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# COMPARATIVE ANALYSIS OF CAT FISH PRODUCTION UNDER EARTHEN AND CONCRETE POND SYSTEMS IN ONDO STATE, NIGERIA

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## ABSTRACT

This study compares the economic benefits of catfish production under the earthen and concrete ponds in Ondo State, Nigeria. A multistage sampling technique was used for the random selection of one hundred and eighty (180) catfish farmers with equal number of earthen pond and concrete pond users. Data collected were analyzed using descriptive statistics and the profitability function to describe the socioeconomic characteristics of respondents and their profitability respectively. The results indicated that there were more male (85.6%) than female (76.7%) users of both methods that are still in their active age of production. At least half of the respondents are married and have mean production experience ranging between 6.3 and 5.8 years. A major number of the respondents employed both family and hired labour. The profitability analysis results showed that earthen pond users realized 53.8% profit higher than concrete pond users. The benefit cost ratio of 1.54 and 1.25 for earthen pond and concrete ponds respectively, also indicated that catfish rearing under earthen ponds were more profitable in the area. This could however, be as a result of high cost of pond construction associated with concrete pond system. It could also be as a result of sizes of ponds which are usually smaller in concrete than earthen ponds, since size is a major determinant factor in stocking and production volume. The major constraints to catfish production were high cost of feeding, capital and lack of organized market. However, the benefit cost ratio of 1.54 and profitability ratio of 0.54 in earthen pond system further confirmed that catfish production business is more profitable and viable enterprise which can drive high income generation for farmers when practiced than concrete pond system. It is recommended that catfish farmers be encouraged to invest more on earthen pond system of culturing catfish than concrete pond in the area.

**Keywords:** Catfish, Earthen pond, Concrete pond and Economic benefit.

## 1. INTRODUCTION

Naturally, from time immemorial, fish production has been from the wild especially from the rivers, estuaries, brackish and marine waters. Fish is an important source of animal protein to households. However, as technology develops and alternative sources of fish production are sought by mankind, artificial construction of earthen and concrete ponds became widely used by producers of fish to the world economy. In Nigeria, aquaculture has been practiced in various media ranging from concrete tanks to plastics, flow through systems, water re-circulatory system and earthen ponds (Yarhere, 2009).

Catfish is suitable for complementing high carbohydrates diets typical for the low income group in Nigeria (Areola, 2007). Unlike pork and beef meat, fish is a cheap source of animal protein and has no religious taboo or any known cultural limitation affecting its consumption (Eyo, 2001). However, local fish production had been below consumption with imports accounting for about $48.8 million in 2002 (CBN, 2004). Fish farming therefore, has been recognized as a viable means of increasing domestic fish production in Nigeria in spite of the decline in fish supplies from the open waters and lagoons (Atanda, 2007). Investment in catfish is still growing especially with the renewed awareness being created by the government of Nigeria through the presidential initiative on fisheries and aquaculture (Miller and Atanda, 2004). In Nigeria, particularly in Ondo State, there are different methods used by fish farmers to raise fishes for sale or for consumption. They could be raised in plastic drums or bowls or unused canoes as well as in constructed concrete tanks and earthen ponds. The recent increase in intensive aquaculture production in Nigeria will require effective water quality management for its success. The tidal fresh water earthen ponds are established to raise fish in areas that

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witnessed tidal regions (6 hourly) while concrete tanks are established where the land are not suitable or there is scarcity of land for earthen ponds (Ezenwa, 2006).

Water is the culture environment for fish and other aquatic organisms. It is the physical support in which they carry out their life functions such as feeding, swimming, breeding, digestion and excretion (Bronmark and Hansson, 2005). Based on this, access to adequate, regular and constant supply of good quality water is vital in any aquaculture project.

Water quality parameters can be divided into three main categories: physical (density, temperature); chemical (pH, conductivity, nutrients) and biological (bacteria, plankton and parasites) (Delince, 1992 and Moody, 2005). All living organisms have tolerable limits of water quality parameters in which they perform optimally. A sharp drop or an increase within these limits has adverse effects on their body functions (Davenport, 1993). Water quality is one of the most critical factors besides good feed/feeding in fish production. It is not constant but varies with the time of the day, season, weather conditions, water source, soil type, temperature, stocking density, and feeding rate and culture systems. For a successful aquaculture venture, the dynamics and management of water quality in culture media must be taken into consideration.

Catfish is very important to the sustainability of the aquaculture industry in Nigeria having possessed the following qualities; hardy, survives in different culture systems and diverse environment (Adediran, 2004). Apart from high protein derived from catfish, it also makes the farmer self-employed and provides extra income for the family. The aim of fish culture principally, is to produce quality fish food for human consumption. It is also to enhance culture based on fishery by providing enough fingerlings for restocking open water like natural and artificial lake, reservoir and running stream in order to prevent the extinction of economically important species of fish especially when and where there is over exploitation.

On national level, it can serve as a source of foreign exchange. Nigeria imports more than 50% of fish consumed locally. Through fish culture, land that cannot be used for any agricultural purpose can be put to productive uses.

Despite the numerous benefits derivable from Catfish production, optimal production method should also be considered. No production methods either earthen or concrete pond is completely perfect with no limitation. Apart from quality control, a major thing that matter most to catfish producers is the profit accrues to production. One would select the method that gives optimal profit margin *ceteris paribus*. A study in this direction is however important as it will help catfish farmers to select the most economical production method.

**Objectives of the Study**

The main objective of this study is to make comparative evaluation of economic benefits of catfish production under earthen and concrete ponds in Ondo State, Nigeria.

Specifically, this study aims to:

i. describe the socio-economic characteristics of catfish farmers in the study area.
ii. estimate the costs and returns on earthen and concrete pond systems in the area
iii. examine the constraints associated with catfish farming under earthen and concrete ponds.

## 2. METHODOLOGY

**Study Area**

This study was carried out in Ondo State, Nigeria. Ondo State is situated within the tropic region of Nigeria and it covers land area of about 14,606km square with a fairly large population of 3.4million (NPC, 2006). The geographical coordinates lies between Latitude $7^0$ 10' 00' E and Longitude $5^0$ 05' 00' E. The land area is about 13,595square kilometers with varying physical features like hills, lowland, rivers, creeks and lagoons. The tropical climate of the state has two distinct seasons: rainy season that starts from April and ends in October, and dry season that last between November and March. It has a temperature range of 21°C-29°C with relatively high humidity. The major occupation of the people in the state is agriculture which promotes aquaculture activities, and offers 75% of employment to the people of the state. The agricultural landscape is characterized by tree crops such as oil palm, mango, cocoa, plantain, cashew, citrus species and wild fishes.

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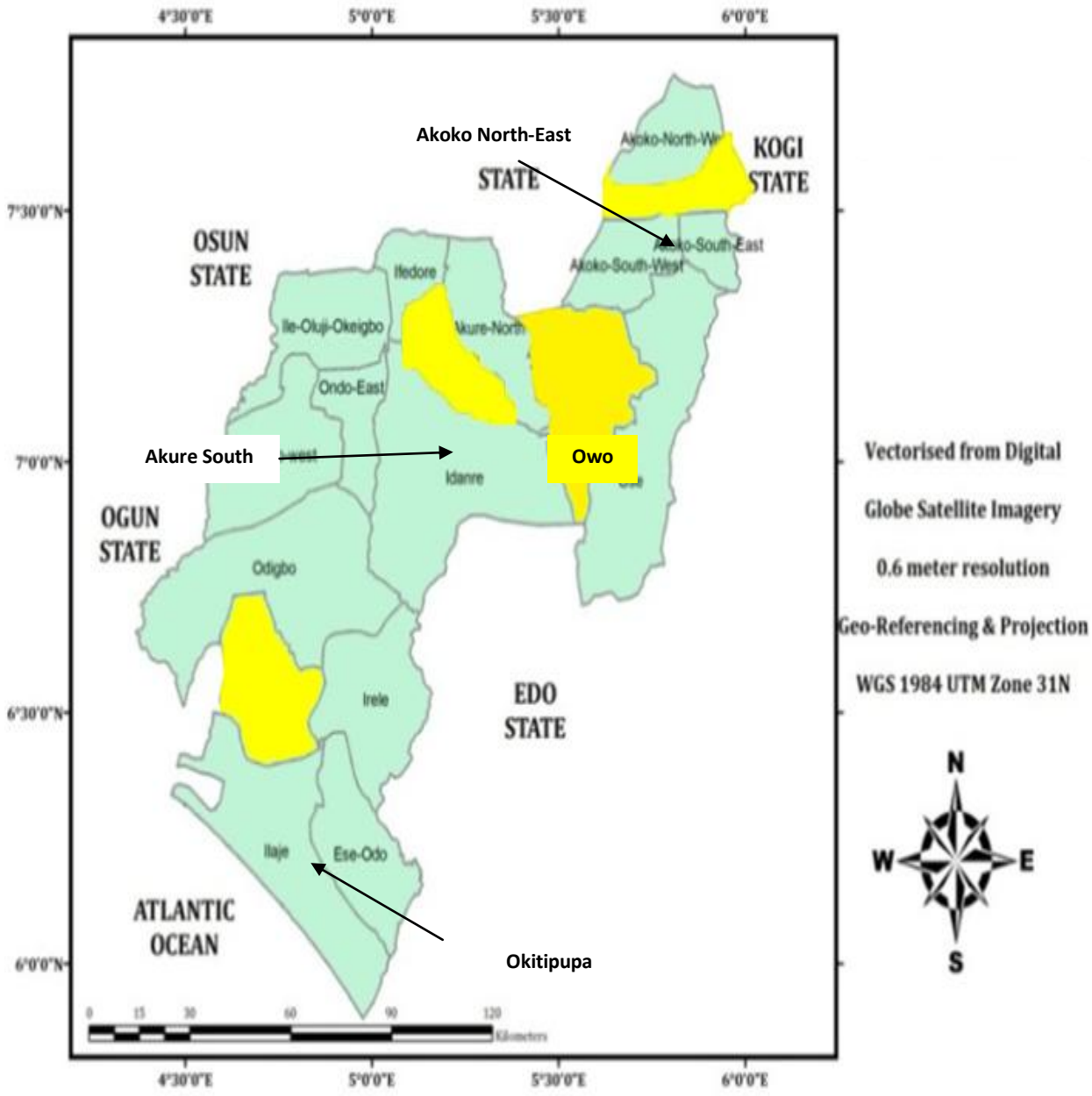


***Fig 1: Map of Ondo State, showing the study areas. Source: computed from field survey (2016) and Ondo State census (2006).***

## 3. DATA AND SAMPLING TECHNIQUE

Primary data were used for this study. The data were collected through direct personal interview and well-structured questionnaire in order to obtain pertinent information on socio-economic characteristics of catfish farmers. This include the costs and returns, yield determinants and constraints on the different methods of catfish rearing in the area. A multistage sampling technique was used for the random selection of Ninety (90) catfish farmers in the State. The sampling technique commenced by clustering the State into three (3) senatorial

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districts, namely, Ondo North, Ondo Central and Ondo South senatorial districts. In the second stage, three local government areas were purposively selected from each senatorial district based on the areas where catfish productions were prominent. The local governments are Owo, Ose, Akoko North East, Akure South, Ifedore, Ondo West, Odigbo, Okitipupa and Ilaje. Stage three involved a random selection of one (1) community from each local government area, making a total of Nine (9) communities. Finally, a simple random sampling technique was also used to randomly select ten (10) respondents from each community, thereby, making a total of ninety (90) respondents used for the study.

## 4. METHOD OF DATA ANALYSIS

Data collected were analyzed using descriptive statistics to describe the socio-economic characteristics of catfish producers. Profitability analysis was employed to analyze the cost and returns associated with earthen and concrete ponds rearing methods. Profit, which is the difference between Total Revenue and Total Cost, was estimated.

Mathematically, profit was represented by;

$$\pi = TR - TC$$

$$Where, \pi = profit$$

$$TR = Total\ revenue$$

$$TC = Total\ cost$$

$$TC = TFC - TVC$$

$$Where, TFC = Total\ fixed\ cost$$

$$TVC = Total\ variable\ cost$$

## 5. RESULTS AND DISCUSSION

**Socio-economic characteristics of Catfish farmers**

Table 1 shows the distribution of catfish farmers in the study area. The results indicated that there were more male users of both production methods (85.6% and 76.7%) that are still in their active age of production. The respondents have a fairly large household size as their mean household size was 4.6. A larger percentage of the respondents (95.6%) had either secondary or tertiary education. This implies that majority of the catfish farmers are elating and would be ready to accept any innovation towards improving their fish farming system. Majority of the respondents are married and have mean production experience of 6.3 and 5.8 years. A major number of the respondents employed both family and hired labour (53.3% and 50%).

***Table 1: Socio-economic Characteristics of Catfish Farmers***

| **Variable** | **Earthen Pond System** | | **Concrete pond system** | |
|---|---|---|---|---|
| | Frequency (n = 90) | Percent (%) | Frequency (n = 90) | Percent (%) |
| **Sex** | | | | |
| Male | 77 | 85.56 | 69 | 76.67 |
| Female | 13 | 14.44 | 21 | 23.33 |
| **Age (years)** | | | | |
| 21 – 30 | 35 | 38.89 | 28 | 31 |
| 31 – 40 | 42 | 46.67 | 41 | 45.56 |
| 41 – 50 | 8 | 8.89 | 13 | 14.44 |
| > 50 | 3 | 3.33 | 8 | 8.89 |
| **Marital status** | | | | |
| Single | 40 | 44.44 | 38 | 42.22 |
| Married | 50 | 55.56 | 52 | 57.78 |
| **Household size** | | | | |
| 1 – 5 | 45 | 50.00 | 46 | 51.11 |
| 6 – 10 | 40 | 44.44 | 38 | 42.22 |

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| | | | | |
|---|---|---|---|---|
| Above 10 | 5 | 5.56 | 7 | 7.78 |
| **Educational level** | | | | |
| Primary education | 3 | 3.33 | 1 | 1.11 |
| Secondary education | 38 | 42.22 | 37 | 41.11 |
| Tertiary education | 49 | 54.44 | 52 | 57.78 |
| **Catfish farming experience (years)** | | | | |
| 1 – 5 | 35 | 38.89 | 45 | 50.00 |
| 5 -10 | 48 | 53.33 | 40 | 44.44 |
| 11 -15 | 7 | 7.78 | 5 | 5.56 |
| **Number of ponds owned** | | | | |
| 1 – 5 | 30 | 33.33 | 49 | 54.44 |
| 6 – 10 | 42 | 46.67 | 29 | 32.22 |
| Above 10 | 18 | 20.00 | 12 | 13.33 |
| **Secondary occupation** | | | | |
| Crop farming | 15 | 16.67 | 13 | 14.44 |
| Livestock farming | 14 | 15.56 | 13 | 14.44 |
| Trading | 12 | 13.33 | 11 | 12.22 |
| Civil service work | 47 | 52.22 | 50 | 55.56 |
| Others | 2 | 2.22 | 3 | 3.33 |
| **Sources of credit** | | | | |
| Personal savings | 17 | 18.89 | 18 | 20 |
| Friends and relations | 7 | 7.78 | 6 | 6.67 |
| Cooperative societies | 28 | 31.11 | 27 | 30 |
| Commercial banks | 22 | 24.44 | 24 | 26.67 |
| Agricultural banks | 6 | 6.67 | 5 | 5.56 |
| Thrift | 10 | 11.11 | 10 | 11.11 |
| **Sources of labour** | | | | |
| Hired | 35 | 38.89 | 32 | 35.56 |
| Family | 7 | 7.78 | 13 | 14.44 |
| Hired and family | 48 | 53.33 | 45 | 50.00 |

**Source**: Field Survey, 2016

**Cost and Returns of Catfish Production under Earthen and Concrete Ponds System**

The result of costs and returns for catfish production per season in the study area as shown in Table 2 revealed that under earthen pond system, the average cost of transportation (₦ 288428.57), cost of fertilizer (₦12342.86), cost of lime (₦2804.67), cost of herbicides (₦5343.1), cost of feed (₦654178.85), cost of fingerlings/juvenile (₦137200.44), cost of medication (₦26246.15) and cost of labour (₦10411.5) made up of the total variable cost and is about 64.64% of the total production cost of the business. The fixed cost under this system is made up of costs of pond construction (₦180367.93), cost of net (₦15950), cost of fencing (₦35000), cost of weighing scale (₦20820), cost of pumping machine (₦45538.46), cost of wheel barrow (₦16136.36), cost of cutlasses (₦5777) and cost of borehole (₦302480) amounted to ₦622069.75 .The total cost of production (TFC + TVC) and total revenue of the earthen system were ₦622069.75 and ₦1136956.14 respectively. The gross margin and profit of ₦1569992.93 and ₦947923.18 respectively also established the profitability of system in the area.

Under concrete pond system, it is further revealed from the table that average costs of transportation (₦23666.67), cost of fertilizer (₦3000), cost of lime (₦9062.5), cost of herbicides (₦3900), cost of feeds (₦616504.55), cost of fingerlings/juvenile (₦104375), cost of medication (₦4420.8) and cost of labour (₦10261.3) is made up of the total variable cost which is 64.64% of the total production cost of catfish production under the system. Under this practice the fixed cost which form about 35.36% of the total cost is

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made up of costs of pond construction (₦345461.54), cost of net (₦22272.73), cost of fence (₦113000), cost of weighing scale (₦17550), cost of pumping machine (₦57000), cost of wheel barrow (₦11454.55), cost of cutlass (₦4333.33) and cost of borehole (₦377333.33).

The total cost of production (TFC + TVC) and total revenue were ₦948405.48 and ₦775190.82 with the gross margin and profit of ₦1569992.93 and ₦437650.13 respectively.

When comparing the net farm income (profit of the enterprises), earthen pond users made 53.8% higher profit than concrete pond users. This could be due to high cost of construction and smaller sizes of ponds peculiar to concrete pond users than earthen pond users.

The benefit cost ratio of 1.25 and profitability ratio of 0.25 under concrete pond system indicated that catfish production business under concrete system is equally profitable. However, the benefit cost ratio of 1.54 for earthen and 1.25 for concrete showed that earthen pond system is more profitable and can drive high income generation for farmers than concrete pond system of production.

***Table 2: Cost and Returns Associated with Catfish Farming Under Earthen and Concrete Ponds System***

| **Costs** | **Earthen Pond System Amount (₦)** | **Concrete Pond System Amount (₦)** |
|---|---|---|
| ***A. Variable cost*** | | |
| Cost of fertilizer | 12342.86 | 3000 |
| Cost of lime | 2804.67 | 9062.5 |
| Cost of herbicides | 5343.1 | 3900 |
| Cost of feed | 654178.85 | 616504.55 |
| Cost of fingerlings/juvenile | 137200.44 | 104375 |
| Cost of transportation | 288428.57 | 23666.67 |
| Cost of medication | 26246.15 | 4420.8 |
| Cost of labour | 10411.5 | 10261.3 |
| **Total variable cost** | **1136956.14** | **775190.82** |
| ***B. Fixed cost*** | | |
| Cost of pond construction | 180367.93 | 345461.54 |
| Cost of net | 15950 | 22272.73 |
| Cost of fence | 35000 | 113000 |
| Cost of weighing scale | 20820 | 17550 |
| Cost of pumping machine | 45538.46 | 57000 |
| Cost of wheel barrow | 16136.36 | 11454.55 |
| Cost of cutlass | 5777 | 4333.33 |
| Cost of borehole | 302480 | 377333.33 |
| **Total fixed cost** | **622069.75** | **948405.48** |
| **Total cost** | **1759025.89** | **1723596.3** |

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| | | |
|---|---|---|
| **Total revenue** | **2706949.20** | **2161246.43** |
| **Gross margin** | 1569992.93 | 1386055.61 |
| **Net farm income** | 947923.18 | 437650.13 |
| **Benefit Cost Ratio (BCR)** | 1.54 | 1.25 |
| **Profitability Ratio (PR)** | 0.54 | 0.25 |

**Source**: Field Survey, 2016

**Revenue for Earthen pond System**

$Total\ Quantity = Total\ average\ weight\ of\ matured\ fishes$
$= 4113.904kg$
$Average\ unit\ price = ₦\ 658.00$
$Total\ Revenue\ (TR) = Price\ (₦)\ x\ Quantity\ (kg)$
$= 658\ x\ 4113.904$
$= ₦\ 2706946$

***Revenue for Concrete Pond System***

$Total\ quantity = Total\ average\ weight\ of\ matured\ fishes$
$= 3284.57\ kg$
$Average\ unit\ price = ₦\ 658.00$
$Total\ Revenue\ (TR) = Price\ (₦)\ x\ Quantity\ (kg)$
$= 658\ x\ 3284.57$
$= ₦\ 2161246.43$

***Profit for Concrete Pond System***

$Gross\ Margin\ (GM) = Total\ Revenue\ (TR) - Total\ Variable\ Cost\ (TVC)$
$= 2161246.43 - 775190.82$
$= ₦\ \mathbf{1386055.61}$
$Profit\ (\pi) = Total\ Revenue\ (TR) - Total\ Cost\ (TC)$
$= 2161246.43 - 1723596.3$
$= ₦\ \mathbf{437650.13}$
$Benefit\ Cost\ Ratio\ (BCR)$
$= TR\ /\ TC$
$= 2161246.43\ /\ 1723596.3$
$= \mathbf{1.25}$
$Profitability\ Ratio = \pi\ /\ TC$
$= 437650.13\ /\ 1723596.3$
$= \mathbf{0.25}$

***Profit for Earthen Pond System***

$Gross\ Margin\ (GM) = Total\ Revenue\ (TR) - Total\ Variable\ Cost\ (TVC)$
$= 2706949.07 - 1136956.14$
$= ₦\ \mathbf{1569992.93}$

$Profit\ (\pi) = Total\ Revenue\ (TR) - Total\ Cost\ (TC)$

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$= 2706949.07 - 1759025.89$

$= ₦\,947923.18$

$Benefit\ Cost\ Ratio\ (BCR) = TR\ /\ TC$

$= 2706949.07\ /\ 1759025.89$

$= 1.54$

$Profitability\ Ratio = \pi\ /\ TC$

$= 947923.18\ /\ 1759025.89$

$= 0.54$

**Problems of Catfish Farming**

Table 3 shows the constraints faced by Catfish farmers in Ondo State. Sixteen (16) critical problems were itemized by the respondents and were ranked according to the sum of scores of complaints in a Likert rating scale. The most common problem, were considered first among other problems facing the respondents in the study area. High cost of feeding was the greatest problem as attested by 93.5% of earthen pond catfish farmers and 85.7% of concrete pond catfish farmers. The second most common problem was lack of capital as submitted by 72.6% and 63% of earthen pond and concrete pond users respectively. Problem of organized market was also a major constraint as affected by 62.5% and 67.9% of earthen and concrete pond users (respondents). Transportation, storage, high mortality and environment problem were all part of the militating factors affecting catfish farming in the study area.

***Table 2: Showing Problems of Catfish Farming***

| **Problems** | **Earthen pond System** | | **Concrete pond System** | | | |
|---|---|---|---|---|---|---|
| | **Frequency (n = 62)** | **Percentage** | **Frequency (n = 28)** | **Percentage** | **Score** | **Rank** |
| High Cost of Feeding | 84 | 93.33 | 78 | 86.67 | 82 | 1st |
| Lack of Capital | 66 | 73.33 | 58 | 64.44 | 63 | 2nd |
| Scarcity of viable foundation stalk | 22 | 24.44 | 18 | 20.00 | 19 | 16th |
| High cost of labour | 43 | 46.67 | 36 | 40.00 | 38 | 7th |
| Poaching | 18 | 20.00 | 20 | 22.22 | 20 | 15th |
| Inadequate water supply | 28 | 31.11 | 25 | 27.78 | 27 | 13th |
| Poor storage facility | 31 | 34.44 | 35 | 38.89 | 32 | 6th |
| High mortality Rate | 39 | 43.33 | 43 | 47.78 | 32 | 11th |
| Diseases and pest | 37 | 41.11 | 25 | 27.78 | 34 | 10th |
| ***Outbreak Non availability | 31 | 50 | 12 | 42.9 | 47 | 4th |
| Problem of organized markets | 58 | 64.44 | 59 | 65.56 | 58 | 3rd |
| Theft | 28 | 31.11 | 15 | 16.67 | 22 | 14th |
| Environmental pollution | 30 | 33.33 | 29 | 32.22 | 31 | 12th |

**source: field survey, 2016**

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## 6. SUMMARY, CONCLUSION AND RECOMMENDATION

The study examined the comparative analysis of catfish production under earthen ponds and concrete ponds in nine local government areas of Ondo State. Result from the study revealed that 51.6% and 50.0% of earthen and concrete pond users were married. This implies that majority of catfish farmers were responsible. About 72.6% and 88.9% of the users of earthen and concrete pond users had tertiary education which indicated that majority of catfish farmers had appreciable level of education needed for the success of the business in terms of adoption of modern technology and innovations. The study also indicated that only 31.11% and 32.23% of the earthen and concrete pond users financed their farm through commercial and agricultural bank credits. This however, implied that majority of the respondents relied on their personal and other informal sources in financing their business. This could reduce large scale production. Majority (78.8%) of the respondents using concrete pond system culture catfish for commercial purpose only, while 68.5% of the earthen pond respondents, culture fish for both home and commercial consumption. The study further revealed a profit of ₦ 947,923.18 and ₦ 437,656.13 for earthen and concrete ponds respectively. The most common problem encountered by the respondents are high cost of feed, lack of capital and lack of organized market for sales.
Catfish farming in the study area under concrete or earthen pond production system is a profitable enterprise. The use of any of the ponds yielded positive net income and net return on investment. However, the earthen pond system is more profitable with the benefit cost ratio and profitability ratio of 1.54 and 0.54 as compared to concrete pond system with benefit cost ratio and profitability ratio of 1.25 and 0.25.

Based on the result obtained from this study, it is recommended that catfish farmers be encouraged to invest more on earthen pond system of culturing catfish than concrete pond system in the area

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