formal education, 8% had primary education, 11% had secondary education while 80% had tertiary education. It is also worthy of note that the fish farmers had different levels of education based on their indicated acquired levels. The high level of education recorded in this study might be due to the metropolitan nature of the study area particularly Akure South LGA which is the seat of Government of Ondo State and the implication is that the farmers according to Olagunju *et al*. (2007) may be very receptive to new innovations. This result shows that at least more than half of the respondents had the capacity to learn new things within a short period of time based on their levels of education.

Table 4.2: Distribution of fish farmers according to their educational level

Educational level	**Frequency**	**Percentage**
No formal education	1	1
Primary education	8	8
Secondary education	11	11
Tertiary education	80	80
Total	**100**	**100**

4.1.3 Gender of fish farmers

Gender is an important factor to consider in farming activities or any other activity that demands energy. Out of all the respondents sampled, 86% were male while 14 % were female. This result can be justified by the assertion of Brummett *et al*. (2010) that fisheries activities are mostly dominated by men. However, the observation can also be said to be contrary to the report of Worby (2001) who reported that women are often motivated than men to adopt new technologies that provide nutritional benefits such as

fish culture. Based on the technologies involved which may be energy demanding, farming occupation is largely controlled by men and this may be due to the general belief that men are more energetic than women. This research finding can be further supported by the assertion of Ekong (2003) that women play minimal roles in farming among the Yorubas. Olayiwola (2013) also posited that women are more into post cropping activities such as marketing and processing of fish into consumable products like smoked fish.

4.1.4 Family size of fish farmers

The distribution of the respondents according to family size is presented in Table 4.3. Most of the farmers interviewed had a relatively large family size. Out of all the farmers sampled, 60 percent of the fish farmers had a family size of 1 – 5 persons. This result is contrary to that of Fapohunda (2005) on profitability of homestead fish farming in Ondo State where he observed that only 9.1% of the farmers had between 1 – 5 persons. Family size has implication on the size of the hired labour employed by fish farmers because the higher the size of the family the lower the hired labour and vice versa.

Table 4.3: Distribution of fish farmers according to family size

Family size	**Frequency**	**Percentage**
1 – 5	60	60
6 – 10	35	35
>10	5	5
Total	**100**	**100**
Average	**5**	

4.1.5 Years of experience of fish farmers

Experience plays significant role in any farming enterprise. The results are presented in Table 4.4. It indicated that 70% of the fish farmers had 1 – 7 years of experience. This is in consonance with the work of Nwosu and Onyeneke (2013) on the effect of productive factors of pond fish on the output of fish in Owerri, Imo State where they reported that 77.5% of the fish farmers had less than 7 years of experience in fish farming. This indicates that this type of farming is relatively new as compared to other farming practices like cocoa farming or kola nut farming which has been in existence for years. The reason why this farming practice is relatively new could be due to the fact that there is no much awareness about the large economic potential of fish farming which had suffered neglect by policy makers and development professionals. It was further revealed that 18% of the farmers had 8 – 14 years of experience in fish farming while only 12% of the fish farmers had over 15 years of experience.

Table 4.4: Distribution of fish farmers according to farming experience

Farming experience	**Frequency**	**Percentage**
1 – 7	70	70
8 – 14	18	18
15 – 21	6	6
22 – 28	5	5
> 28	1	1
Total	**100**	**100**

4.1.6 Sources of start-up capital of fish farmers

The distribution of fish farmers according to start-up capital is presented in Table 4.5. The results revealed that 61% of the fish farmers sourced their initial capital investment from their personal savings. This agrees with the work of Adewuyi *et al*. (2010) on

analysis of profitability of fish farming in Ogun State, Nigeria where they reported that 82.9% of the fish farmers financed their farms from their personal savings. The results further revealed that 16% of the fish farmers sourced their initial capital from Cooperative Society, 7% from Banks, 10% from family and friends, 3% from personal savings, Banks and Cooperative Society while 3% sourced their initial capital investment from personal savings, friends and family members. A high percentage of farmers sourcing their start-up capital from their personal savings might be connected with difficulty in accessing loan from financial institutions and high interest rate being charged by some of these lending organizations. The implication of this is that it will be very difficult for fish farmers to go into large scale fish production particularly those farmers who are targeting the foreign markets.

Table 4.5: Distribution of fish farmers according to sources of start-up capital

Sources of capital	**Frequency**	**Percentage**
Personal savings	61	61
Cooperative society	16	16
Bank	7	7
Family and friends	10	10
Personal savings, bank and cooperative society	3	3
Personal savings, family and friends	3	3
Total	**100**	**100**

4.1.7 Nature of involvement in fish farming

The results of the study indicating the nature of involvement in fish farming revealed that 37% of the fish farmers were full time fish farmers while 63% of them were part time fish farmers. A greater proportion (63%) of those into part time fish farming is a confirmation that they are likely to be engaged with other activities which took most of their time unless they delegate their responsibilities to others to help them on their

farms. This is in line with the work of Ele *et al.* (2013) on economic analysis of fish farming in Calabar, Nigeria where it was reported that 89% of the farmers who practice aquaculture were part time fish farmers. Also, 37% of those into full time fish farming indicated that they were fully devoted to their farming enterprise in order to achieve maximum results.

4.2 Species of Fish and Culture Systems

The choice of species to culture is very essential to the success of any aquaculture venture (Ugwumba and Ugwumba, 2003). Certain criteria are developed in order to select the species that are most suitable for commercial culture. The species to be cultured must have a high market value, acceptability of artificial feed, tolerance to culture condition in pond and most importantly, regular availability of fish seed for culture. The most common species of fish being raised in the study area is catfish (88%). This is in consonance with the work of Ele *et al.* (2013) on economic analysis of fish farming in Calabar, Nigeria where they observed that the major species of fish stocked by farmers was catfish. The implication of this is that most of the farmers practice what is known as monoculture which is the system of culturing a single species of fish. Adducible reasons why farmers raise catfish are its rapid growth rate, wide market acceptability and its high flesh to bone ratio. The number of fish farmers raising more than one species was very minute. Only 12% of the farmers raised catfish together with tilapia (polyculture i.e. the system of culturing more than one species of fish).

4.2.1 Sources of fingerlings and juveniles

The availability of fish seed within reach of entrepreneurs is of economic importance in agribusiness. Fish seed (fingerlings and juveniles) are production factors which can

either be raised by the farmer or purchased from other sources. The results of the sources of fish seed are presented in Table 4.6. A large number of the fish farmers (86%) purchased their fish seed from fish farms. This agrees with the work of Raufu *et al*. (2009) on the determinants of yield performance in small scale fish farming in Alimosho LGA of Lagos State where they reported that 62.9% of the fish farmers in the LGA obtained their fish seed from fish farms. The results further revealed that only 4% of the fish farmers purchased and also bred their fish seed while 10% bred the fish seed they used for raising table size fish. From the results, it is clearly seen that no farmer obtained his/her fish seed from the wild as seed obtained from the wild do not grow rapidly and they are also possible sources of new diseases.

Table 4.6: Distribution of fish farmers according to sources of fish seed

Sources of fish seeds	**Frequency**	**Percentage**
Purchased from fish farms with hatchery	86	86
Purchased from fish farms and self bred	4	4
Self bred	10	10
Total	**100**	**100**

4.2.2 Rearing facilities of fish farmers

The distribution of fish farmers according to facilities used for rearing fish is presented in Table 4.7. A fraction of the farmers (15%) cultured their fish in concrete ponds, 6% made use of concrete and earthen ponds and 1% used plastic pond. A lot of the fish farmers (78%) cultured their fish in earthen pond. This agrees with the work of Ele *et al.* (2013) on economic analysis of fish farming in Calabar, Nigeria where they reported that earthen pond was mostly preferred by fish farmers in Calabar. This could be due to the fact that earthen ponds are easier to manage and production is usually faster because of the addition of natural food to supplement artificial feed being given to fish.

Table 4.7: Distribution of fish farmers according to rearing facilities

Pond	Frequency	Percentage
Concrete	15	15
Concrete and earthen	6	6
Plastic	1	1
Earthen	78	78
Total	**100**	**100**

4.2.3 Sources of water

Water is an indispensable input in fish rearing. Fish need water to grow and that is one of the reasons why adequate and constant source of water is a must for every farmer that wants to achieve the best in terms of raising fish either for fingerling or table size. The sources of water used for raising fish are presented in Table 4.8. A significant portion of fish farmers (74%) sourced their water from the stream as this had little or no cost attached to it. This agrees with the work of Joshua *et al*. (2012) on economic viability of catfish farming in Nasarawa State where they observed that 53.3% of the fish farmers sourced their water from streams.

Table 4.8: Distribution of fish farmers according to sources of water

Water sources	Frequency	Percentage
Borehole	4	4
Stream	74	74
Underground	2	2
Well	12	12
Well and rain	2	2
Well and stream	6	6
Total	**100**	**100**

4.3 Factors Influencing the Intensity of Fish Farming

The results of the Tobit model estimates of factors influencing the intensity of fish farming are presented in Table 4.9. In order to determine the influence of some factors such as the size of pond, feed, capital, labour etc on the intensity of fish farming in the study area, a Tobit regression analysis was conducted.

Table 4.9 Tobit model estimates of factors influencing fish farming intensity

Variables	**Coefficients**	**SE**	**t-ratio**
Constant	0.5381	0.1429	3.765***
Pond size	0.0004	0.0001	3.515***
Number of ponds owned	0.1051	0.0155	6.782***
Feed	0.6411	0.1311	4.891***
Start-up capital	-0.6771	0.2846	-2.379**
Labour	-0.0003	0.0001	-2.828***
Farming experience	0.0105	0.0059	1.798*
Educational level	0.0169	0.0072	2.357**
Number of observations	100		
Sigma	0.3095	0.0218	14.142***
Log likelihood	-24.6139		

*** Significant at 1%, **Significant at 5%, * Significant at 10%, SE = Standard error

The results in Table 4.9 indicated that factors such as pond size (0.0004), number of ponds owned (0.1051), feed (0.6411), start-up capital (-0.6771), labour (-0.0003), farming experience (0.0105) and level of education (0.0169) had influence on intensity of fish farming which implies that they were significant .

The coefficient of pond size was found to be positive and significant at 1%. The implication of this is that the bigger the size of the pond the greater the intensity of fish farming or the larger the scale of production of fish farmer which could lead to an

increase in the quantity of table size fish that will be cropped at end of the production cycle. This is in tandem with the work of Inoni (2007) on allocative efficiency in pond fish production in Delta State. He reported that there is a direct relationship between pond size and fish output.

The coefficient of the number of ponds owned by farmers was positive and significant at 1%. The significant impact of number of ponds owned imply that as number of ponds increases, given other inputs, the scale of production of fish farmers will expand. Therefore, if other inputs are available to increase production capacity, the farmer will have no choice but to increase the number of his ponds if existing ponds are stocked to their optimum capacity. This also agrees with the work of Inoni (2007) on allocative efficiency in pond fish production in Delta State that pond is a critical variable upon which fish output depends.

The coefficient of the amount of feed used was positive and significant at 1%. Feed are vital components of fish farming that if under or over utilized can affect total output of fish farmers. The significance of feed means that there was a direct relationship between the amount of feed consumed by fish and the scale of production of the farmer and invariably fish yield. This is in consonance with the work of Inoni (2007) on allocative efficiency in pond fish production in Delta State. The result of this study also agrees with the work of Onoja and Achike (2011) on resource productivity in small scale catfish farming in Rivers State that fish feed administered had the highest contribution to fish output. This may not be surprising as adequate feeding regime is very necessary for the growth, health and output size of fish to be sold.

The coefficient of start-up capital was significant at 5% but negative. The implication of this result is that the optimum level of capital utilization under the current scale of fish production might have been reached. It must also be noted that 63% of the fish farmers were part time farmers i.e. they engaged in other activities that give them money to draw from whenever the need arises in terms of fish production. Since, a larger number of the farmers are part time farmers; they might not have the technical knowledge in the optimal allocation of productive resources. This result is contrary to the work of Nwosu and Onyeneke (2013) on the effect of productive factors of pond fish on the output of fish in Owerri, Imo State. They reported that capital made positive and significant contribution to the output of farmers who started their fish farming with high amount of capital.

The coefficient of labour was significant at 1% but negative. Although, unlike some of the other variables, the influence of labour was negative and highly statistically significant, this could imply that the use of labour under the current scale of fish production might have reached the optimum level. Therefore, additional increase in the amount of labour use might exert a depressing effect on the result of scale of fish production which ultimately is fish yield. Also, family labour is a readily available pool of labour to draw from whenever the need arises and the tendency to over-utilize in an operation of this scale cannot be over-emphasized. This agrees with the work of Inoni (2007) on allocative efficiency in pond fish production in Delta State that there was an inverse relationship between labour and fish yield.

The coefficient of farming experience was positive and significant at 10%. This indicates that there was a direct relationship between the years of experience of fish

farmers and scale of fish production. This further connotes that an increase in the year of farmers' experience could lead to farmers intensifying their scale of fish production. This is contrary to the work of Ele *et al*. (2013) on economic analysis of fish farming in Calabar, Cross River State, Nigeria. They reported that one does not need to have much experience before going into fish production.

Level of education was positive and significant at 5%. This implies that the level of education acquired by fish farmers serves as a guide on whether they are to practice small, medium or large scale fish production. Therefore, level of education could lead to high intensification of fish production. This is contrary to the work of Ugwumba and Chukwuji (2010) on the economics of catfish production in Anambra State, Nigeria. They observed that the level of education does not determine the ultimate goal of scale of fish production which is profit maximization.

4.4 Profitability Analysis

The study examined the profitability of fish production in the study area. The costs and returns analysis is presented in Table 4.10. The average total cost of production for all the farms amounted to ₦792,155.55. Out of this amount, the total variable costs accounted for ₦782,264.13 or 98.75%, leaving only 1.25% for the fixed cost items. Cost of feed alone constituted about 78.41% of this total cost figure, corroborating the findings of Ugwumba *et al*. (2006) that cost of fish feed accounted for over 60% of the total cost of production. Cost of stocking pond with fingerlings or juveniles distantly followed with 11.97% while labour cost was 7.71%. The farms generated total revenue of ₦1,647,476.00 and a net farm income of ₦855,448.45 at the end of the production cycle. This agrees with the work of Ele *et al.* (2013) on economic analysis of fish

farming in Calabar, Nigeria where they reported that aquaculture was a profitable agribusiness among fish farmers in Calabar. Average quantity of table size fish harvested was 3097.00 kilogram and, a kilogram of table size catfish was sold on the average for ₦532.00. The profitability analysis showed that for every one naira invested in fish farming business, there was a profit of ₦1.08. The fixed inputs were depreciated using the straight line depreciation method. It must be noted here that not all the fish farmers own their production inputs such as pond, net and pumping machine; some of the farmers rented these inputs.

Table 4.10: Average costs and returns of fish farming per production cycle

Items	Cost	Cost/m^2	Percentage of cost
A. Variable costs (₦)			
Feed	621,116.70	1759.54	78.41
Fingerling/Juveniles	94,849.55	268.70	11.97
Lime	349.90	0.99	0.04
Fertilizer	183.10	0.52	0.02
Drugs/Supplements	598.40	1.70	0.08
Labour	61,093.00	173.07	7.71
Fuel	2,469.48	7.00	0.31
Miscellaneous	1,604.00	4.54	0.20
Total variable costs (TVC)	782,264.13	2216.05	98.75
B. Fixed costs (₦)			
Cost of renting pond	1,300.00	3.68	0.16
Cost of renting pumping machine	96.00	0.27	0.01
Cost of renting net	322.00	0.91	0.04
Pond	3,436.50	9.74	0.43
Pumping machine	1,011.00	2.86	0.13
Nets	3,202.42	9.07	0.40
Weighing scale	523.50	1.48	0.07
Total fixed costs (TFC)	9,891.42	28.02	1.25
Total costs = (TVC+TFC)	792,155.55	2244.07	100.00
C. Revenue (₦)			
Average fish quantity harvested	3097.00 kg	8.77kg	
Average price of fish per kg	532.00		
Total Revenue (TR)	1,647,604.00	4667.43	
D. Net Farm Income (NFI)			
NFI = TR-TC	₦855,448.45	2423.37	
Returns to Naira invested (NFI/TC)	1.08		

Average pond size = 353.00m^2

4.5 Poverty line among Fish Farmers

A poverty line value of ₦13,856.34 per month was computed and used for this study. In determining the poverty line, the study measured the well being of the fish farmers by their consumption expenditure and by their household size using the adult equivalent. Expenditure per adult equivalent for each household was gotten by dividing each household expenditure on monthly basis by the adult equivalent. Secondly, the expenditure per adult equivalent for all the households was summed up to give a total expenditure value of ₦2,078,450.33. Then, the mean household expenditure was calculated by dividing the total expenditure per adult equivalent household (₦2,078,450.33/100) by the sample size of 100 to give a value of ₦20,784.50. The poverty line value was gotten by taking the two-third of the mean household expenditure 2/3(20,784.50) to give ₦13,856.34. With this value, it was clearly shown that only 36 percent of the fish farmers were below the poverty line i.e. moderately poor.

4.5.1 Poverty status of fish farmers

With the poverty line value (Z) calculated, total expenditure of the poor (TEP) was calculated by summing up all the expenditures of all the households below the poverty line to arrive at a value of ₦370,517.43. AEP (Average expenditure of the poor) was gotten by dividing the total expenditure of the poor by the number of those below the poverty line; (₦370,517.43/36) to give ₦10,292.15. Poverty incidence (P_0) was calculated by dividing the total number of poor households by the sample size; (36/100) to give 0.36. The poverty incidence value of 0.36 indicates that 36% of the farmers were below the poverty line. Poverty gap ratio (PGR) was calculated by finding the difference between poverty line value and the average expenditure of the poor and

expressing it as a fraction of the poverty line; (₦13,856.34 – ₦10,292.15)/₦13,856.34 to give 0.26 which indicates the ratio of average extra consumption that would be required to bring all poor fish farmers to the poverty line. Poverty depth ($P_{1)}$ was gotten by multiplying the poverty incidence by the poverty gap ratio; (0.36 x 0.26) to give 0.09 which implies that the depth of poverty among the farmers was only 9%. Poverty severity (P_2) was calculated by multiplying the poverty incidence by the poverty gap ratio raised to the power of 2; 0.36 x $(0.26)^2$ to give 0.02 which indicates that the severity of poverty among the fish farmers was just 2%.

4.6 Contribution of Fish farming to Poverty Alleviation

The contribution of fish farming to poverty alleviation was ascertained using z test. At 5% level of significance, the calculated z value (290,060.31) was greater than the tabulated or critical value (1.96). It hereby ascertained that fish farming contributed significantly to household poverty alleviation. This is in line with the work of Agbebi (2011) on impact of fish farming on poverty alleviation in Ekiti State who reported that fish farming was profitable in the State and that it also contributed towards poverty reduction. With the poverty line value of ₦13,856.34/month already computed from fish farmers' expenditure, which translates to ₦461.89/day and which is higher than one dollar a day poverty line benchmark of the World Bank, it goes further to show that household spending is greatly being supported by profit realized from selling fish.

4.7 Problems facing Fish Farmers

Fish farmers encountered many problems during the process of rearing fish. These problems include inadequate capital, insufficient fingerlings or juveniles, inadequate extension service, inadequate market and high cost of feed. The results are presented in Table 4.11.

High cost of feed (33.06%) was indicated by the farmers as the most serious constraint to fish farming. This situation was equally the case in the costs and returns analysis where cost of feed constituted 78.41% of total cost of production of the farmers. The importation of most commercial feed into the country and problems associated with importation and distribution could be the main reasons for the hike in feed prices. These commercial feed possess floating and high protein qualities and are therefore preferred by fish farmers. Ugwumba and Nnabuife (2008) also identified high cost of feed as serious setback to profits realizable from fish farming. Good quality fish feed are expensive are as a result of high cost of most fish feed ingredients particularly fish meal. Also, there are few commercial fish feed producers in Nigeria and Ondo State in particular and this makes a lot of fish farmers to depend on imported quality fish feed which are very expensive. This increases their cost of production and reduces their profit margin.

The second serious problem in decreasing order of magnitude was the problem of insufficient capital (22.98%). Fish farming is capital intensive and thus requires big capital investment for reasonable profit to be made (Ugwumba and Chukwuji, 2010). Many fish farmers do not have sufficient capital to either operate their farms profitably or expand them. The situation is made difficult by the unwillingness of financial

institutions to grant loan to farmers. Most fish farmers find it difficult to secure loan from financial institution because they do not have the required collateral security.

Marketing of fish (12.09%) is becoming a problem in Ondo State as result of near glut situation currently being experienced. Also, there are no coordinated marketing programmes which can actually link farmers to markets and as a result many fish farmers sell their fish to middle-men at very low prices. Also, fish farmers association in Ondo State does not have an outlet of their own where members can take their fish to for sale.

Poaching (7.26%) is a threat that may snowball into a big problem to the aquaculture industry in Ondo State and Nigeria if not properly checked. Many farmers have lost some of their stocks to the activities of poachers. This is most common in fish farms that are not fenced at all or farms with low perimeter fencing. As a result of this, many fish farmers may find it difficult to recoup their initial capital investment.

There have been series of complaints coming from farmers on not getting adequate extension service from the government either at the State or local government level. Farmers need adequate information especially on culture systems, suitable soil and topography for pond construction, water quality control, feeding regime, stocking rate and post harvest management and when this information are not provided at the right time, it can lead to serious setback which can make farmers not to reach their target goal especially in the area of profit maximization.

Table 4.11: Problems facing fish farmers

Problems	**Frequency***	**Percentage**	**Rank**
High cost of feed	82	33.06	1st
Inadequate capital	57	22.98	2nd
Inadequate market	30	12.09	3rd
Poaching	18	7.26	4th
Inadequate extension service	14	5.65	5th
High cost of drilling bore hole	12	4.84	6th
Flooding	10	4.03	7th
Insufficient fish seed	8	3.23	8th
Predators	6	2.42	9th
Water shortage during dry season	5	2.02	10th
Diseases	5	2.02	10th
Bad breed	1	0.40	12th
Total	**248**	**100.00**	

*Multiple responses

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study assessed the economics of fish farming and its contribution to household poverty alleviation in Akure South and Owo Local Government Areas of Ondo State. A multi stage sampling technique was used to select 100 fish farmers for this study. Data were collected using structured questionnaires administered to fish farmers and analyzed using descriptive statistics, net farm income analysis, expenditure approach of estimating poverty line, Foster, Greer and Thorbecke technique for measuring poverty, Tobit regression analysis and z test in order to achieve the set specific objectives.

The study revealed that 63% of the fish farmers were in the economically active age group of 20 – 49 years. The study went further to reveal that 88% of the farmers practiced monoculture (catfish only) and 12% practiced polyculture (combination of catfish and other species of fish). Earthen pond was well used by the farmers to culture their fish as 78% of them made use of it.

The Tobit regression analysis revealed that all the independent variables significantly determined the intensity of fish farming. The calculated z value ascertaining the contribution of fish farming to poverty alleviation was statistically significant at 5% level of probability.

The costs and returns analysis showed that the cost of feeding constituted 78.41% of the total cost of production while cost of stocking pond and labour constituted 11.97% and 7.71% respectively. A kilogram of table size catfish was sold on the average for

₦532.00 and an average profit of ₦855,448.45 was realized from an average quantity of 3097.00kg of fish harvested from an average pond size of 353.00m^2 and for every one Naira invested in the business there was a profit of ₦1.08. A poverty line value of ₦13,856.43 was computed from the consumption expenditure of the farmers and it was revealed from the research findings that 36% of the fish farmers were below this poverty line. Notable among the problems facing fish farmers were high cost of feed, inadequate capital, inadequate market and poaching.

5.2 Conclusion

Variables such as pond size, number of ponds, feed, start-up capital, labour, years of experience and level of education determined significantly the scale of fish production in the study area. The costs and returns analysis showed that fish farming was a profitable agricultural business in the study area which makes it an attractive entry point to improve the economic status of fish farmers thereby reducing the level of poverty among fish farming households and in the society at large.

5.3 Contribution to knowledge

i. The remarkable emergence of fish farming as a tool for wealth creation cannot be over-emphasized. From the result of this research, it was clearly seen that an average quantity of 3097.00 kilogram of table size fish was harvested from an average pond size of 353.00m^2 that was stocked with an average number of 4,406.00 juveniles in one production cycle and the total cost of production incurred was ₦792,155.55. The implication of this is that for every metre square size of pond stocked with 12 juveniles, 8.77 kilograms of table size fish was harvested and the total cost of production incurred was ₦2,244.07 in one

production cycle and the total revenue was ₦4,667.43 since a kilogram of table size catfish was sold for ₦532.00 leading to a profit of ₦2,423.37 being realised per metre square. Based on this research finding of 8.77 kilograms of table size harvested per metre square, it is possible to realize a harvest of 4,385.00 kilograms of table size fish from a pond size of 500.00m^2 in the study area.

ii. The poverty analysis showed that 36% of the farmers were below the poverty line value of ₦13,856.43. Also, poverty depth among fish farmers was 9% while poverty severity was 2%. These results indicate that poverty was not all that prevalent among fish farmers in the study area.

iii. The profitability analysis showed that the cost of feeding alone constituted 78.41% of the total cost of production. Feed, therefore, is the most important input in fish production. As a result, there must be adequate amount of quality feed that must be fed to fish if a reasonable level of productivity is to be achieved by the farmer.

5.4 Recommendations

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

i. There is need for training to enhance capacity in terms of fish farmers compounding fish feed themselves. Farmer's profit margin will be raised significantly if they are able to compound the feed themselves as this will help them to reduce the amount of money they spend on conventional feed.

ii. Financial institutions should be more pro-active in granting loans to fish farmers and would be investor especially feed producers at a reduced interest rate but with proper monitoring. Access to loan will help farmers to practice modern culture system such as re-circulatory aquaculture system which requires huge capital investment and the yield is also very high.

iii. The menace of poaching can be reduced by fencing off the farm and through the employment of trustworthy security personnel for those who have big fish farms. Curtailing the menace of poaching will help farmers to safeguard their investments and this will ensure that they do not run at a loss and that the level of poverty among farmers does not increase.

iv. Access to market is very crucial for fish farming development. Farmers should pool their resources together and get an outlet where they can market their fish at reasonable price which will ensure good returns for their investments of money, time and energy i.e. it will help farmers to increase their profit thereby contributing to household poverty alleviation. Farmers should also link directly with buyers such as owners of fast food chains, social centres and avoid the problem of intermediaries (middle men) who rip them off. Farmers can also employ the option of niche marketing i.e. producers in one area can take profitable advantage of the inability of farmers in other areas to supply for a particular period. Alternatively, farmers should also consider the option of smoking their fish for sale instead of selling them fresh to middle men as some consumers especially those who have heart-related diseases prefer smoked fish to fresh fish.

v. Tackling poverty requires a holistic approach by all and sundry. Therefore, agricultural experts, rural development professionals and policy makers should raise more awareness on the poverty alleviation potential of aquaculture.

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APPENDIX I

QUESTIONNAIRE ON ECONOMIC ANALYSIS OF FISH FARMING AND ITS CONTRIBUTION TO HOUSEHOLD POVERTY ALLEVIATION IN AKURE SOUTH AND OWO LOCAL GOVERNMENT AREAS OF ONDO STATE, NIGERIA

Dear respondent, the questions below are in respect of the above mentioned M.sc research topic which is basically for academic purpose. Please read the questions carefully and provide appropriate answers to them. All information provided will be kept confidential and will not be used for tax imposition.

Town/Village of residence.....

Local Government Area of residence.....

Date: .....

(A) SOCIO ECONOMIC CHARACTERISTICS OF RESPONDENT

Please tick where necessary

(1) Sex: Male ( ) Female ( )

(2) Age: .....

(3) Marital status: Single ( ) Married ( ) Divorced ( ) Widowed ( )

(4) How many of your household members fall in the following categories?

Category	Number of male	Number of female
Children		
Adults		

(5) What is your status of education? No formal education ( ) Primary school ( ) Secondary school ( ) NCE ( ) B.Sc. ( ) M.Sc. ( ) others (specify) .....

(6) What is the nature of your involvement in fish farming? Part time ( ) Full time ( )

(7) Do you do any other job apart from raising fish? Yes ( ) No ( )

(8) If yes, what job is it? .....

(9) How much do you earn from this job on monthly basis? .....

(10) How many years of experience do you have as a fish farmer? Less than 5 years ( ) 5 – 10yrs ( ) 11 – 16yrs ( ) 17 – 22yrs ( ) 22yrs and above ( )

(11) What type (species) of fish do you raise? Cat fish ( ) Tilapia ( ) others (specify).....

(12) What are the reasons for raising such type (species) of fish? Grow rapidly ( ) Highly resistant to diseases ( ) Most consumers prefer because of its flesh ( ) It's the most popular food fish ( ) others (specify).....

(13) What actually attracted you to fish farming? To be self-employed ( ) To supplement household income ( ) My parents are into it ( ) People say it is highly profitable ( ) it is my profession ( ) Retired from work but not tired of doing something ( ) others (specify).....

(14) How much (capital) did you use to start your fish farm?.....

(15) How did you get the capital used for starting your fish farm? Personal savings ( ) Loan ( )

(16) If it is loan, from where did you obtain the loan? Banks ( ) Friends ( ) Cooperative societies ( ) Family members ( ) others (specify).....

(**B) POND DATA**

(1) What is the size of your fish pond (in metres)? Length: ..... Breadth..... Depth: .....

(2) How many fish ponds do you have? .....

(3) What type of pond do you have? Earthen pond ( ) Plastic pond ( ) Concrete pond ( ) Fibre glass pond ( ) Recirculatory pond ( ) others (specify).....

(4) Why do you prefer that kind of pond?.....

(5) How much did it cost you in constructing or building a pond?.....

(6) What is the stocking density for fingerling per pond? 1–50/m^2 ( ) 51–100/m^2 ( ) 101–150/m^2 ( ) 151–200/m^2 ( ) others (specify).....

(7) What is the source of water used in raising fish? Borehole ( ) Well ( ) Rain ( ) Stream ( ) others (specify).....

(8) At what interval do you change pond water? Daily ( ) Weekly ( ) Fortnightly ( ) others (specify).....

(9) What is the source of fingerlings used? Purchased ( ) Self-bred ( )

(10) If purchased, how much does each cost? .....

(11) If bred, what is the cost incurred per fingerling? .....

(12) How many fingerlings do you stock per pond in a production cycle? .....

(13) How many do you harvest as table size fish? .....

(14) How many of these table size fish are catfish? .....

(15) How much do you sell a kilogram of catfish? .....

(16) How many of these table size fish are tilapia? .....

(17) How much do you sell a kilogram of tilapia? .....

(18) How many of these table size fish do you and your family consume per month?.....

(19) How many table size fish were you and your family consuming per month before you started raising fish?.....

(20) How many table size fish do you give out as gift? .....

(21) How many table size fish normally get damaged? .....

(22) What is the average weight of your table size fish at harvest? 0.5kg ( ) 0.6kg ( ) 0.7kg ( ) 0.8kg ( ) 0.9kg ( ) 1kg ( ) others (specify).....

(23) What is the age of your table size fish at harvest? 5months ( ) 6months ( ) 7 months ( ) others (specify).....

(24) How many times do you produce table size fish in a year? Once ( ) Twice ( ) Thrice ( ) others (specify).....

(25) Do you also produce fingerlings for sale? Yes ( ) No ( )

(26) If yes, how many do you produce in one production cycle? .....

(27) How many normally die? .....

(28) How much do you sell a fingerling?.....

(29) How many times do you produce fingerlings for sale in a year? Once ( ) Twice ( ) Thrice ( ) others (specify).....

(C) FISH MARKETING

(1) Is the price of a kilogram of table size fish stable throughout the year? Yes ( ) No ( )

(2) If no, what is the price range like? .....

(3) Is the price of a fingerling stable throughout the year? Yes ( ) No ( )

(D) FEED DATA

(1) What type of feed do you use? Pelletized feed ( ) Self-compounded feed ( ) others (specify).....

(2) How many times do you feed your fish per day? Once ( ) Twice ( ) More than 2 times ( )

(E) VARIABLE COSTS

	Items	Quantity/Month	Unit price	Total cost
i	Feeds			
ii	Lime			
iii	Fertilizer			
iv	Drugs/Supplements			
v	Hired Labour			
vi	Family Labour			
vii	Fuel for pumping machine			
viii	Miscellaneous			

(F) FIXED COSTS

	Items	Cost	Estimated life
i	Pond construction		
ii	Fencing		
iii	Nets		
iv	Weighing scale		
v	Pumping machine		
vi	Land		

(G) FISH REARING CHALLENGES

(1) What are the problems militating against fish farming in your area?

Inadequate capital ( ) Insufficient fingerlings ( ) Inadequate extension service ( )

Inadequate market ( ) High cost of feeds ( ) High cost of drilling bore hole ( )

Poaching ( ) others (specify).....

(H) HOUSEHOLD EXPENDITURE

Please, indicate the amount you and your family spend on these items for household consumption

ITEMS	AMOUNT/MONTH(Naira)
Food (rice, beans, yam, meat, fish, groundnut oil, palm oil, sugar, salt, maggi, beverages, bread etc)	
Drinks (beer, palm wine, soft drinks, sachet water etc)	
Clothing (wears)	
Rent	
School fees (annual amount)	
Health	
Celebrations (birthday etc)	
Shoes (leather, plastic)	
Kerosene/Gas	
Toothpaste	
Detergents, washing and bathing soaps, body creams.	
Petrol for generator	
Petrol for vehicle/motor cycle	
Repairs of vehicle/motor cycle/bicycle	
Remittances/Gifts/Donations	