PROFITABILITY ANALYSIS OF FISH PRODUCTION FROM CONCRETE POND SYSTEM IN BENUE STATE, NIGERIA

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ABSTRACT

The study was carried out in Benue State, Nigeria, and made use of both primary and secondary data. The main instrument for collecting the primary data was well structured questionnaires. Descriptive analysis showed that 62% of the fish farmers fall into the economically active age group of 20–50 years and 50.8% of the respondents had tertiary education. Most of the respondents (93%) were part-time fish farmers and financed their fish production through personal savings. Equally evident from the results is that an average total cost of N302,614.25 was incurred per annum, by the respondents while a mean gross revenue of N466,610.84 was realised thereby returning an average gross margin of N284,800.00 and a profit of N163,995.59. The rate of return on investment of 0.65 implied that for every one naira invested in fish production in concrete ponds by the farmers, a return of N1.65 and a profit of N0.65 were obtained. Stochastic frontier production function results revealed that fish output was significantly determined by cost of feeds, pond size and quantity of fingerlings. Stochastic frontier production function results also revealed that the mean technical efficiency was 0.619. This implies that on the average the fish farmers were able to obtain 61.9% potential output for a given mix of production inputs. The study concluded that fish production under concrete pond system in the study area is economically rewarding and capable of creating employment, augmenting income and improving the standard of living of the people. Therefore, it recommended government participation in fish farming to enhance the quantity of fish available for consumption.

Key words: profitability, fish farming, concrete pond, elasticities, gross margin.

1.0 INTRODUCTION

The rapid increase in reproduction of the world has resulted in a huge increase in the demand for animal protein, which is essentially higher in quantity than plant protein. The nutritional requirement is particularly critical in a developing country such as Nigeria where malnutrition and starvation are the major problems faced by Millions of rural dwellers. The low protein intake is an indication of shortage of high quality protein food in the diet of Nigerians. The consumption has been estimated to be 1.5627 metric tones annually, Tabor (1990).

Fishing industry in Nigeria contributes only 2.0% of the GDP and account for 0.2% of the total global fish production. Nigeria is one of the largest importers of fish with per capital consumption of 7.52kg and a total consumption of 1.2m metric tones with imports making up about 2/3 of the total consumption. This indicates the large deficit in fish supply in Nigeria, Olapade and Olaokun (2005). It is therefore, expedient to examine the profitability of pond fish production in the study area to indentify possible areas that require improvement. The study therefore described the Soc-o –Economic status of the fish farmers, determined the profitability of fish farming and examined the determinants of fish output in the study area.

2.0 OBJECTIVES OF THE STUDY

i. To determine the socio-economic characteristics of fish farmers in the study area

ii. To determine the level of profit of fish farming using concrete ponds

iii. To determine the technical efficiency of fish farming using when using concrete ponds

3.0 RESEARCH METHODOLOGY.

3.1 Area of study

The study area is in Benue State, which has twenty – three Local government areas. The state was further divided into three agricultural
Zones namely: Zone A (Eastern Zone); Zone B (Northern Zone) and Zone C (Southern Zone). The 2006 census put the population of the state at 4,219,244 Million (Federal Republic of Nigeria Official gazette, 2007). The state is located in the Middle belt of Nigeria, approximately between latitude 6° 30' N and 8° 10' N quarter and longitude 6°35' E and 8°10' E of Green which Meridian.

Data used for the study were collected as primary data from a cross-section of these fish farmers with the aid of questionnaires that was administered to the respondents. Multi-stage random sampling technique was used to obtain the data. Firstly, the state was stratified into the three agricultural zones of the state from which three local government areas each were purposively selected because of high concentration of active fish farmers in these areas; to give a total of nine local government areas used for the study. Secondly, 71 fish farmers using concrete pond were randomly selected from the sampling frame of fish farmers from the list maintained by BNARDA extension agents by simple random sampling.

3.2 Model Specification

Data analysis was done using descriptive statistics, budgetary technique and stochastic frontier production function model. The budgetary technique involves costs and returns analysis. It is used to determine the profitability of fish farming in the area.

\[ \pi = \text{TR} – \text{TC} \]  
\[ \text{TR} = \text{PQ} \]

Where,
\[ \text{TR} = \text{Total revenue (₦)}; \]  
\[ \text{TC} = \text{Total cost (₦)}; \]  
\[ \text{P} = \text{Unit price of output (₦)}; \]  
\[ \text{Q} = \text{Quantity of output (kg)}. \]

The stochastic frontier production model was used to analyze the productivity and technical, allocative and economic efficiency of fish farmers using concrete ponds. This according to Ogundari and Ojo (2006) has been used by many empirical studies, particularly those relating to developing countries’ agriculture and also for the fact the functional form meets of being self-dual.

\[ \ln y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \cdots + \beta_n \ln X_n + (V_i - U_i) \]  

Where,
\[ \ln = \text{logarithm to base}; \]  
\[ Y = \text{Fish output (kg)}; \]  
\[ X_1 = \text{pond size}; \]  
\[ X_2 = \text{feeds}; \]  
\[ X_3 = \text{fingerlings}; \]  
\[ X_4 = \text{labour}; \]  
\[ X_5 = \text{fertilizer}; \]  
\[ \beta_0 = \text{Constant term}. \]
\[ \beta_1, \beta_2, \ldots, \beta_n = \text{Regression coefficients}. \]
\[ V_1 = \text{are random variables which are assumed to be independent of } U_i \text{ and normally distributed with zero mean and constant variance}; \]
\[ U_1 = \text{are non-negative random variables which are assumed account for technical inefficiency in production and are often assumed to be independent of } V_i. \]

The range of technical inefficiency is defined by:

\[ U_1 = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \cdots + \delta_n Z_n \]

Where,
\[ \delta_1, \ldots, \delta_n = \text{parameters}. \]

The technical efficiency of individual pond was expressed as:

\[ \frac{y_i}{y^*} \]

Where, \( y_i \) = observed output and \( y^* \) = frontier output. Analytically and defined as follows:
\[ \text{Lny} = \beta_0 + \beta_1 \text{Ln } X_1 + \beta_2 \text{Ln } X_2 + \beta_3 \text{Ln } X_3 + \ldots + \beta_n \text{Ln } X_n + (V_i - U_i) \]  

\text{Ln Logarithm to base. } y = \text{fish output (₦/kg)}

\[ X_1 = \text{cost of pond construction (₦)} \]

\[ X_2 = \text{cost of Labour (₦)} \]

\[ X_3 = \text{cost of feeds (₦)} \]

\[ X_4 = \text{cost of transport (₦)} \]

\[ X_5 = \text{cost of fertilizer (₦)} \]

\[ X_6 = \text{cost of fingerling (₦)} \]

\[ X_7 = \text{cost of lime (₦)} \]

\[ \beta_0 = \text{Constant term.} \]

\[ \delta_0 - \delta_n = \text{Regression Coefficients.} \]

Specific allocative efficiency of individual pond was computed as; \[ AE_i = \frac{y^*}{y^m} \]  

\[ \text{Where, } AE_i = \text{Allocative efficiency of } i^{th} \text{ pond} \]

\[ Y^* = \text{frontier output and } y^m = \text{optimum output.} \]

### 4.0 RESULTS AND DISCUSSION

#### 4.1 Descriptive Analysis

Evidence from the analysis of socio economic characteristics of the respondents in Table 1 showed that 62% of the fish farmers fall into the economically active age group of 20 – 50 years. The result of the marital status shows that majority, 81.7% of the fish farmers were married. The high proportion of the respondents who are married is an indication that family labour could be available for fish production in the study area. A large proportion (94.8%) of the fish farmers had one form of education or the other. The farmers can therefore be said to be literate since only small proportion of them had no formal education. The results compares favorably with Aromolaran (2000). The distribution of household size indicated that the household size ranged from 2 – 10. Most of the respondents (91%) were part time fish farmers and financed their fish production through personal savings. The average pond size was found to be 35m² and most respondents fed their fish twice daily to achieve high yield. Most of the respondents (50.8%) had years of experience not more than 5 yrs. The most common breeds of fingerlings Utilized by the respondents were catfish and tilapia.

### TABLE 1: DISTRIBUTION OF CONCRETE POND FISH FARMERS BASED ON SOCIO – ECONOMIC CHARACTERISTICS IN BENUE STATE

<table>
<thead>
<tr>
<th>Index</th>
<th>Frequency</th>
<th>Percentage</th>
<th>Cumulative percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (yrs)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21- 30</td>
<td>4</td>
<td>5.7</td>
<td>5.7</td>
</tr>
<tr>
<td>31 – 40</td>
<td>15</td>
<td>21.1</td>
<td>26.8</td>
</tr>
<tr>
<td>41 – 50</td>
<td>25</td>
<td>35.2</td>
<td>62.0</td>
</tr>
<tr>
<td>≥ 51</td>
<td>27</td>
<td>38.0</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>71</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td><strong>Educational Level (Yrs)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No educational</td>
<td>3</td>
<td>4.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Adult education</td>
<td>5</td>
<td>7.0</td>
<td>11.2</td>
</tr>
<tr>
<td>Primary</td>
<td>10</td>
<td>14.1</td>
<td>25.3</td>
</tr>
<tr>
<td>Secondary</td>
<td>17</td>
<td>23.9</td>
<td>49.2</td>
</tr>
<tr>
<td>Tertiary</td>
<td>36</td>
<td>50.8</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Total  71  100

**Number of Children**

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Percentage</th>
<th>Cumulative Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No child</td>
<td>9</td>
<td>12.7%</td>
<td>12.7%</td>
</tr>
<tr>
<td>1-5</td>
<td>29</td>
<td>40.8%</td>
<td>53.3%</td>
</tr>
<tr>
<td>6-10</td>
<td>21</td>
<td>29.6%</td>
<td>83.1%</td>
</tr>
<tr>
<td>11-20</td>
<td>12</td>
<td>16.9%</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>71</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

**Experience (yrs)**

<table>
<thead>
<tr>
<th>Experience</th>
<th>Count</th>
<th>Percentage</th>
<th>Cumulative Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>36</td>
<td>50.8%</td>
<td>50.8%</td>
</tr>
<tr>
<td>6-10</td>
<td>24</td>
<td>33.8%</td>
<td>84.6%</td>
</tr>
<tr>
<td>Above 10</td>
<td>11</td>
<td>15.4%</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>71</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

**Martial Status**

<table>
<thead>
<tr>
<th>Status</th>
<th>Count</th>
<th>Percentage</th>
<th>Cumulative Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>9</td>
<td>12.7%</td>
<td>12.7%</td>
</tr>
<tr>
<td>Married</td>
<td>58</td>
<td>81.7%</td>
<td>94.4%</td>
</tr>
<tr>
<td>Divorced</td>
<td>1</td>
<td>1.4%</td>
<td>95.8%</td>
</tr>
<tr>
<td>Widowed</td>
<td>3</td>
<td>4.2%</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>71</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

**Pond Size**

<table>
<thead>
<tr>
<th>Size</th>
<th>Count</th>
<th>Percentage</th>
<th>Cumulative Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1-0.4</td>
<td>56</td>
<td>78.8%</td>
<td>78.8%</td>
</tr>
<tr>
<td>0.41-0.7</td>
<td>10</td>
<td>14.07%</td>
<td>92.95%</td>
</tr>
<tr>
<td>0.71-1.0</td>
<td>2</td>
<td>2.82%</td>
<td>95.77%</td>
</tr>
<tr>
<td>1.1-1.3</td>
<td>1</td>
<td>1.41%</td>
<td>95.77%</td>
</tr>
<tr>
<td>≥1.3</td>
<td>2</td>
<td>2.82%</td>
<td>97.18%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>71</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>


### 4.2 Profitability Analysis

The study examined the profitability of fish production in the study area. To determine the profit level, attempts were made to estimate the costs and returns from fish farming. The costs and returns analysis is presented in Table 2. The results revealed that the cost of feeds accounted for the largest proportion (28.10%) of the total cost of fish production. This is followed by cost of labour (12.76%), of fingerlings (8.03%). This clearly shows that large amount of money was spent by the fish farmers in the study area for the purchase of feeds, labour and fingerlings. The fixed costs of production consists of cost of fixed assets such as pond, pumping machine, harvesting materials, shovel, wheel barrow, water basin which accounted for 45% of the total production cost.
Equally evident from the results is that an average total cost of N302,614.25 was incurred per annum by the respondents while a mean gross revenue of N466,610.84 was realized thereby returning an average gross margin of N284,800.00 and a profit of N163,995.59. The rate of return on investment (ROI) of 0.65 implied that for every one naira invested in fish production in concrete ponds by the farmers, a return of N1.65 and a profit of N0.65 were obtained. The implication of this is that there was a considerable level of profitability in fish farming in the concrete pond system in the study area. This result is consistent with the findings of Ashaolu et al. (2005) from their studies on profitability on fish farming. The rate of return per capital invested (RORCI) is the ratio of profit to total cost of production. It indicates what is earned by the business by capital outlay, Awotide and Adejobi (2007). The result revealed that the RORCI of 54% is greater than the prevailing bank lending rate (25%) implying that fish farming in Benue State is profitable. If a farmer takes loan from Bank to finance fish farming he will be 65k better off on every one Naira spent after paying back the loan at the prevailing interest rate.

### TABLE 2: AVERAGE COSTS AND RETURNS OF FISH PRODUCTION IN BENUE STATE

<table>
<thead>
<tr>
<th>Item (annual)</th>
<th>Amount (₦)</th>
<th>% of total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeds</td>
<td>85,031.15</td>
<td>28.10</td>
</tr>
<tr>
<td>Labour</td>
<td>38,614.75</td>
<td>12.75</td>
</tr>
<tr>
<td>Fingerlings</td>
<td>24,300.00</td>
<td>8.03</td>
</tr>
<tr>
<td>Water</td>
<td>5,760.00</td>
<td>1.90</td>
</tr>
<tr>
<td>Transport</td>
<td>5,010.00</td>
<td>1.66</td>
</tr>
<tr>
<td>Lime</td>
<td>3,737.00</td>
<td>1.24</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>2,760.00</td>
<td>0.91</td>
</tr>
<tr>
<td>Total Variable cost (TVC)</td>
<td>165,214.25</td>
<td></td>
</tr>
<tr>
<td>Fixed inputs (FC)</td>
<td>137,400.00</td>
<td></td>
</tr>
<tr>
<td>Total cost (TC)</td>
<td>302,64.25</td>
<td></td>
</tr>
<tr>
<td>Total revenue (TR)</td>
<td>466,610.84</td>
<td></td>
</tr>
<tr>
<td>Profit (π)</td>
<td>163,995.59</td>
<td></td>
</tr>
<tr>
<td>Returns on investment</td>
<td>0.65</td>
<td></td>
</tr>
<tr>
<td>Returns on capital invested (RORCI)</td>
<td>0.54</td>
<td></td>
</tr>
</tbody>
</table>

Source. Computed from field survey data, 2012

### 4.3 Technical Efficiency for Concrete Pond Fish Farming in Benue State

Elasticity of the variables with respect to fish farmers using concrete ponds revealed that feeds (0.177), pond size (0.27) and fingerlings (0.52) were statistically significant. The coefficients are in line with a priori expectation. Hence, the more the amount expended on feeds, fingerlings, and ponds the more the amount that will be realized from fish farms in the study area. Furthermore, the results showed that pond size and quality of fingerlings were the important factors increasing the quantity of output of fish as every increment in pond size and the quantity of fingerlings used increased the quantity of fish output by 29% and 52% respectively. The elasticity of the coefficients were less than unity (0.29 and 0.52) indicating positive decreasing return to scale and in stage II of production surface. The positive and significant effect of pond size implied that there is direct relation between the variable and the fish field. That is as pond size increases given other inputs, fish output will increase. The significance of pond size agrees with Ogundari and Ojo (2006) that revealed farm size to be significantly related to technical efficiency. In other words, all things being equal the quantity of fish produced is directly proportional to the pond size. The degree of responsiveness of the value of fish output to changes in the independent variables shows that a percent increase in the value of pond size, feeds, fingerlings, labour, fertilizer will lead to 0.29%, 0.177%, 0.516%, 0.394%, and 0.09% in value of fish produced respectively. With the production result, increase in the utilization of labour and feeds is likely to boost the fish output substantially.
TABLE 3: RESULTS OF MAXIMUM LIKELIHOOD ESTIMATES OF THE COBB-DOUGLAS FRONTIER PRODUCTION FUNCTIONS FOR TECHNICAL EFFICIENCY FOR CONCRETE POND FISH FARMING IN BENUE STATE.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>$\beta_0$</td>
<td>0.794* (8.226)</td>
</tr>
<tr>
<td>In pond size</td>
<td>$\beta_1$</td>
<td>0.29**  (2.44)</td>
</tr>
<tr>
<td>In feeds</td>
<td>$\beta_2$</td>
<td>0.177*** (-1.67)</td>
</tr>
<tr>
<td>In fingerlings</td>
<td>$\beta_3$</td>
<td>0.516** (3.051)</td>
</tr>
<tr>
<td>In labour</td>
<td>$\beta_4$</td>
<td>0.394(0.006)</td>
</tr>
<tr>
<td>In fertilizer</td>
<td>$\beta_5$</td>
<td>-0.09(-0.84)</td>
</tr>
</tbody>
</table>

**Inefficiency Model**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>$Z_0$</td>
<td>1.635(1.43)</td>
</tr>
<tr>
<td>Level of Education</td>
<td>$Z_1$</td>
<td>1.320(1.32)</td>
</tr>
<tr>
<td>Farmers Experience</td>
<td>$Z_2$</td>
<td>-2.491*** (-2.490)</td>
</tr>
<tr>
<td>Farmers average age</td>
<td>$Z_3$</td>
<td>-9.017*** (-3.490)</td>
</tr>
<tr>
<td>House hold size</td>
<td>$Z_4$</td>
<td>2.348(7.256)</td>
</tr>
<tr>
<td>Extension contact</td>
<td>$Z_5$</td>
<td>1.353(1.240)</td>
</tr>
<tr>
<td>Annual income</td>
<td>$Z_6$</td>
<td>1.75** (2.38)</td>
</tr>
<tr>
<td>Sigma Square</td>
<td>$\sigma^2$</td>
<td>10.98* (5.39)</td>
</tr>
<tr>
<td>Gamma</td>
<td>$Y$</td>
<td>0.98*(116.16)</td>
</tr>
<tr>
<td>Log (likelihood)</td>
<td></td>
<td>-79.07</td>
</tr>
<tr>
<td>Mean Technical Efficiency</td>
<td></td>
<td>0.619</td>
</tr>
</tbody>
</table>

Significant at (p<0.01), ** significant at (p<0.05)


**CONCLUSIONS AND RECOMMENDATIONS**

Based on the value of benefit indicators, it can be concluded that fish production in concrete pond in the study area is economically rewarding and profitable. The result equally suggests the need for fish farmers to purchase more of these inputs to increase their revenue from fish production. Based on the findings of the study the following policy recommendations were made:

i. Policy that will ensure availability of production inputs to fish farmers at affordable price should be put in place by Benue State and Federal Government to increase the revenue from fish production.

ii. Adequate training programs on fish production should be organized for fish farmers in the area for the dissemination of research findings to fill the gap created by poor contact with extension agents.
REFERENCES:

