TITLE: FISH CULTURE PRACTICES IN RELATION TO TYPE OF FISH FEED USE BY FARMERS IN EDO STATE, NIGERIA

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CHAPTER ONE

1.0 INTRODUCTION

Fish farming involves raising fish in tanks or enclosures, usually for food or commercial purposes. However, in Nigeria it is currently becoming a very lucrative business and it's mainly boosted by the continuous rise in the demand for the African catfish. This trend therefore makes monoculture of catfish the most popular form of fish farming in Nigeria with *Clarias gariepinus*, *Heteroclarias spp.* and *Heterobranchus spp.* being the most desirable for culture (Adekoya *et al*., 2006), and they have remained an important species for research in aquaculture. Fish farming has become a worldwide practice and has been for years. Increase aquaculture production is clearly needed to meet this demand in the third millennium because capture fisheries are at capacity of showing perception decline due to over fishing, habitat destination and pollution (World Bank, 2005).

Fish culture, which is the rearing of fish species under controlled environment has proved to be an important sector in the Nigerian economy and a successful method of enhancing fish production in the world (Food and agriculture organisation (FAO), 2002; International Food Policy Research Institute (IFPRI), 2003). But, good nutrition in animal production system is essential to produce a healthy, high quality product. Feeding cost represents the largest single cost item of most fish farm operations, accounting for about 60% of the total cost of fish production according to some research (Jamu and Ayinla, 2003).

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Fish nutrition has advanced dramatically in recent years with the development of new balanced commercial diets that promote optimal fish growth and health. The development of new species' specific diet formulations support the aquaculture (fish farming) industry as it expands to satisfy increasing demand for affordable, safe, high quality fish production (Craig and Helfrich, 2002). Fish have a certain biological requirement for nutrients in order to have a healthy, vigorous growth and these nutritional requirements vary mainly depending on the species, its size / life stage and the environment (Robb and Crampton, 2013). According to Hecht (2000), it is observed that the research on inexpensive feed ingredients has not contributed greatly to aquaculture development in Africa and suggested that more research on how best plant protein can be used as fish feed is required. Development and management of fish feed, play very vital role in aquaculture growth and expansion.

In 2012, aquaculture recorded all-time high production and now provides almost half of all fish for human food. If responsibly developed and practiced, aquaculture can generate lasting benefits for global food security and economic growth (FAO, 2014). In Nigeria, the current demand for fish is about four times the level of local production. Aquaculture, an aspect of fisheries is an integral part of agriculture which was found to have the capacity to increase the country's GDP (Gross Domestic Product) and can solve the unemployment problem for our teeming youths if adequately managed (Emmanuel *et al*., 2014).

Fish production is economically viable and Nigeria has the resources to produce up to 5 million metric tonnes annually (Zayyard, 2008). For instance, Edo State is richly endowed with abundant inland water-bodies, flood plains-wetlands which are highly productive and ideal for artisan fisheries and aquaculture development (Edo State Economic Empowerment and Development Strategy (Edo SEEDS), 2005). Edo state is a natural habitat for fresh water fish and other aquatic organisms. There is abundant rainfall, effective harvesting and storage of surface water run-off which has made it suitable for catfish production (Adikwu, 1999). A

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good agricultural system when efficiently and effectively practiced result to several benefits including: Profit making, job creation, provision of raw materials for several industries and increase in foreign exchange earnings (FAO, 2006). The potentials and importance of fish culture to the Nigerian economy cannot be overemphasized.

1.1 JUSTIFICATION OF STUDY

Fish farming or culture (an aspect of aquaculture) is an integral component of the overall agricultural production system in Nigeria. The major species cultured in Nigeria include tilapias, catfish and carp; however the African catfish (*Clarias gariepinus)* is the most farmed (Agbede *et al.*, 2003). In addition, fish products are relatively cheaper compared to beef, pork and other animal protein sources in the country (Federal department of fisheries (FDF), 2008).

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Fish requires high quality nutritionally balanced diet for growth and attainment of market size within the shortest possible time (Gabriel, 2007). However, fish feed technology is one of the least developed sectors of aquaculture particularly in Africa and other developing countries of the world (FAO, 2003) which includes Nigeria. Feed is one of the major inputs in aquaculture production. It is one of the fundamental challenges facing the development and growth of aquaculture in the African continent. For any aquaculture venture to be viable and profitable, it must have a regular and adequate supply of balanced artificial diets for the cultured fishes. This is so because the dissolved nutrients that promote primary and secondary production in the natural environment are seasonal and might be insufficient or may not occur in required proportions to meet the nutritional demand of cultured fishes (Ugwumba and Ugwumba, 2003). There is therefore the need to develop and encourage fish farmers to make use of ideal

pond fertilization programs, non-conventional feed resources, feed stuff processing, refinement and formulations that take cognizance of the requirements of the various species and their stages (Ibiyo and Olowosegun, 2004). There is therefore a necessity for research into fish culture practices and types of fish feed used by farmers in Edo south to provide accurate information for relevant agencies to work with.

1.2 OBJECTIVES OF THE STUDY

The objectives of this study are as follows:

1. To determine the socio-economic characteristics of fish farmers in Edo south.
2. To determine the fish culture production in Edo south.
3. To determine the fish feed used and farmer's feeding techniques in Edo south and
4. To determine the ingredients used and challenges faced with fish feed formulation and nutrition in Edo south.

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CHAPTER TWO

2.0 LITERATURE REVIEW

Aquaculture with 8–10 % annual growth rate is the fastest growing agricultural sector (FAO, 2013). More than half of world food fish are produced through aquaculture which in turn is heavily dependent on aqua feed input (FAO, 2012). Feed production must be able to sustain growing world fish demand. It is dependent on a number of protein and energy ingredient sources like fishmeal, fish oil and soybean meal which has become costly in international markets (Naylor *et al.*, 2009, Hardy, 2010). In Nigeria the high cost of feed inputs is a major problem of fish farmers in intensive and semi-intensive fish farming culture system (Ayinla, 1988; Fagbenro and Davis, 2003).

The success of the aquacultural industry depends on the amount of nutritional information available and the development of effective and appropriate hatchery management techniques relevant to the fish farmer. Appropriate feeding regime for fish fingerling is a pre-requisite for successful aquaculture (Dada, 2005). In aquaculture, studies on nutrient requirement are aimed at identifying the optimum feeding levels so that the feeding cost is minimized. Often the aquaculturist desires a fast growth rate of cultivated fish and efficient conversion of feed protein to fish tissue. The major obstacles in this respect is the unavailability of quality feed

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for the different fish production systems (Adebayo and Popoola, 2008; Ndimele *et al*., 2011; Shoko *et al.,* 2011a). This problem has driven most fish famers into making their own feeds, by using some locally available food materials like maize (*Zea mays* L.) and rice (*Oryza sativa*) bran, food remains and garbage from their farms. Nevertheless, commercial feeds are recognised for their high value, although they are expensive for most local fish farmers. Most fish farmers who use imported commercial feeds incur more than 60% of the total farm production investments in these feeds (Gabriel, 2007; Aderolu, 2010; Himadri *et al.,* 2012). In some parts of Nigeria, the cost of feed and feed ingredients is often prohibitive as a result of their alternative use as livestock and human food.

The growth and nutritional status of fish depends on the quality and quantity of dietary protein in its meal. Nutritionists give priority to protein since it is the single ingredient needed in largest quantity for growth and development (Lovell, 1981). Therefore, in an attempt to attain a more economically sustainable and viable production, research interest has been directed globally towards the discovering, evaluation and use of unconventional or lesser utilized protein sources, particularly from plant products such as seeds, leaves and other agricultural by-products which are cheaper, readily available and highly digestible (Ayinla, 1988; El-Sayed, 1999; Banyigyi *et al.,* 2001a and b; Anhwange *et al*., 2004, 2005; Olaniyi, 2009a). As fish requires high quality nutritionally balanced diet for growth and attainment of market size within the shortest possible time. Therefore local production of fish feed is very pivotal to the development and sustainability of commercial aquaculture.

2.1 FISH CULTURE PRACTICES

Monoculture

Monoculture, as the name implies, is the culture of a single species of an organism in a culture system of any intensity, be it in any type of water, fresh, brackish or salt. E.g. Fresh water: Catfish, *Clarias gariepinus* in Africa.

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Monospecies Culture: This involves the culture of only one species of fish or aquatic organism in a given fish pond. It is often applied to intensive fish farming of catfish or tilapia species.

Monosex Culture: This is the culture of either male or female fish in a given pond water. This is often applied to fish species that are characterized with excessive spawning abilities or high ability to produce young fishes (fry or fingerlings). Monosex culture is not practical on a large scale and is not easy to carry out. The sexes are kept separate and usually only male fish are used. No spawning occurs so the fish do not become crowded and can grow fast. This is mainly applied to the culture of tilapia species which has the ability to reproduce excessively.

Mixed Sex Culture: In a mixed-sex tilapia culture, the fish is normally harvested before the fish reaches sexual maturity or soon afterwards. This restricted culture period makes it even more important than normally to make the fish grow fast, since they have to reach their proper size within a limited time frame.

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Polyculture

Polyculture is the culturing or rearing of different species of fish in a given pond. This is based on the principle that different fish species have different feeding habits and occupies different niches in an aquatic environment. The culture system generally depends on the natural food of a water body sometime augmented artificially by fertilization and/or by supplementary feeding. If artificial food is given it is a common food acceptable to all or most species that are cultured. Some fish species are bottom dwellers and are at such, benthic feeders. E.g. common carp, *Heterotis* and some species of catfishes.

2.2 FISH NUTRITION

Nutrition is the combination of processes by which a living organism receives and utilizes the materials necessary for the maintenance of its function and for the growth and renewal of its

components (Olomu, 2011). Once fish are removed from their natural environment to an artificial one, enough food must be supplied in order to enable them grow. This could be in the form of complete rations, where the artificial diet furnishes all the nutrients required by the fish or supplementary diets, where part of the nutritional needs of fish is supplied by the natural food in the aquatic environment (Eyo, 2003). Both intensive and semi-intensive fish culture systems involve input of supplementary and complete feed, which account for up to 40 % and 60 % of production costs respectively (National Research Council (NRC), 1993; Fagbenro *et al*., 2003) and can sometimes negate the economic viability of a farm if suitable feed are not used. This problem has become a major source of fear and phobia to many prospective fish farmers in Nigeria and urgent solution must be proffered if fish farming is to be attractive, lucrative and sustainable (Madu *et al*., 2003).

Fish nutrition deals with nutrient requirement of fish and its availability, the best fish feed produces the highest production with limited environmental impact (Omitoyin, 2007). Carefully compounded feed when fed at the recommended level (rate) are usually backed by the manufacturer's guidance to meet the nutrient requirements of physiologically defined farm animals for a sustainable level of production (Balogun, 1992, Falayi, 2003). It is not surprising therefore that fish nutrition has become one of the most important research and development components within aquaculture development today.

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2.3 NUTRIENT REQUIREMENT OF FISH

All animals require protein, vitamins, minerals, lipids, and energy for normal growth and other physiological functions because the nutrient contribution from natural food organisms is considered minimal in intensive catfish farming, nutrients and energy are provided primarily by prepared feed. The primary goal in processing feedstuffs into a feed is to maximize the nutritional value of various feed components to meet nutrient requirements (Robinson *et. al*. 2001). Lall (1991) and Helfrich and Craig (2002) indicated that proper

nutrition is one of the major factors influencing ability of fish to attain genetic potential for growth, reproduction and longevity. Efficient production and growth of fish in the culture systems depends entirely on feeding complete feed at appropriate rate with due considerations to the dietary requirements of the fish which should not be exceeded (Ayinla, 1991).

Formulated or artificial diets may either be complete or supplemental. Complete diets supply all the nutrients (proteins, carbohydrates, fats, vitamins and minerals) necessary for the optimal growth and health of fish. Generally, the basic nutrient composition of fish feed include protein (18-50%), lipid (10-25%), carbohydrate (basal diet) 15-20%, ash (< 8.5%), phosphorus (< 1.5%), water (< 10%), vitamins and minerals. Amongst these nutrients energy forms the bulk or basal diet while protein constitutes the most expensive item in formulated diets. These key nutrients determine the scale of production of a fish diet while the rest of the nutrients promote the efficiency of utilization of these two nutrients (Annune and Oniye, 1993). Fish are normally provided with complete diets when reared in high density indoor systems or confined in cages and cannot forage freely on natural feeds. However, supplemental (incomplete, partial) diets are fed only to help support the natural food (insects, algae, small fish) that are naturally available in fish ponds or outdoor raceways. Supplemental diets do not contain full complement of vitamins and mineral, although they are used to help fortify the naturally available diet with extra protein carbohydrate and lipids (Helfrich and Craig, 2002). The main objective of fish feed formulation is to put together raw materials (feed ingredients) that will provide nutritionally balanced feed for fish. This is actually aimed at providing nutrients for rapid fish growth so as to enhance optimal production at low feed cost (Ayinla, 1991; Annune and Oniye, 1993).

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2.3.1 PROTEIN REQUIREMENT OF FISH

Helfrich and Craig (2002) indicated that proteins are composed of carbon (50%), nitrogen (16%), oxygen (21.5%) and hydrogen (6.5%). The proteins are needed to supply amino acids and to make enzymes and hormones. Helfrich and Craig (2002) further stated that protein is used for fish growth if adequate level of fats and carbohydrates are present in the diet. If not protein may be used for energy and life support rather than growth. The quality of protein is principally influenced by its amino acid composition. Their findings indicated that protein level in aquaculture feeds generally average 28 – 32% for cat fish and 32 – 38% for tilapia. Thus protein requirement is given high priority in any nutritional study since it is the single nutrient that is needed in the largest quantity for growth and development and also because it is the most expensive ingredient in the diet (Lovell, 1989 and NRC, 1993). This implies that fish feeds should be carefully formulated to ensure that the protein fraction does not exceed the optimum level required by the fish in order to minimize wastage. The protein requirements of fish vary for each fish species and with each life state (Lim and Dominy, 1989; Alcestes and Jory, 2000).

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Fishmeal a conventional animal protein source remains unequalled as a major source of protein in fish feeds because of its high nutritive value (rich amino acid profile) and palatability (Ayinla, 1988; Lim and Dominy, 1989). However, its escalating cost and unavailability has forced aquaculture nutritionists and feed manufacturers to use less expensive, readily available plant protein and animal protein as a substitute to fishmeal (Lim and Dominy 1989; Tacon, 1994). Several plant and animal protein sources have been identified, investigated and utilized in domestic animal feeds but relatively few are used in fish feeds due to the high protein dietary requirements of fish (Lim and Dominy, 1989). Commercial aquaculture feeds for grow outs contain 25-45% crude protein with a consequence that only high protein content plant feed stuffs such as oil seed residues are used in fish feed. The extent of plant protein utilization in commercial feeds as stated by Alcestes

and Jory (2000) and Lim and Dominy (1989) depends on its availability, cost, acceptability by fish, ease of processing and nutritive value (adequate balance of essential nutrients), presence of toxins and anti-nutritional factors. Conventional plant protein sources include peanut (groundnut), sesame seed, soybean, sunflower seed and rapeseed. Non-conventional plant protein sources that have been used in fish feed formulation include Lima seed, Jackbean seed, Bambara nut, lablab bean, plants by-products and agro-industrial by-products. Based on the findings of several researchers (Ayinla, 1988; Lim and Dominy, 1989; Alcestes and Jory, 2000 and Eyo, 2003), soybean meal has been demonstrated to be the most commonly used and it often constitutes approximately 30-40% of fish feed.

2.3.2 ENEGRY REQUIREMENT OF FISH

Carbohydrates (starches and sugar) are the most economical and inexpensive sources of energy for fish diets. Carbohydrates are included in aquaculture diets to reduce feed costs and for their binding activity during feed manufacturing. They are also used due to their natural abundance. In fish, carbohydrates are stored as glycogen that are mobilized when necessary to satisfy energy demands (Annune and Oniye 1993; Helfrich and Craig, 2002).

Helfrich and Craig, (2002) indicated that fish have lower dietary energy requirements because they exert relatively less energy to maintain position and move in water than do mammals and birds and because they excrete most of their nitrogenous wastes as ammonia (through the gills) instead of urea or uric acid thus loosing less energy in protein catabolism and excretion of nitrogenous wastes (Goldstein and Forster; 1970). Fish also have a lower dietary energy requirement because they do not have to maintain a constant body temperature. Therefore maintenance energy requirement and heat increment are lower for fish than for land animals; with the implication that carbohydrates are not efficiently used by fish (Lovell, 1981; Helfrich and Craig 2002).

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Helfrich and Craig (2002) stated that mammals can extract about 4Kcal of energy from 1gram of carbohydrate whereas fish can only extract 1.6Kcal from the same amount of carbohydrates. They further indicated that up to 20% dietary carbohydrates can be used by fish as earlier indicated by Buhler and Halver (1961). Most research efforts towards provision of adequate feed for fish have been centred on manipulation of dietary protein used in feed formulation. Generally, fish nutritionists have given priority to meeting the requirements for protein, major minerals and vitamins thereby allowing energy, to take care of itself (Lovell, 1988). Lovell (1988) further stressed that fish uses protein efficiently as a source of energy, it was also maintained that a high percentage of digested energy in protein is metabolizable in fish than land animals. However, a ration poor in carbohydrate entails the use of either lipid or protein to provide necessary calories (Cowey and Sargent, 1972). Up to about 25-30% of dietary carbohydrate can be used by fish (Toft, 2001). Maize is an example of such feedstuff, commonly used as a carbohydrate or energy source in fish diets (Wilson, 1994).

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2.3.3 LIPID AND FATTY ACIDS REQUIREMENT OF FISH

Lipids are non-protein calorie sources which are often neglected in fish feed preparation, they are generally more digestible than some carbohydrates (Hilton, 1982). Due to the high energy content of fats they can be utilized to partially spare or substitute for protein in aquaculture feeds (Helfrich and Criag, 2002). The protein sparing effects of lipids varies between species but appear to be optimal at about 15 – 18% of the diet (De-Silva *et al*., 1995). Lipids supply about twice the amount of energy as proteins and carbohydrates and typically, lipids comprise about 15% of fish diets, lipids supply essential fatty acids (EFA) and serve as transporters of fat-soluble vitamins.

Eyo, (2003) indicated that lipids and fatty acids perform three different functions in the organism, as they serve as energy carriers, metabolic regulators and structural elements in the cell. Francis-Floyd and Millie (2012) indicated that a recent trend in fish feed is to use higher

levels of lipids in the diet. They further asserted that increasing lipids can help reduce the high costs of feeds by partially sparing protein in the feed, it was also noted that problems such as excessive fat deposition in the liver can decrease the health and market quality of fish. They also indicated that simple lipids include fatty acids and triacylglycerol and that fish typically require fatty acids of the Omega 3 and 6 (n-3 and n-6) families for maximum growth and efficient utilization.

For example, the type and amount of lipid used in catfish diets is based on essential fatty acid requirements, economics, constraints of feed manufacture, and quality of fish flesh desired (Ibiyo and Olowosegun, 2005). African catfish has the ability to synthesize most of their fatty acids; thus, nutritionally there may be no "best" level of dietary lipid except that needed to provide essential fatty acids (EFA). Catfish apparently require 0.5 percent to 0.75 percent omega-3 fatty acids in diet (Robinson *et al*., 2006).

2.3.4 VITAMIN REQUIREMENT OF FISH

Vitamins are micro-nutrients required for normal growth, reproduction, health and maintenance of fish metabolism. The requirements of fish depend upon the intake of other nutrients, size of the fish, and environmental stresses (NRC, 1981; 1977). Many vitamins function as co-enzymes (Cowey and Sargent, 1972). Vitamins are normally categorized into two groups namely: the water soluble and fat soluble vitamins. Water-soluble vitamins include: the B vitamins, choline, inositol, folic acid, pantothenic acid, biotin and ascorbic acid (vitamin C). Of these, vitamin C probably is the most important because it is a powerful antioxidant and helps the immune system in fish. The fat-soluble vitamins include A vitamins, retinols (responsible for vision); the D vitamins, cholecalciferol (bone integrity); E vitamins, the tocopherols (antioxidants); and K vitamins such as menadione (blood clotting, skin integrity). Of these, vitamin E receives the most attention for its important role as an antioxidant (Craig and Helfrich, 2002).

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Fishes are extremely sensitive to vitamin deficiencies. Deficiency of each vitamin has certain specific symptoms with retarded growth being the most common deficiency symptom. Other signs common to several vitamin deficiencies were identified as abnormal skin pigmentation, ataxia, hypersensitivity haemorrhage, fatty livers, increased susceptibility to bacterial infection and scoliosis (bent backbone symptom) and dark coloration may result from deficiencies of ascorbic acid and folic acid vitamins, respectively (Helfrich and Craig, 2002). According to Cruz-Suarez *et al*., (2007) Ascorbic acid added to feeds should be phosphorylated to stabilize the vitamin and increase storage time. Generally, Catfish feeds are supplemented with a vitamin premix that contains all essential vitamins in sufficient quantities to meet the requirement and to compensate for losses due to feed processing and storage (Robinson et al., 2006). Shapawi *et al*. (2007) reported that 60 mg/kg of vitamin C is recommended for catfishes.

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2.3.5 MINERAL REQUIREMENT OF FISH

Minerals are inorganic elements necessary in the diets for normal body functions. There are two (2) categories of minerals, macro-minerals and micro-minerals. Macro-minerals are required in large quantities. They include: Calcium (Ca), sodium (Na), chloride (Cl), potassium (K), Phosphorus (P), Magnesium (Mg) and Sulphur (S). These minerals regulate the osmotic balance and aid in bone formation and integrity. Micro-minerals (trace minerals) include: copper (Cu), zinc (Zn), selenium (Se), chromium (Cr), iodine (I), Manganese (Mn) iron (Fe), cobalt (Co), fluorine (F), vanadium (Va), tin (Sn), silicon (Si) and molybdenum (Mo). Micro minerals exist as components of enzyme and hormone systems (Akintomide *et al*., 2008). Their main functions include: formation of skeletal structure, electron transfer, regulation of acid-base equilibrium, and osmoregulation (O'Keefe and Newman, 2011).

Fish can absorb many minerals directly from the water through their gill membranes and skin, this phenomenon allows them to compensate to some extent for mineral deficiencies in

their diet. Thus their mineral requirements are reduced (Helfrich and Craig, 2002). Although these mineral are required in small amounts as compared to proteins, lipids and carbohydrate, they are critically important and the deficiency of one or more of these micronutrients or its excess addition in the diet can be detrimental to fish health. Minerals are potentially lethal when present in amounts slightly above or below the requirement and accurate supplementation are therefore imperative for proper diet formulation (National Research Council (NRC), 1993). Amongst the minerals that are required by catfish, phosphorus is particularly important in fish feeds because it is required by fish in a fairly large amount (Nwanna *et al*., 2008). Feedstuffs, especially those from plants, are poor sources of phosphorus and fish do not get enough phosphorus from pond water. Due to this fact, catfish feed are usually supplemented with phosphorus.

2.4 FISH FEED INGREDIENTS

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Feedstuffs are classified as conventional or unconventional base on its acceptability and usage in fish feed formulation. Some conventional feedstuffs are groundnut cake, soybean meal, palm kernel meal, brewers dried yeast, brewers dried grain, maize, wheat offal, and fish meal. The quality and proportion in which these conventional feedstuffs are used depends on its nutrient composition, presence of anti-nutritional substances, palatability and cost (Robinson *et al*., 1998). This is in spite of the attendant vagaries in high cost and scarcity, creating the existing problems that are apparent in high cost of feed (Robinson *et al*., 1998).

Unconventional fish feed can be of animal or plant source. They contain high quality feed ingredients that can compare favourably with conventional feed types. They are expected to be cheaper by virtue of the fact that there is no competition for human consumption (Roberts, 1989). Unconventional feedstuffs are potential feed ingredients, which have hitherto not been used in fish feed production for some certain reasons like;

- they are not well known or understood,

- no effective study of the method of production with a view to commercializing them,
- they are not readily available, and
- they can be toxic or poisonous (Abowei and Ekubo, 2011).

Some of these unconventional feedstuffs of animal origin include tadpole meal, fly larvae, earthworm meal, feather meal, toad meal, shrimp waste, crab meal, poultry-hatchery waste meal and animal waste such as pig and poultry droppings and blood meal. Plants sources include leaf protein, leaf meal, aquatic macrophytes, and cultivable pulses such as mucuna bean, yam beans, bread beans and winged beans (Abowei and Ekubo, 2011).

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CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 DESCRIPTION OF STUDY AREA

The study area is Edo State of Nigeria which is made up of eighteen (18) local government areas and divided into three Senatorial Districts; Edo North, Edo Central and Edo South. This study was carried out in the southern Senatorial district of Edo state which is made up of seven local government areas, which include; Egor, Orhionmwon, Ovia North-East, Ovia South-West, Ikpoba-Okha, Oredo, and Uhunmwode Local Government areas (Figure 1). The State lies roughly between longitude $06^0\,04^{'}$ E and $06^0\,43^{'}$ E, and latitude $05^0\,44^{'}$ N and $07^0\,04^{'}$ N. It is bounded in the South by Delta State, in the West by Ondo State, in the North by Kogi State and in the East by Kogi and Anambra States. The study area lies within the humid tropical rain forest zone. The Ministry of Lands and Surveys, Benin City, put the total land area of the state at 19,794km^2. It is situated on a relatively flat terrain devoid of plenty of rivers and it is approximately 466m above the sea level.

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The population of Edo State is put at 3,233,366 people (NPC, 2006). Secondary and tertiary activities such as commerce, industry, social services are highly engaged in the area but the dominant occupation of the people is agriculture which includes fishing activities. The study area covers the rural, suburban and urban area.

3.2 SOURCES OF DATA

Data for this study was obtain from two sources namely; primary and secondary sources

- **Primary source:** Data collection was done with the aid of a well-structured questionnaires asking the appropriate question focused on the fish farm production and fish feeding information of the farms.

- **Secondary source:** The zonation of the southern part of Edo state was obtained from the ministry of Agriculture Development Project (ADP), Benin City, Edo state. Data was also sourced from personal interviews which were conducted in mainly English language and Pidgin English. Other language spoken in Edo state is Bini language, also it entails literatures and search for relevant information.

3.2 SAMPLE SIZE

A total of 20 questionnaires were administered in each of the seven (7) Local Government areas of Edo south, making a total of 140 questionnaire (see Appendix 1).

3.3 DATA PRESENTATION AND ANALYSIS

Data obtained from the above information were carefully analyzed using the Statistical technique for Social Science Students Method (SPSS) version 23. Data were presented using descriptive statistic such as percentages, frequencies and charts which was carefully and exhaustively discussed.

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Figure 1: Map of Edo South (Ministry of land and survey, 2008).

CHAPTER FOUR

4.0 RESULT

A total of 140 questionnaires were distributed for the study, 20 questionnaires each for the seven (7) Local Government Areas, the results are presented below.

4.1 SOCIO-ECONOMIC CHARACTERISTICS OF THE FISH FARMERS

The major characteristics discussed were the distribution of respondents by gender, age, marital status, level of education, farming status and years of experience are presented in table 1.

4.1.1 GENDER

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As shown in Table 1 below, majority of the respondents are males (75%), and the rest of them are females (25%). The implication is that fish farming is dominated by males who have strength for the job in the study area.

4.1.2 AGE

Table 1 shows that majority are within the age range of 30 – 40 years (36.4%), then followed by below 30 years (28.6%) while 20% and 15% were within the age range of 41 – 50 years and above 50 years respectively.

4.1.3 MARITAL STATUS

As presented in table 1 below, Majority of the respondents are married (52.1%) while (38.6%) are single, 2.1% and 7.1% are divorced and widower/widow respectively.

4.1.4 LEVEL OF EDUCATION

Table 1 revealed that majority of the respondents had tertiary form of education (58.6%) and (21.4%) had Adult education, while 11.4% and 8.6% had their secondary education and vocational education respectively.

4.1.5 LEVEL OF INVOLVEMENT/FARMING STATUS

Table 1 also reveals that, majority of the fish farmers are into part-time farming (52.9%), 47.1% were into full time farming. This implies that most of the fish farmers are engaged in other occupation apart from fish farming.

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TABLE 1: SOCIO-ECONOMIC CHARACTERISTICS OF FISH FARMERS

	FREQUENCY	PERCENTAGES
GENDER		
Male	105	75.0%
Female	35	25.0%
AGE		
Below 30 years	40	28.6%
30 – 40 years	51	36.4%
41 – 50 years	28	20.0%
Above 50 years	21	15.0%
MARITAL STATUS		
Single	54	38.6%
Married	73	52.1%
Divorced	3	2.1%
Widow/Widower	10	7.1%
LEVEL OF EDUCATION		
JSS	3	2.1%
SSCE	13	9.3%
Adult Education	30	21.4%
Tertiary	82	58.6%
Vocational	12	8.6%
FARMING STATUS		
Full-time	66	47.1%
Part-time	73	52.9%

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4.2 FISH FARMERS PRODUCTION INFORMATION

4.2.1 YEARS OF EXPERIENCE

Table 2 shows the average mean of all fish farmer's experience to be 7.85 years (7 years and 10 months).

4.2.2 TYPE OF FISH CULTURED

From the result shown in Table 2 below, (94.3%) of fish farmers prefer monoculture of catfish because they exhibit many qualities, which make them suitable for culture. These include ability to withstand handling stress, disease resistance, high yield potential, high fecundity as well as high palatability. These fishes also exhibit fast growth in various culture systems. While 3.6% cultured both catfish and tilapia and 2.1% cultured both carp and bony tongue.

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4.2.3 TYPE OF CULTURE FACILITY USED

As shown in Table 2 below, majority of the respondents used concrete tanks (51.4%), to cultured their fishes while 21.4% used plastic fish tanks, 20.7% used earthen pond, 2.9% used both earthen and concrete and 2.1% used concrete and fibre.

4.2.4 NUMBERS OF FISH CULTURED FACILITIES

The results in Table 2 below, shows the numbers of pond the respondents have. The result revealed the following information;

1 – 3 (39.3%), indicating that most farmers in Edo south own small number of ponds. 4 – 6 (32.9%) and 7 – 9 (10%) indicates ownership of medium number of ponds. 10 – 12, 13 – 15, 16 and above (14.3%) indicates that fish farmers in Edo south own large number of ponds.

4.2.5 CYCLE OF PRODUCTION

Table 2 below shows that most farmers in Edo south culture within 6 months (57.6%), followed with 4 months (34.5%), 9 months (3.6%), 3 months and 12 months and above having (2.2%) each**.**

4.2.6 SIZE OF CULTURE FACILITY

Table 2 shows the average pond size of farmers in Edo south to be 712.6 square feet.

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TABLE 2: SHOWING THE FISH FARM PRODUCTION INFORMATION

YEARS OF FARMING (average)	**Mean** 7.85 years (7 years and 10 months)	
	FREQUENCY	**PERCENTAGES**
SPECIES OF FISH CULTURED		
Catfish	132	94.3%
Bony tongue	2	1.4%
Carp	1	0.7%
Catfish/tilapia	5	3.6%
CULTURE FACILITIES USED		
Earthen	29	20.7%
Concrete	72	51.4%
Plastic	30	21.4%
Concrete/Fibre	3	2.1%
Earthen/Concrete	4	2.9%
NUMBER OF PONDS		
1 – 3	55	39.3%
4 – 6	46	32.9%
7 – 9	14	10.0%
10 – 12	13	9.3%
13 – 15	2	1.4%
16 and above	5	3.6%
CYCLE OF PRODUCTION		
3 months	3	2.2%
4 months	48	34.5%
6 months	80	57.6%

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9 months	5	3.6%
12 months and above	3	2.2%
SIZE OF PONDS	**SQUARE FEET**	
Average pond size	712.6	

4.3 FISH FEEDING INFORMATION

4.3.1 TYPES OF FEED USED IN FEEDING FISH

The result of the study in Table 3 indicates that most farmers (83.6%) in Edo south go for commercial source of feed. This is a common practice of many fish farmers who believe that the imported or commercial feeds are of higher quality with a complete nutritional profile for meeting the nutritional requirement of the fish. While, 8.6% used both and 7.9% used Local feed.

4.3.2 FEED APPLICATION METHOD

Table 3 above shows that Farmers (70%) in Edo south feed their fish at a spot. This is a common practice of many fish farmers who want to prevent wastage of feed by monitoring their fish eat. While, 29.3% feed by broadcasting which is majorly used in Fish fry production.

4.3.3 FEEDING DEVICES USED

Table 3 shows that (98.6%) feed their fish by hand (manually) while 0.7% feed using demand feeders.

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TABLE 3: FISH FEED USED AND FARMER'S FEEDING METHODS

	FREQUENCY	PERCENTAGES
FISH FEED USED		
Commercial/Imported Source	117	83.6%
Local Feed Source	11	7.9%
Both	12	8.6%
METHOD OF FEED APPLICATION		
Feeding at a spot	98	70.0%
Broadcast feeding	41	29.3%
FEEDING DEVICES USED		
Manual feeding	138	98.6%
Demand feeders	1	0.7%

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4.4 INGREDIENTS FOR FEED FORMULATION

4.4.1 SOURCE OF INGREDIENTS

From table 4 below, ingredients are sourced more locally (24.3%) because they are cheaper to acquire. 7.1% from both local and imported source then 4.3% are imported/commercial.

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TABLE 4: INGREDIENTS FOR FEED FORMULATION

SOURCE OF INGREDIENTS	FREQUENCY	PERCENTAGE
Local source	34	24.3%
Imported	6	4.3%
Both	10	7.1%

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4.5 READILY AVAILABLE INGREDIENTS

As shown in Figure 2 below, Maize is the most readily available ingredient (29.9%) because it is easily accessible. Followed by 19.5% Soybean, 18.2% Fishmeal, 10.4% Groundnut cake (GNC), 7.8% Flour, 6.5% Cowpea and Blood meal each and 1.3% Garri (cassava flour).

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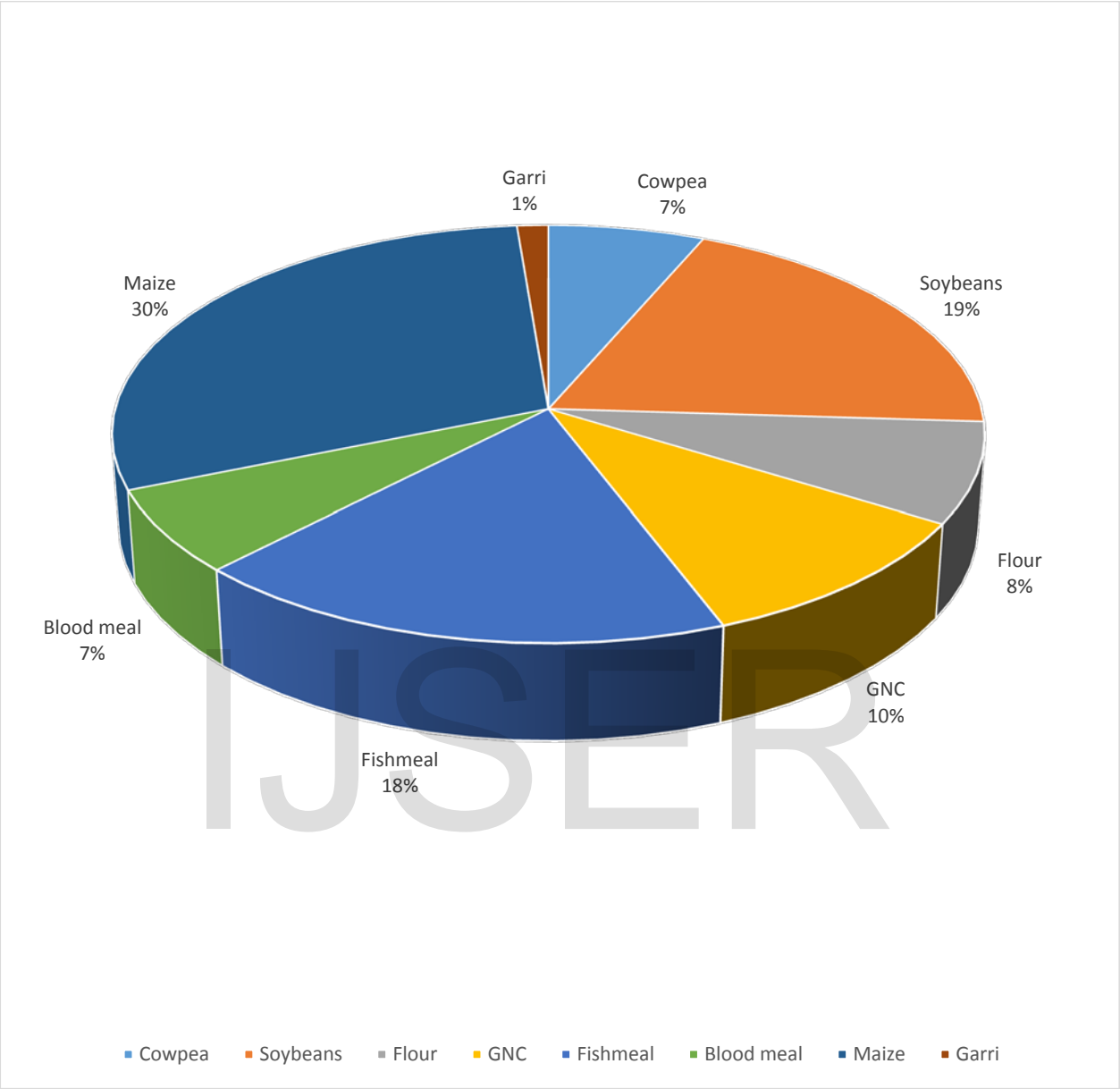

FIGURE 2: READILY AVAILABLE INGREDIENTS

4.6 SOURCE OF PROTEIN

Figure 3 below shows, that source of protein comes more from Soybean (42.6%). This feedstuff is fast gaining increasing acceptability and use in the feed industry. Because it has a balanced amino acid profile and can replace a substantial part of fishmeal. Followed by Fishmeal (29.8%), GNC and Cowpea (10.6%) each and Blood meal (6.4%).

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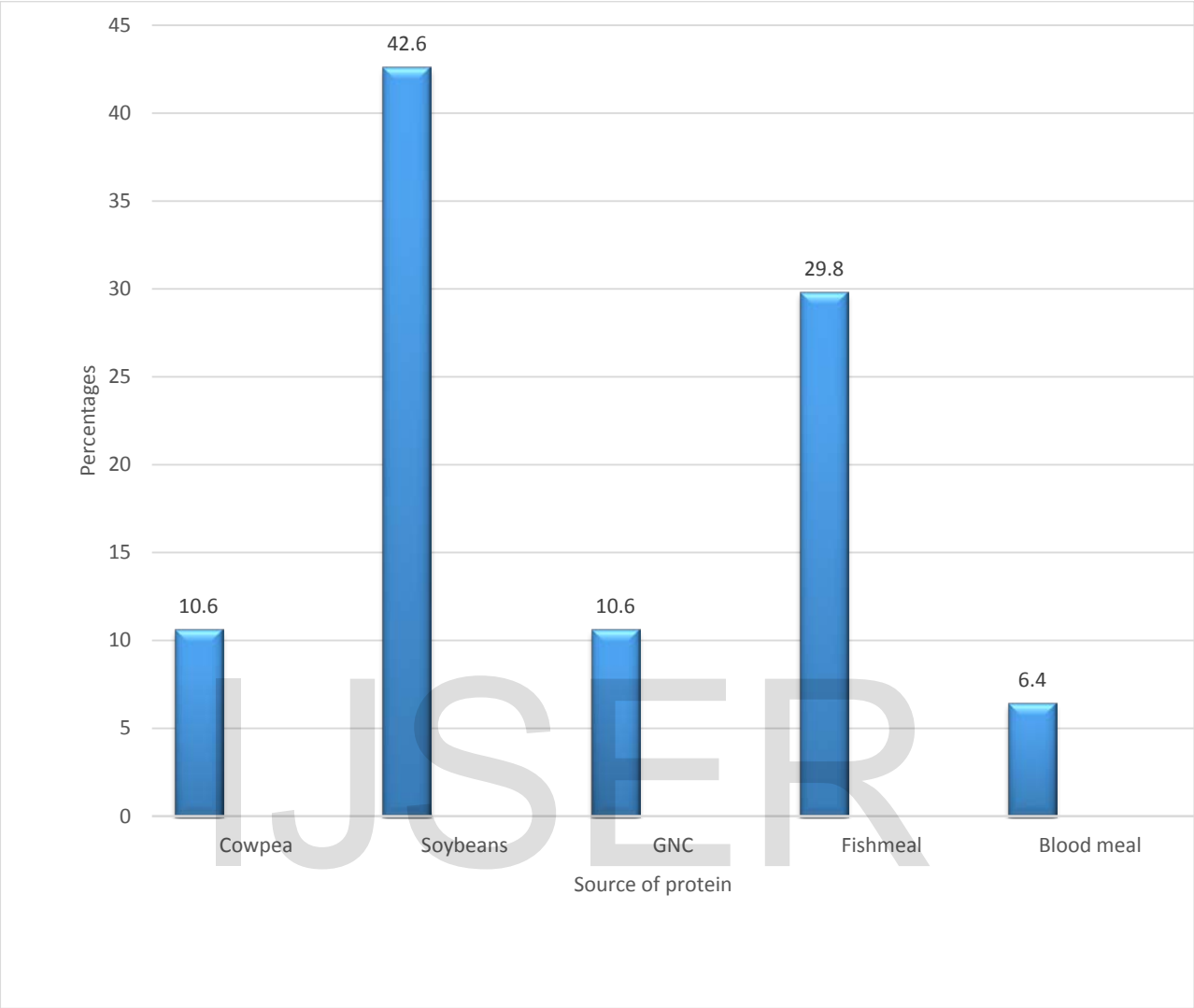

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FIGURE 3: SOURCE OF PROTEIN

4.7 SOURCE OF ENERGY

Figure 4 below shows, that source of energy comes more from maize (62.5%) because it is palatable and its energy content is high. Followed by Flour (22.5%), Millet (12.5%) and Wheat (2.5%).

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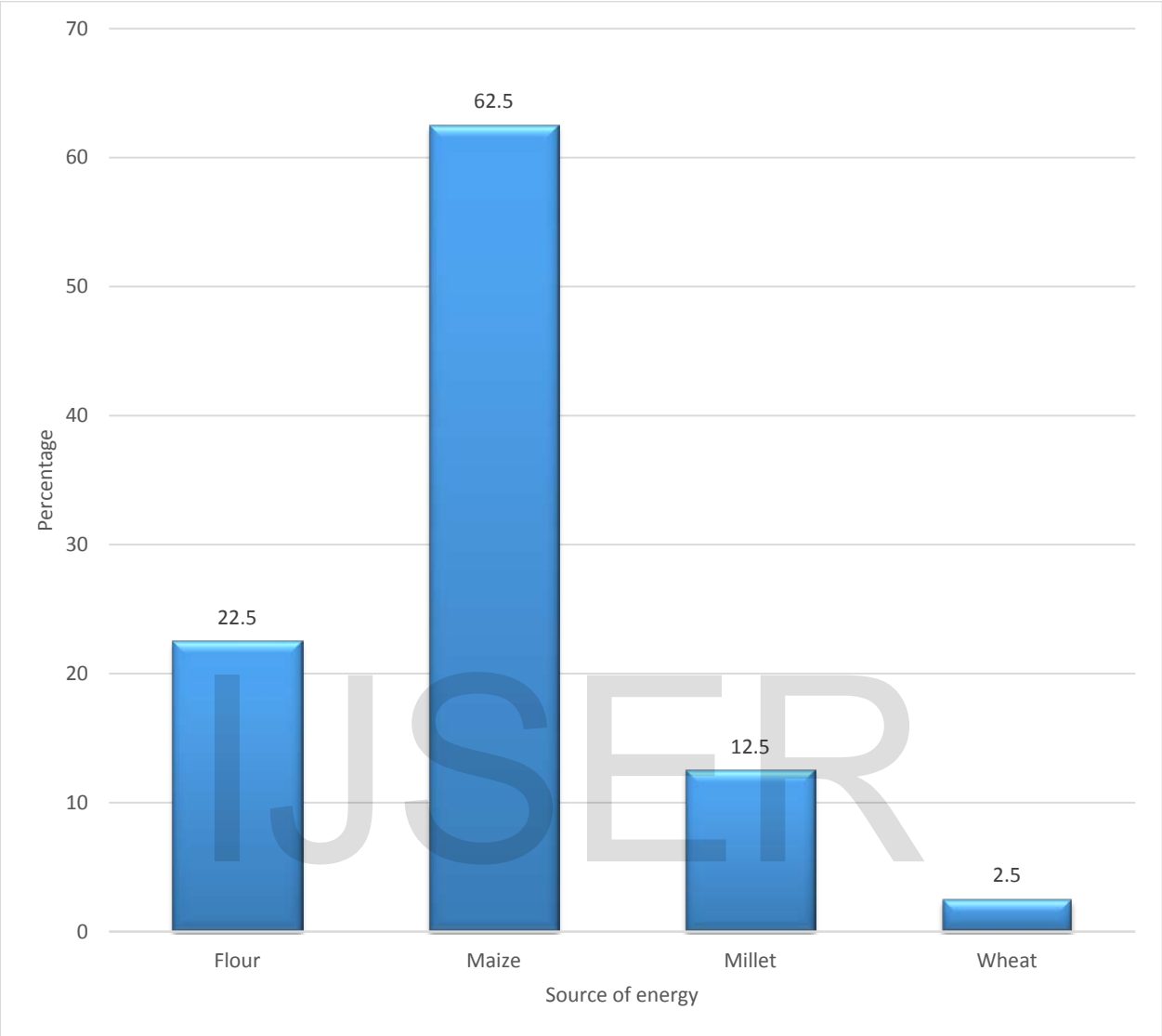

FIGURE 4: SOURCE OF ENERGY

4.8 UNCONVENTIONAL FEED INGREDIENTS USED

From the result in Table 5 below, most of the farmers (42.1%) in Edo south utilizes blood meal as an unconventional ingredient in the diet of fish because it is high in protein content (85%) and an excellent source of lysine. It is also accessible and relatively cheap. 3.6% utilize Earthworm meal and 2.9% utilize Feather meal.

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TABLE 5: UNCONVENTIONAL FEED INGREDIENTS USED

FEED INGREDIENT	FREQUENCY	PERCENTAGE
Blood meal	59	42.1%
Feather meal	4	2.9%
Earthworm meal	5	3.6%

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4.9 FEEDING TECHNIQUES

4.9.1 FREQUENCY OF FEEDING

From the results in Table 6 below, it indicated that 86.4% of fish farmers in Edo south prefer to feed their fish twice a day. This might be to reduce feed wastage and save cost. 7.9% of the farmers chose feeding three times a day and 5.7% chose once a day especially those only into brood fish production.

4.9.2 BASIS OF FEEDING

The result in Table 6 indicated that 45% of farmers in Edo south prefer to feed their fish based on Discretion (Satiation). 37.9% feed their fish based on body weight and 16.4% feed based on availability.

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4.9.3 WEIGHT PERCENT

As shown in Table 6 based on feeding at body weight, 20% of farmers feed their fish at 3% body weight; 16.4% feed at 5% body and 1.4% feed at 7% body weight.

TABLE 6: FEEDING TECHNIQUES

FREQUENCY OF FEEDING	FREQUENCY	PERCENTAGE
Once daily	8	5.7%
Twice daily	121	86.4%
Thrice daily	11	7.9%
BASIS OF FEEDING		
Based on body weight	53	37.9%
Depending on availability	23	16.4%
Discretion	63	45.0%
IF PER BODY WEIGHT AT WHAT RATE		
3% body weight	28	20.0%
5% body weight	23	16.4%
7% body weight	2	1.4%

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5.0 CAN FARM MADE FEED COMPARE WITH COMMERCIAL FEED NUTRITIONALLY?

Table 7 result shows that, 57.9% of fish farmers nutritionally agree that farm made feed is compared better over commercial feed.

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TABLE 7: CAN FARM MADE FEED COMPARE WITH COMMERCIAL FEED NUTRITIONALLY?

	FREQUENCY	PERCENTAGE
Yes	81	57.9%
No	54	38.6%

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5.1 CHALLENGES IN FEEDING AND SOURCING FOR FEED

It was observed in the Figure below that of all the categories, respondent picked high cost of feed (75%) as a major constraint to fish farming in Edo south. 20.7% of farmers in Edo south suffer from inadequate funding, 2.0% chose scarcity of feed ingredients and 1% chose high transportation cost.

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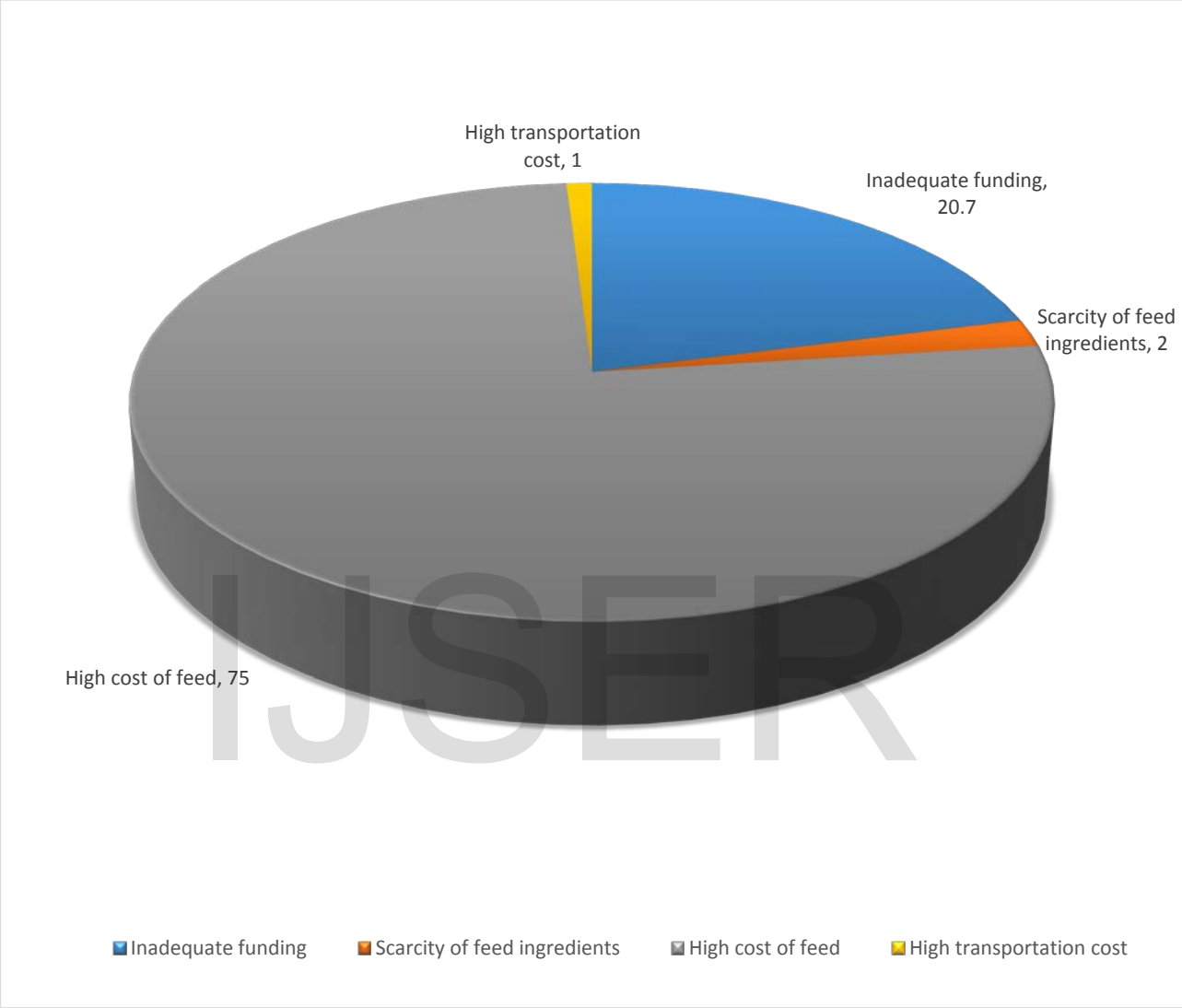

FIGURE 5: CHALLENGES IN FEEDING AND SOURCING FOR FEED

CHAPTER 5

5.0 DISCUSSION

5.1.1 GENDER

Majority of the respondents are males (75%), while 25% of them are female. This confirms the findings of Folayan, Omoniyi and Bifarin, (2014) whose studies showed farm ownership by small scale farmers to be male dominated (about 68%). This result is also in accordance with Adewuyi *et al*. (2010) whe opined that over 80% of the fish farmers in Ogun state were males. Sex is an important factor in determining the choice of an agricultural enterprise to embark upon, for instance, women are found more in marketing and processing activities that require less tedious production activities than men (Oluwasola and Ajayi, 2013). This observation might not be unrelated to the laborious nature of fish farming which makes it easier for males to cope, as corroborated by Ofuoku, *et al*. (2008).

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5.1.2 AGE

The results revealed that majority of the respondents were within the age range of 30-40 (36.4%), followed by 28.6% were below 30 years while 20% and 15% were within the age range of 41- 50 years and above 50 years respectively. This implies that higher proportions of the respondents are still within their productive age and are likely to possess the necessary strength to carry out fish farming operations. The result agrees with the findings of Egbufor *et al*., (2012) who reported that the average age of 33years (young able bodied men) were the ones largely and actively involved in fish farming in Edo South.

5.1.3 MARITAL STATUS

As presented in the result, majority of the respondent were married (52.1%), while 38.6% were single. Meanwhile, 7.1% and 2.1% were widow/widower and divorced respectively.

This is similar to the findings of Nwosu and Onyeneke (2013), whose study of pond fish farmers in Owerri agricultural zone Nigeria, shows that majority (85%) were married. This may imply that majority of the respondents being married may likely influence productivity positively as well as promote agriculture (farming) because of the need for more food for the families. In addition, Odefadehan *et al*., (2015) opined that rural populace often get married quickly in order to have a helping hand from their offspring in the farming enterprise because labour is a significant resource input and could be scarce at very critical periods. Aihonsu, (2002) in her study in Ogun State and Oluwasola and Alimi, (2007) in their study of Financial Intermediation in Agriculture in Nigeria also agree to these findings by stating that fish farming is been invaded by married fish farmers with large families in the rural-urban areas.

The fact that majority of the respondent were married may be as a result of the study area because Okoedo and Ovharhe (2012), assessed the fish farming operation in Delta State and opined that higher proportion (47.3%) of the fish farmers were single, this could be attributed to the young age of the respondents, and implication that marital status was not a bias in fish farming in Delta State.

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5.1.4 LEVEL OF EDUCATION

The results revealed that majority of the respondents had tertiary form of education (58.6%) and 21.4% had their Adult education. This implied that aquaculture is mainly practiced by educated people. This result is similar to the findings of Ifejika *et al*., (2013) who reported that 82.8% of farmers in Niger state were found to be graduates of various degrees. From this result, respondents in the study area were moderately educated implying that they will take better decisions as regards acceptance of innovations and apply better production practices since education is the tool to adoption of newly improves technology. This finding

compares favourably with the findings of Aromolaran (2000), who stated that level of education of farmers increases their farm production and also enhances the ability to understand, evaluate and adopt new technology.

5.1.5 LEVEL OF INVOLVEMENT/FARMING STATUS

The result from the study reveals that 52.9% of fish farmers were into part-time farming while 47.1% were into full time farming. This is an indication that most of the farmers were into other forms of business due to the fact that fish farming is less tedious compared to other forms of agriculture. This result agrees with Ideba *et al.*, (2013), who reported that 89% of fish farmers in Cross River state were part time fish farmers and 11% full time fish farmers. And Ifejika and Ayanda, (2005) in Niger State who reported that, involvement of most fish farmers in the state are on part-time basis. Thus fish farming provide a gainful means of employment to majority of fish farmers in the study area. Oluwasola and Alimi (2007); Aihonsu (2002), opined that since fish farming is majorly done by married fish farmers with large families in the rural-urban areas the fish farmers tend to involve in other forms of businesses.

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5.2 FISH FARM PRODUCTION INFORMATION

5.2.1 YEARS OF EXPERIENCE

This shows the average mean of all fish farmer's experience to be 7.85 years (7 years and 10 months). The level of experiences that an individual acquires in any business to help boost production (Onu and Unaeze, 2009). This implies that fish farmers are experienced in farming activities thus must be able to give adequate knowledge on their farming production activities and its challenges. This agree to the results of Odefadehan *et al*., (2015), that farmers are considered to be quite knowledgeable on the operations and constraints involved in fish production as a results of their years of experience.

5.2.2 TYPE OF FISH CULTURED

The result shows that majority of the respondent cultured catfishes (94.3%), while 3.6% cultured both catfish (*Clarias garienpinus*) and tilapia This is similar to findings of Olaoye et al., (2007) and Olaoye, (2010) in Ogun state that adoption rate of monoculture of *Clarias sp*. had replaced poly culture due to better market prices, greater demand preference, cultural preferences of most customers, hardiness of fish stock convenient for culture, presentation of fish live at sales point and relatively superior/timely growth performance. The dominance of clariid catfish could be because of the acceptability of catfish in the study area as the dominant culture species. Odefadehan *et al*., (2015) in their study on factors affecting tilapia fish farming in Ondo and Ekiti states, South West Nigeria, stated that tilapia fish production is not as popular as catfish production. This also agrees with the findings of Adewumi *et al*., (2015), who stated that catfish is the most cultured fishes in Nigeria.

5.2.3 TYPE OF CULTURE FACILITY USED

From the result, majority of the respondents used concrete tanks (51.4%), to culture their fishes while 21.4% used plastic, 20.7% used earthen pond, 2.9% used both concrete and earthen and 2.1% used both concrete and fibre. This implies that most respondents prefer to use concrete tanks compared to other facilities in the study area. The prevalence of concrete tanks in the study area may be due to the non-availability of suitable soil type with sufficient clay particles for pond construction with poor water retention capacity of the available soil in the study area. This is similar to the findings of Adeogun *et al*., (2007) in Lagos State, who reported that the use of concrete tanks was the most widely adopted (62.5%) due to its durability, ease of management and pollution control. This results also agrees with Olaoye *et al*., (2014) in their assessment of socio-economic analysis of fish farming in Oyo, who reported that 75% of fish farmers used concrete tanks.

5.2.4 FISH SIZE (NUMBER OF FISH POND)

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The result shows that aquaculture production in the study area is dominated by farmers with few production facilities, with 39.3% having 1-3 and 32.9% having 4-6 number of ponds. This may account for the low production rate because of the small scale practice. This is similar to the findings of Adeogun *et al.* (2007) who reported that 55.4% of fish farmers had between 1-10 production facilities. It also agrees with (Aphunu and Nwabeze, 2012) who reported that 73.8% had culture facility of between 1 and 5. Thus aquaculture production in the study area is characterized by low production inputs.

5.3 FISH FEEDING INFORMATION

5.3.1 TYPES OF FEEDS USED FOR FEEDING FISH

The result of the study indicates that most farmers (24.3%) in Edo south go for local source of feed because of its lower cost when compared to commercial or imported fish feed (4.3%). Since the success of fish farming depend on the provision of suitable and economical fish feeds, we need to use locally available feedstuff especially aquaculture by-products to reduce the price of complete feeds (Fagbenro *et al*., 1999).This report is also in agreement with the work of (Rana and Hasan, 2013) who reported that when farmers used locally made feeds, feed cost always tend to drop by 10-20% irrespective of intensity of stocking or species stocked.

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5.3.2 SOURCE OF PROTEIN

The most expensive part of feed is the protein and this is the most important because it is used for body building. From the result on source of required protein, it was observed that 42.6% of farmers in Edo south choose soybean cake while 29.8% choose fishmeal. This is because, fishmeal though the best conventional protein source in fish diet, is expensive and scarce. Fish farmers resorted to the use of soybean which is presently the most used plant protein in fish feed production and also for African catfish, *Clarias gariepinus* (Shipton and Hetch, 2005). High-protein soybean meal contains around 48 % crude protein while soy

protein concentrate contains about 65 % crude protein (Gatlin *et al*., 2007; Salze *et al*., 2010). Soybean has a good amino acid profile, although it is poor in sulphur and amino acids like lysine and methionine (Cai and Burtle, 1996, Gatlin *et al*., 2007).

5.3.3 SOURCE OF ENERGY

The most economical and inexpensive part of feed is the energy source. From the result, source of required energy indicate that 62.5% of fish farmers use maize, this is followed by 22.5% of farmers that use flour as source of energy. Maize is usually used in finely ground form as an energy component in compound feeds. The main acceptance of maize as a source of energy might be due to its palatability and also the fact that it is relatively free from anti nutritional factors and also have very high energy content (Abowei and Ekubo, 2011).

5.3.4 FREQUENCY OF FEEDING

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From the result above, it indicated that 86.4% of fish farmers in Edo south prefer to feed their fish twice a day. This might be to feed fish adequately as well as reduce feed wastage and save cost. This result is similar to what was reported by (Marimuthus *et al*., 2010) that feeding of *Clarias gariepinus* fingerlings twice a day is the best feeding frequency.

Ajani *et al*. (2010) also reported that feeding *Clarias gariepinus* fingerlings twice or thrice a day was effective for optimum result in growth. 7.9% of the farmers chose feeding three times a day and this is similar to report of Adewolu and Adoti, (2010) that feeding *Clarias gariepinus* fingerlings thrice a day gave best results in terms of growth and economic profit. Dada and Akinwande, (2005) found that feeding *Heterobranchus bidorsails* once a day had the best result. This is however, represented by 5.7% of fish farmers.

5.3.5 BASIS OF FEEDING AND WEIGHT PERCENT

The result of the study indicated that 45% of farmers in Edo south prefer to feed their fish based on discretion. 37.9% of farmers feed their fish on the basis of body weight while the

remaining 16.4% feed their fish depending on availability. On feeding of fish based on body weight 20% of farmers feed their fish at 3% body weight; 16.4% feed at 5% body weight while 1.4% feed at 7% body weight.

Arboe and Grant, (1996) reported that newly hatched fry are fed several times daily at 6–10 percent of fish weight. Fingerlings are fed between 2 and 5 percent of their body weight per day, while brood fish are fed 1 to 2 percent of their weight per day.

5.3.6 UNCONVENTIONAL FEED INGREDIENTS USED

Unconventional fish feeds are potential feed ingredients, which have not been used in fish feed production They contain high quality feed ingredients that can compare favorably with conventional feed types and are expected to be cheaper by virtue of the fact that there is no competition for human consumption. Unconventional fish feed can be of animal or plant source

(Roberts, 1989).

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From the result, most of the farmers (42.1%) in Edo south utilizes blood meal as unconventional ingredient in the diet of fish. This might be due to it being available and relatively cheap. Blood meal is a good quality ingredient for fish and has been tested successfully in many fish species. Spray-dried blood meal can be used as a binder in fish feeds. In gibel carp (*Carassius auratus gibelio*), African catfish (*Clarias gariepinus*) (Goda *et al*., 2007) and tilapia, spray- dried blood meal can replace 50 to 75 % of the fish meal, and in rainbow trout (*Onchorhynchus mykiss*) up to 100 % (Watanabe *et al.*, 1998; Médale and Kaushik, 2009). However, it was found to lower performance in tilapia when replacing fish meal (El-Sayed, 1998).

5.3.7 CAN FARM MADE FEED COMPARE WITH COMMERCIAL FEED NUTRITIONALLY?

This result implies that there is improvement in the feed production technology in Edo south. With 57.9% preferring farm made feed to commercial feed. This result is in disagreement with Jamu and Ayinla, (2013) who said that the low quality of fish feed and its attendant high cost are the major factors limiting the development of aquaculture in Africa.

5.3.8 CHALLENGES IN FEEDING AND SOURCING FOR FEED INGREDIENTS

The result of the study revealed 75% of farmers suffer from high cost of feed. 20.7% are inadequate funded. 2% and 1% chose scarcity of feed ingredients and high transportation cost respectively in Edo south. Obe and Omojola, (2015) also reported high cost of feed as a major constraint facing fish farmers in Ekiti state. Jamu and Ayinla, (2003) have reported that feed constitute about 60% of production cost.

Omitoyin, (2006) acknowledged fish feed to be the most expensive input in fish culture operations and accounts for about 70% of production cost. Rawle *et al*., (2011) also stated that Diet costs constitute the largest annual variable outlay, up to 80% of operating expenses incurred during intensive production of an aquaculture enterprise.

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CHAPTER SIX

6.0 CONCLUSION

It is therefore evident from the results obtained in this study that monoculture of catfish is the most adopted cultural practice and this cultured species should be fed twice daily; morning and evening time of the day to reduce wastage. Feed is the single most important cost in total production cost for fish. This study has shown that the cost of feed for fish farmers in Edo South is high, but is similar to prices in other parts of Nigeria. The study has also shown that many fish farmers use commercial or imported feed, causing extra cost and low profit margin. Farmers need to improve their feed production practices and knowledge on fish feed formulation, so they can reduce the amount they spending on fish feeds and put their income to more productive use.

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6.1 RECOMMENDATIONS

1. It is recommended that proper awareness about feeding practices and feeding to meet the nutrient requirements of fish should be created in the rural and urban areas of this senatorial districts and the state at large, and that government agency like the Agricultural Development Programme (ADP), Ministry of Agriculture and Development, Fisheries Division and extension agents should be more involved in creating awareness.

2. Prospective fish farmers are advised to consult fisheries experts rather than quacks when starting their business.
3. Concerted efforts should be made on fish feed production techniques to increase production and meet the demand for fish feed need by farmers.
4. Improvement of the effectiveness of Edo State aquaculture extension services to work with farmer groups, cooperatives and business associations to improve farmers' production practices leading to more efficient use of feed and increased productivity. Farmers need to be better informed on proper feeding regimens (both volume of feed and quality of feed), and understand the impact of feeding regimens on profitability to incentivize them to invest in using manufactured feeds of high quality.
5. Subsidies on variable inputs from Governments such as fingerlings and feeds are advocated to boost aquaculture production.
6. Young and energetic youths should be encouraged to engage in fish farming especially around their homes.

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APPENDIX 1

QUESTIONNAIRE

SURVEY OF FISH CULTURE PRACTICES IN RELATION TO TYPE OF FISH FEED USE BY FARMERS IN EDO SOUTH

Sir/Madam,

I wish to solicit for your co-operation in collection of information on the above subject matter. The information provided will be used for research purpose only.

Instruction: Please kindly tick/fill (√) the option that is appropriate to you.

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Name of farm: ……

Location of fish farm: ……

SECTION A

DEMOGRAPHIC PROFILE OF FISH FARMERS.

1. **Gender:** Male ( ) Female ( )
2. **Age:** Less than 30yrs ( ) 30 - 40yrs ( ) 41 – 50yrs ( ) Above 50yrs ( )
3. **Marital Status:** Single ( ) Married ( ) Divorce ( ) Widow/Widower ( )
4. **Level of Education:** Non-formal ( ) Primary ( ) JSS ( ) SSCE ( ) Adult Education ( ) Tertiary ( ) Vocational ( )
5. **Farming Status:** Full-time ( ) Part-time ( )

SECTION B

FISH FARM PRODUCTION INFORMATION

6. How long have you been in fish farming: (……..)
7. Types of culture facilities: Earthen ( ) Concrete tank ( ) Plastic tank ( ) Fibre glass ( ) Wooden troughs ( ) Cages ( ) Race ways ( ) Flow-through ( ) Re-circulatory ( ) Concrete/Fibre ( ) Earth/concrete ( ) Earth/Fibre ( )

8. Farm size (No of fish ponds): 1-3 ( ) 4-6 ( ) 7-9 ( ) 10-12( ) 13-15 ( ) 16 and above ( )

9. Pond Size ……

10. Types of fish cultured: Catfish ( ) Tilapia ( ) Bony tongue ( ) Carp ( ) Catfish/Tilapia ( ) Catfish/Bony tongue ( ) Tilapia/Bony tongue ( ) Catfish/Tilapia/Bony tongue ( ) any other combination (please specify)……..……

11. Cycle of production: 3months ( ) 4months ( ) 6months ( ) 9months ( ) 12months ( ) above ( )

SECTION C

FISH FEEDING INFORMATION

12. Types of feed use for feeding: Commercial Source ( ) Local feed Source ( )

13. Type of feeding devices used in feeding? Manual feeding ( ), demand feeders ( ), automatic feeders ( ), others (specify).....

14. Methods of feed application? Feeding at a spot ( ), broadcast feeding ( ), others (specify).....

15. If feed are manufacture in the farm what is the source of ingredients? Local source ( ) Imported ( )

16. Which of the ingredients are readily available? …….

17. Source of required protein ……

18. Source of required energy ……

19. How often do you feed your fish? Once a day ( ) Twice a day ( ) Three times a day ( ) others specify ( )……..

20. Do you determine the quality of feed giving to fish? Yes ( ), NO ( )

21. How is feeding done? Based on body weight ( ) Depending on availability ( ) Discretion ( )

22. If it's per body weight, at what rate? 3% bodyweight ( ) 5% bodyweight ( ) others specify……

23. Would you say farm made feed can compare with commercial feed nutritionally ……

24. What unconventional feed ingredients do you use, Blood meal ( ) Feather meal ( ) Earthworm meal ( ) others specify ( )…….

25. What are the challenges faced with feeding and sourcing for feed in the farming business? Inadequate funding ( ) Scarcity of feed ingredients ( ) High cost of feed ( ) High cost of transportation ( ) others specify ( )……

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THANKS FOR YOUR CO-OPERATION

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