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DETERMINATION OF THE OPTIMUM POND SIZE OF CATFISH PRODUCTION ENTERPRISE IN NIGER STATE, NIGERIA

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ABSTRACT

Aquaculture, also known as fish farming, is the practice of breeding, rearing, and harvesting aquatic species such as fish, crustaceans, mollusks, and aquatic plants for human consumption and other purposes. In Nigeria, aquaculture has become an important sector for food production, income generation, and employment. The growth of aquaculture in Nigeria is now largely being boosted by a steady rise in catfish culture. Catfish farming is increasingly becoming an attractive form of aquaculture for the private sector investors especially the young people. The catfish enterprise requires optimal farm organization most especially when large pond size is involved and therefore, optimum pond size is needed to be determined so as to bring about high return on investment. Proper planning and design of pond construction is critical to the success of a commercial catfish operation. This study was conducted in some Local Government Area of Niger State to assess the prototype optimum pond size of catfish production enterprise in the study area. Fifty-seven (57) catfish farmers were selected from the study area using simple random sampling techniques. Structured questionnaire was used to collect data from the respondents. The analytical tools used include, descriptive statistics and linear programming. Findings from the study revealed that 62.70 percent of the respondents are in their active age while 82.5 percent were male and majority of the farmers are married. The optimum plan for catfish production in the study established from the present investigation shows optimum pond size of 224.90m²; 1054.01kg of feed; 1,061 fingerlings; 4 man-days of labour and ₦195, 295.80k of capital.

Keywords: Aquaculture, Catfish, Enterprise, fisheries, Optimum, Pond size, Production

1.0 INTRODUCTION

Fish farming is an aqua-cultural activity that involves rearing of fish in a controlled environment such as ponds (concrete or earthen), vats (wooden or fibre glass) and plastics from which social and economic gains are realized (Ugwumba and Okoh, 2010; Adebayo and Daramola, 2013). There are three types of ponds used in catfish farming (Tucker, 2012). The first, called embankment or level ponds, is the most common type of pond used in channel catfish farming. Embankment ponds are the preferred type for large-scale catfish farming because, they can be built in large contiguous tracts, which aids in pond management. Embankment ponds are built on flat land by removing soil from the area that will be the pond bottom and using that soil to form levees or embankments around the pond perimeter. The second type, called watershed ponds are built in hilly areas by damming a small stream. In the long term, the major source of water is runoff from the drainage basin above the dam, although a source of pumped water is desirable to help offset evaporation and seepage during droughts. Watershed ponds represent less than 10 percent of the total pond area devoted to channel catfish farming. The third type is the hybrid embankment-watershed ponds which are built in regions with gently rolling topography. They may have two or three sides consisting of embankments (actually low dams) across a relatively small drainage basin. Considerable amount of water may be obtained from runoff, but a source of pumped water also must be made available as the catchment area above the pond is relatively small (Tucker and Hargreaves, 2003).

The stocking rate in a monoculture of African catfish influences the size of the fish at harvest. It can be varied from 2 to 10 fingerlings per square meter depending on the desired corresponding marketable size of fish of approximately 500 and 200 g respectively after 6 months. It is not advisable to use higher stocking densities due to difficulty in managing the adverse water conditions that results at the end of the production cycle. Adverse water quality has been associated with "crack head" disease in pond culture. For intensive monoculture, the African catfish must be fed with a balanced composed feed which should contain 30–35 percent digestible protein (about 40–50 percent crude protein) and 2500–3500 kcal digestible energy/kg feed (about 3500–4500 crude energy/kg feed). The feed is distributed two to three times a day in equal portions (FAO, 1994)

Adopting a prototype enterprise combination has profound implication on improving the family income of an average farmer (Igwe***et al***., 2013). If there were no resource constraints, farmers perhaps could allocate without optimizing or optimize without considering the implication of allocation (Olayemi and Onyenweaku, 1999). Linear programming is a mathematical procedure for determining optimal allocation of scarce resources and very useful in management science. They offer the best prospects for success in optimizing work. (Schipper ***et al***., 1995). The technique entails procedure for optimizing the value of some objective when the factors involved are subject to some constraints with a major factor requirement that all relationships are linear. This major factor explains the "linear" part of the term linear programming while the "programming" part refers to the solution method. This is invariably carried out by an iterative process whereby one moves from one solution to a better solution progressively on until a solution is reached which cannot be improved upon, that is, optimum (Lucey, 2002).

Among the culturable species of food fish in Nigeria (carp, tilapia and catfish), catfish is the most sought after species, very popular with fish farmers and commands a very good commercial value in Nigerian markets (Samson, 1997). In addition, there has been a drastic increase in price of catfish in recent times due to high demand (Adebayo and Daramola, 2013). Channel catfish farming is a capital intensive enterprise in both facility development and production. Prospective producers should complete an economic feasibility study before investing in an enterprise. However, Information on economic viability of aquaculture is relatively scarce in Nigeria (Olasunkanmi, 2012). Most lending institutions require a detailed economic prospectus before considering a loan to a new or established producer. In a study to carry out an economic analysis of fish farming in Osun State Olasunkanmi (2012) found out that only 5.6% of the farmers had access to bank loans.

Cost of land, quantity harvested and number of pond units have been identified as important variables influencing the profitability of a catfish production venture. Though, catfish aquaculture generally requires less space, time, money and has a higher feed conserving rate, it is capital intensive and moderate to high capital investment is needed to make reasonable profit. In addition, high cost of commercial feeds which are mostly imported can

seriously affect profits realizable from the farm. A survey of catfish farmers showed that the socio-economic characteristics of the catfish farmers and the total revenue are significantly related. Farmers prefer earthen pond because of the less cost of construction and maintenance associated with it compared to other types (Adebayo and Daramola, 2013). The quality and quantity of feeds and fingerlings are important to the success of a farm and should not be compromised. According to Yong-Sulem***et al***., (2007), profitability is more dependent on fingerling production costs as well as on their number, size and selling price than on survival as fenced ponds did not return higher profits than unfenced ones. It was however, noted that maximal protection of fry at the lowest cost and stocking as may be permitted by the level of food availability is necessary for maximization of profits.

Previous studies show that increased total yield obtained from higher stocking density, results in smaller fish size at harvest. Conversely, lower stocking densities result in increased individual fish size (Brown 2011). Furthermore, interaction between stocking rates and feeding rates influences the profits derivable from a pond culture. When prices of feed are high, maximal profit is obtained at lower stocking rates. In contrast, when feed prices are low, profit is maximized at higher stocking rates. Moreover, efficiency (output per unit of input) rather than yield (output per unit area or volume), is a more useful and appropriate measure in catfish pond aquaculture that seeks to maximize profits via optimum resource utilization. This is due to the fact that an efficiency-based catfish pond aquaculture aimed at maximizing profits does not necessarily imply maximizing production (Hargreaves and Tucker, 2003). Whether ponds are operated as single-batch systems or multiple-batch systems, stocking rate is best defined as the maximum fish density (number per acre) over the production period. Under commercial conditions, stocking rate becomes an approximate goal rather than a precisely managed population variable because it is nearly impossible to know the true inventory of fish in large commercial ponds that are used for several years without draining. Generally, higher production and survival of *C.gariepinus* has been observed in small ponds rather than in larger ponds. Smaller ponds are easier to manage and to fertilize, for rapid development of plankton bloom and thus ensuring plentiful food for the stocked hatchlings (FAO, 1996). The focus of this study is to obtain optimum pond size in

catfish aquaculture with a goal of maximizing returns on investment in the production of catfish in Niger State, Nigeria

2.0 METHODOLOGY

2.1 Study Area

This study was carried out in Niger State, Nigeria. The State is located between Latitudes 8°22′N and 11°30′N and Longitudes 3°30′N and 7°20′E. It is characterized by wet and dry seasons. The wet season lasts for a period of seven months (April- October) while the dry season covers the remaining five months (November – March). It has an average temperature of 27°C and an annual rainfall of about 100 – 150mm. The area making up Niger State comprises of old Nupe and Kontagora Kingdoms, Suleja with links to the famous kingdom of Zauzau and a host of other political entities. The state was excised from the defunct North-Western State and made a full-fledged State in the Federation, National Population Commission (NPC, 2013).

Currently, the State covers a total land area of 74,244 sq.km, or about 8% of Nigeria's total land area. Niger State had a total population of 2,482,367 people in 1991 (NPC, 2013). The population of the State was projected to 4,634,105 as at December 2012, with a total land area of 74,244sq.km, this gives the State a population density of about 33 per sq km; the lowest in the country. It should be noted, however, that this low population density conceals local variations, particularly in some of the largest local government areas such as Wushishi, Borgu, Mariga and Shiroro where population density is below the state average (NPC, 2013). The State is bordered to the North by Zamfara State, to the Northwest by Kebbi State, to the South by Kogi State, to the Southwest by Kwara State; while Kaduna State and the Federal Capital Territory, Abuja border the State to the Northeast and Southeast parts respectively. Furthermore, the State shares a common international boundary with the Republic of Benin at Babanna in Borgu Local Government Area of the State (Aiyedun, 1989).

Generally, agricultural activities form the mainstay of the State's economy and engage directly or indirectly more than 80 percent of the population. The Gwari, Koro, Kadara and Kambari are noted for yam and guinea corn production, while the Nupe are the major rice producers. The Hausa and Fulani in Mariga Local Government area are well known in the field of animal husbandry. The three principal ethnic groups of the State are the Nupe, the Gwari and the Hausa. Other

groups include the Koro, the Kadara, the Kambari, the Kamuku, the Pangu, the Bassa, the Baushi, the Fulani, the Dukawa, the Gade, the Godara, the Ganagana, the Mauchi, the Ayadi, the Ingwai, the Dibo, the Gulengi, the Abishiwa and the Shigini (Aiyedun, 1989).

Figure I: Map of Nigeria showing the location of Niger state

Figure II: Map of Niger state showing the different Local Government Areas.

2.2 Method of Data Collection

Preliminary survey was carried out in form of field trips to the study locations to establish rapport with the catfish farmers in the study area as well as compile the frames from which the samples were drawn. Data collection commenced from April, 2022 to July, 2022. Information elicited from the respondents include those on the socio–economic characteristics of owners of the catfish firms like age, sex, marital status, household sizes, catfish production experience in years and educational level; surface area of the catfish pond (pond size) (in m^3); returns on investment (Gross Profit) (₦); annual production (in metric

tonnes or kg of catfish); annual total sales of production in metric tonnes or kg of catfish and its value in Naira; quantity of feed used (kg) and its cost (in Naira ₦);quantity of fingerling used in metric tonne or kg and its cost (in Naira ₦); quantity of drugs and chemical used in mg and its cost (in Naira ₦) and quantity of labor and cost (in Naira ₦). Others include: labor input used on the farm were collected from farmers based on the type of labor used , such as family and hired labor by age and sex and was converted into man equivalent (in man days) and quantity of lime used (in kg).

2.3 Analytical Techniques

The Analytical tools used in the study were descriptive statistics, budgeting analysis, ordinary least squares (OLS), multiple regression analysis and Linear Programming Model.

2.3.1 Descriptive Statistics

It involved the use of frequency distribution, means, standard deviation and percentages. This was used to achieves objective 1 of the study to describe the socio-economic characteristics of the catfish farmers such as age, sex, marital status, catfish production experience(years), household size, educational level and also identify the constraints faced by catfish farmers in the area.

2.3.2Specification of the Empirical Linear Programming Model

The determination of optimal pond size was done by the use of Linear Programming Model. The model was used to formulate prototype optimum pond size and the corresponding maximum net profit. The model sought to maximize the net farm profit which is gross farm income minus the cost of pond construction, feed, fingerlings, drugs and chemicals used, human labour, marketing, cash rent on land, depreciation costs and interest payments on each farm simultaneously in a typical production cycle.

The model is specified in explicit form as:

$$\text{Maximize } Z = \sum_{J=1}^{n} p x_i - \sum_{j=1}^{n} \beta_i FC_i - \sum_{j=1}^{n} \beta_i CF_i - \sum_{j=1}^{n} \beta_i DR_i - WhL_i - rP - DC - MC - R \quad (1)$$

Subject to:

$$\sum_{j=1}^{n} 1_i X_i \leq PS \text{ (Pond size)} \quad (2)$$

which implies that the total pond size in m^3 (cubic metre) required to produce n fisheries enterprises must not exceed total available pond size for all the fish species.

$$\sum_{j=1}^{n} a_i X_i . FD \leq TF \text{ (feed input)} \quad (3)$$

Which implies that the total feed required to produce 'n' fish species must not exceed the total feed available.

n

$$\sum_{j=1} b_j X_j - CF \leq NF \text{ (Fingerlings)} \quad (4)$$

Which implies that the total amount of money required to purchase n number of fingerlings must not exceed the amount available.

$$\sum_{j=1}^{n} c_j X_j - HL \leq TH \text{ (Human labour)} \quad (5)$$

Which implies that the total man-days of human labour required to produce the n catfish activities must not exceed the total human labour available.

$$\sum_{j=1}^{n} d_j X_j - CP \leq CT \text{ (Capital)} \quad (6)$$

Which implies that the total capital required to produce the n catfish farmers must not exceed the total amount of capital available.

X_j , FD, CF, HL,CP ≥ 0 (7)

This implies that decision variables must be non-negative.

Where Z = Net profit in Naira,

X_j = Unit of activity of the j^{th} catfish farmer (m^2) in Naira,

P_j = price of unit of output of the j^{th} catfish farmer,

FC = Quantity of feed purchased,

β_2 = cost per unit of fingerlings purchased in Naira,

CF = Quantity of fingerlings purchased,

β_3 = cost per nuit of drug/ chemical (mg) used in Naira,

DR = Quantity of drug/chemical used in Naira,

Wh = wage rate per unit of human labour in Naira,

L = Number of hired labour in a cycle,

r = rate of interest for six months,

P = Capital borrowed in Naira,

DC = Depreciation cost on fixed items such as nets and ponds in a production cycle in Naira,

MC = Marketing costs in Naira,

R = Rent on land / facility in Naira,

l_j = input coefficient for pond size, 1 acre/m^2 with restrictions,

a_j = input coefficient of feed input for j^{th} catfish activity,

b_j = input coefficient of fingerlings for j^{th} catfish activity,

c_j = input coefficient of human labour in mandays for j^{th} catfish activity,

d_j = input coefficient of capital used in producing one acre/ m^2 of j^{th} catfish activity process in a cycle and

$\sum_{j=1}^{n}$ = summation of j^{th} catfish activities where j = 1, 2, 3 ---------, n.

The unit of activity was one catfish. According to Aliyu and Shaib (1997), Nigerian fish farmers can be categorized into three namely, small scale (with 0.10 to 5.99 hectares) medium scale (with 6 to 9.99 hectares) and large scale holdings with ten hectares upward. The carrying capacity or production capacity is based on species of fish, water quantity, temperature and quantity of fish feeds. The recommended stocking density for catfish is six fish/m^2 assuming up to 20% mortality rate.

The catfish farmers in this study were categorized into three (3) as follows:

i. Small Scale with 300 – 1000 catfish
ii. Medium Scale with 1001 – 9,999 catfish
iii. Large Scale with 10,000 and above.

3.0 RESULTS AND DISCUSSIONS

3.1 Socio-Economic Characteristics of the Catfish Farmers.

The socio-economic characteristics of catfish farmers such as age, gender, marital status, level of education, farming experience, household size, source of finance and cooperative membership are presented below:

The results in Table 1 showed that the majority of the catfish farmers in the study area were within the age range of 31-40 years followed by those between 41-50 years at 40.40% and 22.30% respectively. A total of 8.0% were below 30 years of age while 7.0% fell within the age range 50-60years. The predominant age brackets belong to the productive and economically active age group which portends better future for catfish production (Olowosegun ***et al***., 2005). This indicates that very few younger and older people are involved in fish farming. This may be because fish farming requires adequate attention and high sense of responsibility. This also agrees with the findings of Sikiru**et al**., (2009) whose study showed that individuals participating in catfish farming are within the productive age brackets thus indicating a better future for catfish production. Sex plays a very important role in fish farming as is the case in other agricultural practices with regards to property acquisition such as fixed assets like land and machines.

Table I: Socio – Economic Characteristic of the Catfish Farmers

Socio – Economic Variable	Frequency	Percentage
Age		
21-30	8.0	14.0
31-40	23.0	40.4
41-50	13.0	22.8
51-60	7.0	12.3
>60	6.0	10.5
Total	57.0	100.0
Sex		
Male	47.0	82.5
Female	10.0	17.5
Total	57.0	100.0
Marital Status		
Married	48.0	84.2
Single	9.0	15.8
Total	57.0	100.0
Educational Background		
None	1.0	1.8
Primary	4.0	7.0
Secondary	5.0	8.8
Tertiary	47.0	82.5
Total	57.0	100.0
Years of Experience		
<5	39.0	68.4
6 – 10	15.0	29.3
11 – 15	2.0	3.5
16 – 20	1.0	1.8
Total	57	100.0
Household Sizes		
<3	8.0	14.0
4 – 6	23.0	40.0
7 – 10	14.0	24.6
>10	12.0	21.1
Total	57.0	100.0
Cooperative Society		
Non – Member	44.0	77.2
Member	18.0	22.8
Total	57.0	100.0
Sources of Finance		
Personal Saving	47.0	82.5
Friends/Relatives	8.0	14.0
Commercial Bank	1.0	1.8
Local Money Lender	1.0	1.8
Total	57	100.0

Source: Field Survey, 2022.

Majority of the respondents involved in catfish production in the study area were males which constitute 82.5% while 17.5% were females. This result can be justified by the assertion of Brummett***et al***., (2010) that fisheries activities are mostly dominated by men. The dominance of the males could lead to improvements since males have more access to productive assets as compared to the females. Majority of the

respondents are married constituting 84.2% while 15.8% were single as shown in Table 1. The implication of this result is that there could be more support from the spouses and children of the farmers with a view to improving and increasing fish production. It could mean that, unmarried people rarely engage in fish farming as they may not have the where-with-all to undertake such economic activity (Nwosu**et al.**, 2012). Ekong, 2003 also pointed out that marriage in our society is highly cherished and this assertion was further supported by the report of Fakoya (2000) and Oladoja ***et al.,*** (2008) who affirmed that marriage confer some level of responsibility and commitment on individual who are married.

Respondents without formal education were 1.8 percent while 82.5 percent had tertiary education. This implies that fish farming is dominated by the educated class and mostly by those armed with high levels of education. This is so because, fish farming requires a lot of technical and scientific knowledge to be successfully undertaken and that the more an individual is educated, the more likelihood the individual will be able to decode information and the more willing the individual will be able to adopt or try out new innovations. This finding is consistent with that of Nwosu***et al.,*** (2012), Emenyonu ***et al.,*** (2010). The level of education of farmers increases their farm production and also enhances the ability to understand and evaluate new production technologies. This could be a strategy to assist in the family upkeep. Munir (2009) also noted that average level of education within the general populace increases with farm sizes as farmers with higher educational achievements are likely well-to-do before commencing the farm operations. Table 1 also shows that 68.4% of the respondents have 1-5 years of experience. This shows that the catfish farmers are relatively new in the enterprise. Williams ***et al.,*** (2012) noted that the ability to manage fish pond efficiently depends on the years of experience and this is directly related to the total productivity of the farm. The level of experience that an individual acquires in any business will help boost production (Onu and Unaeze, 2009). Langgintuo and Mekura (2005) also believed that experienced farmers are generally better able to access the new relevant technologies through interaction with their neighbors and the outside world.

Family size has a positive relationship with technology adoption, as large family size is a potential source of cheap labour, thereby reducing labour cost

in executing catfish production activities (Onyenweuaku ***et al.***, 2010). The farmers would divest money saved from cheap labour availability to augment their meagre resources in procuring improved production inputs which would facilitate the intensity of technology adoption. Table 1 shows that the household size of those that ranged between 4 and10 had the highest percentage of 65%. This shows that there were enough hands (family labour) engaged to carry out fish farming operations. The large family size can serve as source of free and cheap labour, though it is not the size per se, but the composition of the family (Adebayo, 2012).

Result in Table 1 also revealed that majority (77.2%) of the respondents in the study area were non-members of a Cooperative Society and only 22.8 percent of the respondents were registered members of cooperative Society. This could be due to their little or no knowledge on the importance of being a member of Cooperative Society. This implies that most of the respondents were operating independently and have not being benefiting from the government incentives channeled through Cooperative Societies. Apart from the recognition accorded by the government and funding organizations, cooperatives also play onerous role of meeting the financial and resource need of members which underscores the need for catfish farmer to embrace being members of Cooperative Societies. Similar results were obtained by Ibrahim (2011) who found that 70 percent of the farmers in Kaga, Kukawa Local Government Area of Borno State, Nigeria were non-members of Cooperative Society.

3.2 Optimal Plan and Existing Fish Farm Plans

The existing and optimum enterprise patterns are presented in Table 2. The results indicated a divergence between the existing and optimum farm plans. The existing plan for all enterprises i.e small scale, medium scale, large scale and pooled samples are presented in the Table 4.8. The optimum plan prescribed 224.90cm^3 pond size which is a medium scale enterprise, 1054.01kg of feed, 1,060.89 number of fingerlings, 3.94 man-day's of labour and ₦195,295.80 of capital. The maximum profit realizable by a typical fish farmer in the optimal plan was ₦340, 040.00. The relatively high

optimum values obtained in this study and in other similar studies relative to other previous findings in other enterprises such as crop could be because the fisheries

enterprise is generally a lucrative business with great financial potentials.

Table II: Existing and Optimum Catfish Farm Plans and Resources Utilization

Variables	Small Scale	Medium Scale	Large Scale	Pooled Samples	
	Existing Plan	Existing Plan	Existing Plan	Existing Plan	Optimum Plan
Pond Size(m^2)	0.026	0.037	0.026	224.990	224.900
Feed(kg)	167.631	131.256	124.304	322.610	1054.010
Fingerlings(No.)	28.500	25.586	29.113	1,123.770	1,060.890
Human Labour(Manday)	16.252	37.968	74.792	97.260	3.940
Capital(Naira)	20.049	45.598	51.003	195,407.860	195,295.800

Source: Field Survey, 2022.

3.3 Problems Confronting Catfish Farmers in the Study

This study found that fish farmers encountered problems in their production activities. The results are presented in table 3. The table shows that majority (96.49%) of the respondents interviewed complained of high cost of feed. This problem ranked 1st on the list. The importation of most commercial feeds into the country and problems associated with importation and distribution could be the main reasons for the hike in feed prices. These commercial feeds possess floating and high protein qualities and are therefore preferred by fish farmers (Ugwumba and Chukwuji, 2010). This result is in consonance with the findings of Ocmer (2006). Ugwumba and Nnabuife (2008) also identified high cost of feed as very serious drawback to profits realizable from catfish farming. Ike ***et al.***, (2003) reported that high cost and often unavailability of fish feed concentrate make fish farming unproductive. The effect is that farmers stop feeding their fish when the price of feed is high and resume only when they can afford the cost. Madubuike (2012) also reported high cost feed as one of the problems of livestock production in Nigeria

Table III: Problems Confronting Catfish Farmers in the Study Area.

	Problems	Frequency	Percentage	Rank
1.	High cost of feed	55	96.49	1
2.	Inadequate Finance	45	78.95	2
3.	Lack of access to fingerlings	42	73.68	3
4.	Poor extension education/ service	42	73.68	3
5.	Limited market sales	42	73.68	3
6.	Lack of encouragement from Government	40	70.18	4
7.	Inadequate power supply	38	66.67	5
8.	Inadequate research on agriculture	23	40.35	6
9.	Poor access roads and transportation facilities	21	36.84	7
10.	Inadequate harvesting and transportation equipment	19	33.33	8
11.	Predators	16	28.07	9
12.	Inadequate storage facilities for feeds and drugs	13	22.81	10
13.	Pilfering / theft	11	19.30	11
14.	Disease incidence	8	14.04	12
15.	Flood problems	7	12.28	13
16.	Water pollution	3	5.26	14

***Implies multiple responses were recorded**
Source: Field Survey, 2022.

Inadequate finance was also indicted by the respondents as one of serious constraints facing catfish production with 78.95% and was ranked 2nd. Catfish farming is capital intensive and thus requires big capital investment for reasonable profit to be made. Also, Sikiru *et al.* (2010) identified inadequate finance as a serious problem in catfish production. This was indicated by Ugwumba and Chukwuji (2010) as one of the major problems facing catfish farmers in Anambra State, Nigeria. Adeogun***et al.***, (2007) also reported lack of capital as one of the problems affecting aquaculture in Lagos State, Nigeria. Access to adequate capital enables the fish farmer acquire more production inputs and to hire labour for the accomplishment of farm operations. This necessitates the introduction of subsidized credit to

practicing catfish farmers to boost production. Lack of good sources of fingerlings was the third serious problem reported by 73.68% of the catfish farmers. This could be due to the near inexistence of local supplies of pond fish fingerlings in the study area. Farmers relied on the importation of most of their fingerlings from neighboring States. Limited market sales also ranked the 3rd problem whereby 73.68% of the respondents indicated it as a problem. Marketing of aquaculture products is becoming a problem in Nigeria. This is not because the supply is in excess of demand but because of uncoordinated marketing programmes. Many farmers sell their fish in fresh form to middlemen at very low prices. There is, therefore the need for networking and marketing information among fish farmers, processors and consumers on availability of fish and current market prices all over the country to prevent the farmer from being ripped-off. There is also the need to add value to aquaculture products in order to increase the profit margin of farmers. Modern fresh fish distribution chains should be developed as to make fish available to consumers in form and places. The quality control of such products should be ensured by regulatory agencies.

Poor extension education also ranked 3rd in decreasing magnitude of importance. This was identified by 73.68% of respondents. Catfish farmers were lacking the proper coordination that links them with the government and the research institutes. This could be that the extension agents were not enough in terms of number and or perhaps they were not adequately provided with extension facilities to meet their schedules. It may also be due to the study of Eze and Akpa, (2010), who cited that inadequate transfer of information to farmers by extension agent due to bottle necks such as negative attitude of the extension agents to their works and inadequate motivation by appropriate quarter, affect technology transfer and consequent adoption. The fourth constraint was lack of encouragement from the government with 40% as been identified by the respondent. Government should place more emphasis on credit facilities toward agricultural production in general and fisheries in particular; such include Agricultural Credit Guaranteed Scheme Fund which enhanced credit availability to the farmers and taking care of tangible proportion of any default so as to encourage the commercial banks to make credit facilities available to farmers.

4.0 CONCLUSIO N AND RECOMMENDATION

4.1 Conclusion

It was concluded from findings of this study that the predominant age brackets belong to the productive and economically active age group which portends better future for catfish production also resources were not optimally allocated in the existing plan for catfish farming operations in the study. However, the area has great potential for catfish production as a lucrative venture. Major constraints faced by the catfish farmers include but not limited to high cost of feeds, inadequate finance, lack of access to fingerlings, poor extension education etc.

4.2 Recommendations

Based on the findings of the study, the following recommendations are hereby made to promote increased catfish production in the study area:

i. Farmers should organize their resources as prescribed by the optimum plans, that is 224.90m^3 pond sizes which is medium scale enterprises, 1054.01kg of feed, 1,060.89k number of fingerlings, 4 mandays of labour and ₦195, 295.80k of capital.

ii. Government should provide facilities such as incentives, subsidies and facilitate access to credit by catfish farmers in the study area by the review of the stringent lending policies of the formal lending institutions. Catfish farmers should come together to form Cooperative Unions to facilitate their access to credit and other inputs.

iii. There is need for adequate supply of fingerlings of fast growing and cultivable species. This should necessitate aggressive research to this study to produce fish species that are high – yielding and well adapted to our niches.

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