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Analysis of socio-economic factors of fish pond production in Enugu State, Nigeria

K.P. Adeosun*, C.O. Ume and R.U. Ezugwu

Department of Agricultural Economics, University of Nigeria, Nsukka 410 001, Nigeria

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Abstract

The study determined the socioeconomic factors of fish pond production by assessing cost and returns, and the effect of socioeconomic factors on net-income from fish ponds, as well as its constraints. Primary data were used for the study. A systematic random sampling technique was employed to select 120 fish farmers from the list provided by the Fish Farmers Association in the State. Data collected were analyzed using descriptive statistics, budgeting analysis, Ordinary Least Square (OLS) and Quantile regression. The study revealed that the mean age, household size, years spent in school and fish farming experience were 41 years, 5 people, 15 years and 3.6 years, respectively. The result showed that the average net farm income of fish farmers in the State was $41,902 and gross margin was $46,635. The profitability indices such as benefit-cost ratio (1.4), return on investment (1.45), return on variable cost (2.58), net farm income margin (0.58) and gross ratio (30.64) were positive. The result of multiple regression showed that fish pond production experience and number of ponds per farmer were significant at OLS and all the quantile levels. Size of ponds was significant at OLS and 75th quantile. Likewise, access to credit and male household size were significant at OLS, and 55th and 75th quantile. Results indicate that government and private sectors should invest in fish pond production to subsidize costly inputs in fish production and important socio-economic factors should be institutionalized.

Key words: Fish pond production, Performance indices, Quantile regression.

Introduction

Fish is a prerequisite for nutrition and income. Availability of fish in Nigeria is achieved by increasing productivity and profitability of fish producers. While Nigeria enjoyed several fish policy phases, the average production and utilization trend remained stationary. As result, Nigeria relies heavily on imports to face the local fish demand. For instance, the total fish demand in Nigeria based on the population estimate of 180 million is 3.2 million metric tons, while domestic production represents only 800,000 mt, and Nigeria has imported, on an average, 2.4 million metric tons of fish annually (Fishery Committee for West and Central Africa Gulf of Guinea (FCWC), 2016). The heavy reliance of Nigeria on imports for food supply leaves local population vulnerable to increased prices, volatility from international markets during crises and has a detrimental effect on her economy as the Federal government spent 700 million dollars on fish importation annually, resulting in loss of foreign exchange.

Presently, Nigeria is estimated to be producing about 800,000 mt fish annually excluding other aquatic resources (Miller and Atanda, 2011). This placed Nigeria among the top leading producers of fish in Africa, followed by Madagascar, South Africa, Tanzania, Uganda and Zambia. These

*Author for Correspondence: Phone: +2340867359255, Email: paul.adeosun@unn.edu.ng

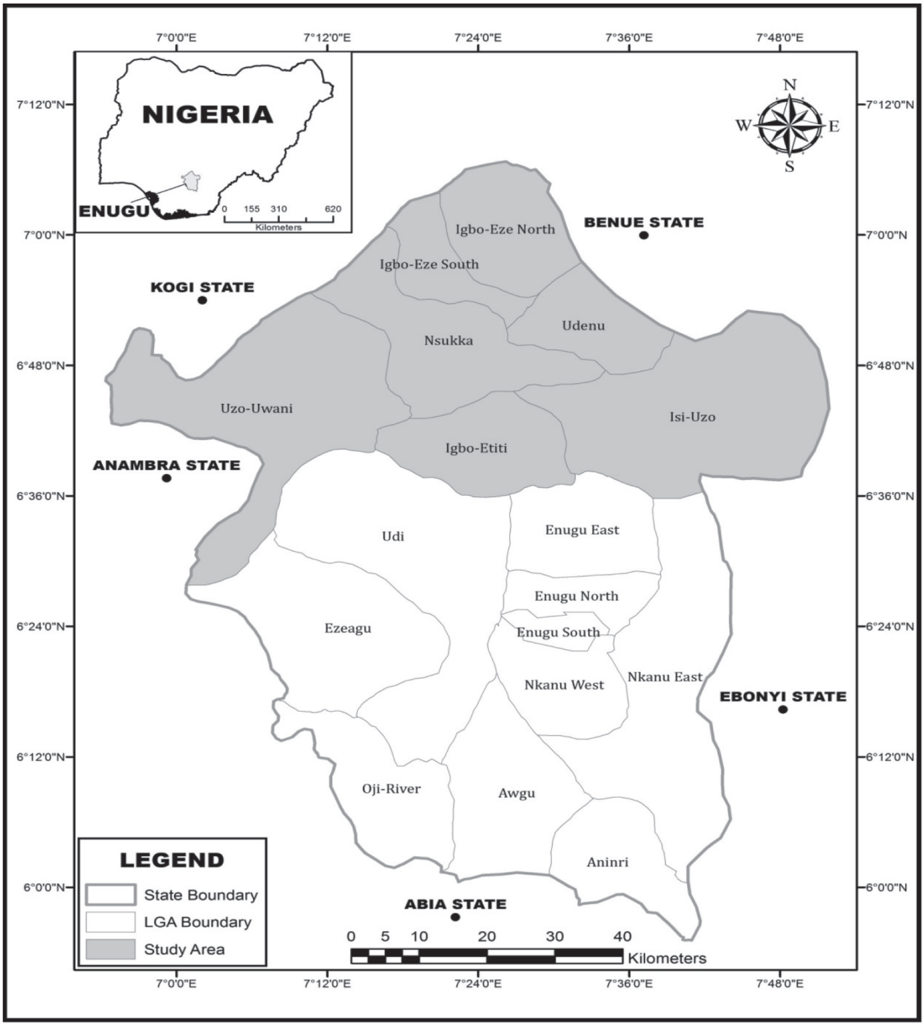

Figure 1. Map of Enugu State, Nigeria

countries produce above 5000 tons each annually and over 80 percent of the total fish from the sub-Saharan Africa region (Crentsil and Ukpong, 2014). Olaoye et al. (2014) argued that the gap between food production and population growth necessitated increase in fish importation. Realizing the importance of fish sub-sector the government sought to expand it with youth empowerment programme with 30% of new investments, while the private sectors, particularly commercial banks, were willing to give loans into the sub-sector (Miller and Atanda, 2011). There was need for more investments in fishery sub-sector, and inclusion of youth in the value chain. For this to happen, it was important to show that fish production was a profitable venture, and sustainable. Also, with the growing population of Nigerians, food was required to ensure that the inhabitants did not suffer from malnutrition. In order to meet this need, viable fish pond production could improve the livelihood and protein supply of the people. The present study determined the socio-economic factors of fish pond production by assessing its cost and returns, and the effect of socioeconomic factors on net-income from fish ponds, as well as its constraints.

Materials and Methods

Study Area

Enugu State, the study area, is surrounded by five south eastern states including Imo, Ebonyi, Anambra and Abia. Enugu is located between latitudes 5°61‘N and longititudes 6°53‘E and 7°55‘E (Enugu State Agricultural Development Programme (ADP), 1997). Enugu is made up of three agricultural zones *viz.,* Nsukka, Enugu north, and Enugu centre. The state has a total land mass of about 8,022.96 km^2. It has a population of about 4,185,509 (National Population Census (NPC), 2006). Most of the population lives in rural communities with farming as their major occupation. Rainfall distribution is between 1680 mm and 1700 mm. The area has tropical climates marked by two distinct seasons. The vegetation is of derived savannah and people in this area are predominately farmers; farming constitutes their major economic activity.

Sampling Procedure

Enugu State was purposively selected for the study because they are predominant in fish pond production. From the seventeen local government areas (LGA) in Enugu State, ten LGAs were randomly selected for the study. A list of all fish farmers in the 10 LGAs was obtained from Fish Farmers Association in the State. Then a systematic random sampling technique was employed to select 12 respondents as the sample for each selected LGA list. A total number of 120 fish farmers were randomly selected for the study.

Data Collection

The primary data were obtained through administration of semi-structured questionnaires. The questionnaire was used to obtain information such as the socio-economic characteristics of fish pond producers, cost of production and returns as well as data on constraints in fish pond production. The fish pond farmers selected were farmers with one to five fish ponds, thus, small ponds of 1000 m^2 and less and medium fish ponds between 1001 and 3000 m^2 were also selected for the study. However, these were measured by the concrete size of the pond used for fish production (Nunoo et al., 2012).

Data Analysis

Model Specification

Net farm income, gross margin, benefit - cost ratio and return to investment, return to variable cost, net farm income margin and gross ratio were used to achieve the profitability aspects of the study. Ordinary least square (OLS) and quantile regression were used to achieve the effect of key socioeconomic factors on net farm income.

$$GM = TR - TVC \quad (1)$$

$$NFI = GM - TFC \quad (2)$$

Where;

NFI = Net Farm Income ($), GM = Gross Margin ($), TFC = Total Fixed Cost ($), TR = Total Revenue ($), TVC = Total Variable Cost ($)

$$TR = Py.Y \quad (3)$$

Py = Unit price of output ($), Y = Quantity of output (fingerlings and matured fish in kg)

The fixed cost included Land rent charges, Depreciation of concrete pond, Pumping machine. Total Variable Cost included Hired labor cost, Fingerlings cost , Fertilizer cost, Lime cost, Feed cost fuel cost, Transportation cost, Water cost, Family labor cost, Management cost, Maintenance and repair cost

Multiple Regression

Ordinary Least Square

The socio-economic factors that influenced small scale fish pond production and net farm income were analysed using multiple regression model. The implicit multiple regression equation was written as follows:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, U) \quad (4)$$

where, Y was net farm income

X_1 was the age of the farmer (years), X_2 was the sex of the farmer (1 if male, 0 if female), X_3 was marital status (1 if married, 0 otherwise), X_4 was level of education (number of years spent in school), X_5 was male household size (number), X_6 was female household size (number), X_7 was years of experience in fish production (years), X_8 was number of fish ponds, X_9 was size of fish pond (m^2), X_{10} was access to credit (1 if access, 0 no access) U was error term.

Quantile Regression Model

The model was needed to assess full impact of regressors on the regressand. OLS summaried the average relationship of a set of regressors and regressand based on the Conditional Mean Function (CMF). This was not sufficient as it provided only partial view of the relationship compared to quantile regression that provided the capacity to view the impact of the regressors at different levels of quantile based on the Conditional Median Function (CMF). Median regression (quantile regression) was more robust to outliers than mean regression (OLS).

If Y was a random variable with cumulative distribution function (CDF): $F_Y(y) = P(Y \leq y)$. (5)

The τ^{th} quantile of Y was $Q\tau(Y) = \inf\{y : F_Y(y) \geq \tau\}$, (6)

where $0 < \tau < 1$ was the quantile level.

where,

Q0.15(Y): median, the first quartile, 15^{th} percentile, Q0.35(Y): median the second quartile, 35^{th} percentile, Q0.55(Y): median the third quartile, 55^{th} percentile, Q0.75(Y): median the fourth quartile, 75^{th} percentile

Such that,

$Q\tau_1(Y) \leq Q\tau_2(Y)$ for $\tau_1 < \tau_2$.

If Y was the response variable, and X the p-dimensional predictor,

$F_Y(y|X = x) = P(Y \leq y|X = x)$ would denote the conditional CDF of Y given X = x. Then the τ^{th} conditional quantile of Y would be deûned as $Q\tau(Y|X = x) = \inf\{y : F_Y(y|x) \geq \tau\}$. (7)

τth quantile of Y :

$Q\tau(Y) = \text{argmin}_a\, E\{\rho\tau(Y - a)\}$, (8)

where $\rho\tau(u) = u\{\tau - I(u < 0)\}$

The τth quantile:

$$\min_a \sum_{i=1}^{n} \rho\tau(yi - a) \quad (9)$$

Assuming $Q\tau(Y|X) = X^T\beta(\tau)$, then;

$$\beta(\tau) = \arg\min_\beta \sum_{i=1}^{n} \rho\tau\{yi - xT\, i\, \beta) \quad (10)$$

(Trivedi and Cameroon, 2005)

Results and Discussion

Socio-economic characteristics of the respondents

Table 1 showed that majority (82.5 %) of the respondents were male while 18% were female. This indicated that male farmers dominated fish farming enterprise in the area. This could be due to the nature of fish farming which involved regular supervision and monitoring. This was also supported by Olaoye et al. (2014). Data on Table 1 showed that greater proportion (33.8%) of the respondents were between the age bracket of 41 and 50 years, followed by 30%, and 16.2% with the age range of 21 to 30 and 31 to 40 respectively. The average age of the respondents was 41.09 years. This implied that most of the respondents were within the economically active age and could make decision and enhance productivity (Maina et al., 2014). 61.2% of the respondents were married while 31.2% were single, 2.5% separated and 5% were widowed with a mean size of household of 5. The implication was that there could be more support from spouses and children of the farmers with a view to improving and increasing fish production. This also implied that the fish farmers were responsible and had more roles to play in their families and as such they would be eager to improve their agricultural productivity in order to earn more income. This was supported by Olawumi et al. (2010) who observed that married household with a reasonable size could provide cheap labour to the family. Data from Table 1 showed that

Table 1. Socio-economic characteristics of respondents

Socio-economic characteristics	Frequency	Percentage (%)	Mean
Sex			
Male	66	82.5	
Female	14	17.5	
Age (years)			
21-30	24	30.0	
31-40	13	16.2	
41-50	27	33.8	41.09
51-60	10	12.5	
Above 60	6	7.5	
Marital status			
Single	25	31.2	
Married	49	61.2	
Separated	2	2.5	
Widowed	4	5.0	
Years spent in school (years)			
0-10	8	10	
11-20	66	82.5	15.09
Above 20	6	7.5	
Household size (numbers)			
Below 4	24	30	
5-7	53	66.2	5.25
Above 8	3	3.8	
Farm size (hectares)			
0.1-0.5	67	83.8	
0.6-1.0	7	8.8	
1.1-1.5	3	3.8	
Above 1.5	3	3.8	
Years of experience (years)			
1-5	68	85	3.66
6-10	10	12.5	
11-15	1	1.2	
Above 15	1	1.2	
Number of ponds (numbers)			
1-5	64	80	
6-10	11	13.8	
11-15	2	2.5	
Above 15	3	3.8	

majority (83.8%) of the respondents had farmlands between 0.1-0.5 hectares while 8.8%, 3.8% and 3.8% had 0.6-1 hectares, 1.1-1.5 hectares and 1.6-2 hectares respectively. This implied that fish pond production enterprise in the area was mainly of small-scale type, and this supported the findings of Nunoo et al. (2012), that most fish farmers in Ghana were mostly on small scale.

Cost Analysis in Fish Pond Production Fixed Cost

These are costs that do not change in the course of production but can be altered in the long run. Such cost incurred by the respondents included cost of depreciation of fish ponds and equipment. The straight line method was used in calculating depreciation of equipment. It was computed and listed in Table 2.

Table 2. Value of fixed assets and their depreciated value

Fixed cost items	Annual depreciation($)
Pond construction	3809
Land rent	173
Pumping machine	284
Wheel barrow	68
Weighing scale	141
Smoking equipment	200
Feed mill machine	58
Total fixed cost	4733

Costs and returns from fish production

Revenue generated from fish production came from sale of mature or adult sized fish and fingerlings. Fish of different weights and sizes were sold. Weight was a major tool for measuring the cost of sales in the study area using a functioning scale. The weight of marketable sized fish in the area was 1kg to 5kg, in which 1kg was sold at between $2.2 to $2.8, while, fingerlings were sold at $0.042 to $0.083. The study further revealed that the revenue accrued from fish production in the study area for 70961 fishes was $139,364 and revenue received from sale of fingerlings was $5,669.

The cost and return analysis for the study area is shown in Table 4. The result shows the important variable costs and fixed costs incurred during one production cycle (6 months). The average total variable cost amounted to $99,151, while the average total fixed cost amounted to $4,733. It was inferred that most production materials for fish pond production were short run variable costs. Hence the total cost for variable materials was far higher than total fixed cost. This was supported by Olaoye et al. (2014) who found that variable costs was always higher than fixed costs for fish pond production for a particular production cycle. The average total cost for fish pond production for one cycle production period was $103,884.

Table 3. Returns structure for fish pond production (per production period)

Variable	Total ($)
Quantity of matured fish	197
Quantity of fingerlings	556
Revenue	
Revenue from sale of marketable sized fish	139,364
Revenue from sale of fingerlings	5,669
Total revenue	145,786
Variable cost	
Feed	75,050
Transportation	564
Fuel	47
Water	14,236
Treatments	208
Fingerlings	5566
Hired labour	500
Family labour	433
Maintenance	756
Fertilizer	198
Basins	335
Fishing net	9
Broom	24
Spade	39
Matchet	164
Hormone	653
Miscellaneous	417
Total variable cost	99,151
Fixed cost	
Pond construction	3,809
Land rent	173
Pumping machine	284
Wheel barrow	68
Weighing scale	141
Smoking equipment	200
Feed mill machine	58
Total fixed cost	4,733
Total cost	103,884

Furthermore, two important outputs among others that generated revenue for fish farmers were matured fish and fingerlings. From the study, average revenue from matured fish amounted to $139,364, while average revenue from fingerlings amounted to $5,669. Therefore, the total average revenue from fish pond production cycle was $145,786. From Table 5, the average gross margin and net farm income were $41,902 and $46,635 respectively. This indicated that fish pond production was profitable and viable in the study area. This is consistent with the findings of Adewuyi et al. (2010) and Olaoye et al. (2014) that fish pond production was profitable. The benefit - cost ratio was 1.40, indicating that fish pond production was resource efficient, profitable and viable in the study area. This was in accordance with the findings of Omobepade et al. (2015) that since fish farmers could cover their expenses, then it was profitable and the profitability indices were positive. Furthermore, profitability indices in Table 5 like return on investment, net farm income margin, rate of return on variable cost and gross ratio were measured as values of 1.45, 0.59, 2.58 and 30.64, respectively. All the values were positive. The profitability indices showed that fish pond production was profitable. This is supported from findings of previous studies that fish pond production is profitable and viable (Adewuyi et al., 2010; Olaoye et al., 2014; Omobepade et al., 2015).

Table 4. Profitability indices for fish pond production

Performance indices	Value
Net Farm Income (NFI)	$41902
Gross Margin (GM)	$46635
Benefit Cost Ratio (BCR)	1.4
Return on Investment (ROI)	1.45
Net Farm Income Margin (NFIM)	0.59
Return on Variable Cost (RRVC)	2.58
Gross Ratio (GR)	30.64

Source: Field survey, 2016

Determinants of socio-economic factors influencing net farm income of fish pond production

An econometric method of ordinary least square (OLS) and quantile regression was employed to assess the effect of factors that influenced net farm income of fish pond production. The results in Table 5 showed that six explanatory variables (level of education, male household size, fish pond production experience, number of ponds, size of ponds and access to credit) were significant in the OLS regression, while six explanatory variables (sex, age, male household size, fish pond production experience, number of ponds and access to credit) were significant at different levels of quantile. The quantile results showed that net farm income increased along different levels of the quantile from 15th through the 35th to 55th and finally to 75th quantile which was the biggest.

Table 5. Determinants of socio-economic factors influencing net farm income of fish pond production and estimates of ordinary least square and quantile regression

Variables	OLS	15th Quantile	35th Quantile	55th Quantile	75th Quantile
Gender	13,680	-4,123	9,402	17,771	15,348**
	(9,503)	(14,425)	(16,031)	(10,893)	(7,199)
Age	-387.1	-127.2	-701.0	-681.5	-710.9**
	(416.7)	(632.5)	(702.9)	(477.6)	(315.6)
Marital Status	3,774	8,472	2,252	-3,230	-1,560
	(9,108)	(13,825)	(15,364)	(10,440)	(6,900)
Level of Education	-1,909**	-1,327	-1,592	-965.6	-841.2
	(836.2)	(1,269)	(1,411)	(958.5)	(633.5)
Male household size	-8,838**	-863.9	-6,571	-8,876**	-4,918
	(3,533)	(5,362)	(5,959)	(4,049)	(2,676)
Female household size	-1,093	85.18	-1,220	4,738	2,911
	(3,282)	(4,982)	(5,537)	(3,762)	(2,486)
Fish pond experience	11,392***	4,233**	14,240***	11,915***	10,668***
	(1,320)	(2,004)	(2,227)	(1,513)	(999.9)
No. of ponds	14,556***	7,381***	11,070***	15,722***	16,036***
	(1,065)	(1,617)	(1,797)	(1,221)	(806.8)
Size of ponds	390.4***	139.8	74.49	182.1	616.1***
	(106.0)	(160.9)	(178.8)	(121.5)	(80.31)
Access to credit	-35,371***	-2,783	-23,487	-36,122***	-39,967***
	(11,693)	(17,749)	(19,725)	(13,403)	(8,858)
Constant	22,543	12,438	30,747	16,932	15,298
	(21,786)	(33,070)	(36,751)	(24,973)	(16,504)
Pseudo R^2		0.2997	0.5051	0.6456	0.7759
R-squaredF(10, 79)Prob > F 0.89	73.39	0.0000***			

***, and **are significant level at 1% and 5% respectively., Credit access is 1 if access or 0 otherwise
Marital status is 1 if married or 0 otherwise

Firstly, fish pond production experience and number of ponds were statistically significant (P<0.01) and positively related to net farm income at both OLS and through all the levels of the quantile, except at 15th quantile in which fish pond production experience was significant at 5% level of probability. This indicated that farmers with more experience might have technical know-how on how to efficiently manage the input resources. Yanan et al. (2016) found out that there was positive relationship between experience and economic efficiency. In addition, this result was in line with the study of Oluwemimo and Damilola (2013) which observed that years of experience was statistically significant and positively related to net farm income in fish production. Increase in number of fish ponds increased net farm income. This result is supported by the findings of Adebayo and Daramola (2013) that total revenue is significantly and positively influenced by number of fish pond units.

Secondly, size of pond had a positive relationship and was statistically significant at 1% probability level. This implied that as size of pond increased given other inputs, net farm income increased. This is in line with the findings of Ogundari and Ojo (2009) and Olawumi et al. (2010) who reported that size of pond was statistically and positively related to net farm income in fish pond production.

Thirdly, gender was significant and positively influenced net farm income at 5% probability level at the highest quantile (75th). It implied that male managers might get more net farm income from fish production. This finding was against the finding of Boateng et al. (2013) that although sex was significantly related to output from fish farming, the direction was negative. The findings might be different because the effect was checked on output, while the present study was checked on net farm income, and also the significant level was at OLS while this study was at 75th quantile level.

The importance of fish consumption and its contribution to human growth and development cannot be over-emphasized. Therefore, the need for input subsidization and youth inclusion in fish production is very essential for production increases and job creation. The study revealed that fish pond production in Enugu State was profitable and viable despite the problems faced by fish farmers. Those challenges could be properly managed to improve fish production output. Level of education, sex, age, male household size, fish pond production experience, number of ponds, size of ponds and access to credit were important socio-economic factors that influenced net income from fish pond production. Hence, for fish production to have smooth production activities, critical attention should also be focused on these socio-economic factors. We recommend that government and private sectors should invest in fish pond production to subsidize costly inputs in fish production and important socio-economic aspects should be institutionalized.

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