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SOCIO-ECONOMIC DETERMINANTS OF POND FISH OUTPUT IN AKWA IBOM STATE, NIGERIA

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Abstract
Pond fish production has contributed to food security, rural income generation, employment, and foreign exchange earnings. Many developing nations have prioritized pond fish production as a critical sector for national development. This study investigated the socio-economic factors that influence the output of pond fish farmers in Akwa Ibom State, Nigeria. A multistage sampling procedure was used in selecting 110 pond fish farmers using structured questionnaires. Data obtained were analyzed using descriptive statistics and multiple regression analysis. The results showed that the mean output of fish was 2,290.73kg, while the mean expenditure on feed and mean labor cost were ₦664,310.00 and N 292.60 respectively. The average age of the respondents was 51.69 years, with a mean household size of about 6 persons, and the mean years of formal schooling was 8.59. Also, the mean years of experience in fish production was about 10.17 years while the mean stock size was 1,718. The results of the regression analysis showed that variables such as farming experience ($p<0.10$), pond size ($p<0.10$), labor cost ($p<0.01$), expenditure on feed ($p<0.01$), and stock size ($p<0.05$) had a positive and statistically significant influence on the output of pond fish production in the study area. It is recommended that private feed mills should be encouraged to use local materials for feed production to reduce the high cost of feed.
Keywords: Pond fish, protein, local feed, income, food security.

Introduction

Fish is known to be the principal source of animal protein for over one billion people globally and provides many important nutritional and health benefits (Iruo *et al.*, 2020). Fish is a rich source of n-3 (DHA, EPA) and n-6 (AA) unsaturated fatty acids, which are crucial for managing conditions such as hypertension, diabetes, and obesity (Anyanwu *et al*., 2009). Fish also provides essential minerals like iodine and selenium, which are vital for treating goiter (Ucha *et al.*, 2018; Oladejo, 2010). The significance of fish in human health and development is well-established (Eyo, 2007; Ogundari *et al*., 2006; Ume *et al*., 2013). Beyond its nutritional value, the fisheries sector is a substantial source of employment and job opportunities (Ucha *et al.*, 2018; FAO, 2012).

The per capital consumption of animal protein in the country has been put at 5gm per day (Federal Ministry of Agriculture and Rural Development, (FMARD), 2020), this is a far cry from the FAO's recommended level of 35gm per day (Food and Agricultural Organization (FAO), 2021). Although Nigeria is the largest consumer of fish products in Africa (Ohamesi *et al.*, 2024), the output from captured fishes is far below the country's demand. In this regards, aquaculture or pond fish production has emerged as a rapidly expanding sector within global fish production (Udoh, Idio, and Umoh, 2016). Pond fish culture is the most prevalent fish-farming practice in Nigeria. Its potential to contribute to food security, rural income generation, employment, and foreign exchange earnings has led many developing nations to prioritize aquaculture development within their national plans (Udoh and Akpan, 2019; Udoh *et al*., 2016).

The industry's rapid growth has prompted national, regional, and international entities to focus on strategies for enhancing the economic viability and environmental sustainability of aquaculture operations. This has spurred innovations in fish pond design and other non-

technical aspects of fish farming (Akpan, 2011). Cultured catfish is the most preferred by fish farmers in southern region of Nigeria. The preference of farmers to culture catfish may be due to their better growth performance and survival (Inoni *et al.*, 2017), as well as a better market value that is two to three times that of tilapia (Olagunju *et al.*, 2007; Ike and Chuks-Okonta, 2014). Catfish can thrive in a wide range of conditions because it is hardy and can tolerate dense stockings (Ume *et al.*, 2016). Other forms of culture include Cage, Pen, Burrow-pits, flow-through and water recirculation systems (Umaru, Okoh, and Ishiwu, 2021).

As the human population increases and consequent protein demand, the over-exploitation of the natural fish resources and increasing climate variability (Okon *et al.*, 2018) has made aquaculture a major option to combat protein malnutrition in the country (Abasiekong, Ogban, and Idiong, 2021). Given the present scenario, pond fish farming, and especially catfish still holds the greatest potential to rapidly boost domestic fish production and lead the nation towards self-sufficiency in fish production (Inoni *et al.*, 2017). Apata *et al*. (2018) reported total domestic fish production in 2015 as 579,500 tonnes, with aquaculture contributing 56,300 tonnes. Ifie and Erhieguren (2024) estimated Nigeria's fish demand-supply gap at 1.0 million metric tonnes, with a fingerling gap exceeding 500 million. Apata *et al*. (2018) attributed 491 million tonnes to artisanal fisheries, 57 million tonnes to aquaculture, 33 million tonnes to industrial (trawler) fishing, and 612 million tonnes to distance fishing (imports). Nigeria ranks as the world's fourth-largest fish product importer, with $876 million in imports and $106,000 in exports of frozen fish (excluding fillets and other fish meat) in 2020 (Trend Economy, 2021). This shows that less than half of Nigeria's annual fish consumption is domestically produced (Ekanem *et al.*, 2024). Consequently, maximizing fishery resource exploitation and prioritizing aquaculture development for increased local production and export becomes imperative (Ifie and Erhieguren, 2024). This shortfall is still evident as recent studies showed the demand for fish protein is about 2.7million MT and only 800,000 MT is produced locally. It shows that there is still a short in supply of about 1.9 million MT (Federal Department of Fisheries (FDF), 2020; Esiobu *et al.*, 2022). As a consequence, there is widespread hunger and malnutrition in the country, especially the South-south region. In an attempt to bridge the widening demand-supply gap, there is a huge import of fish to augment local demand (Inoni *et al.*, 2017).

Also, the Nigerian fish industry is facing numerous challenges such as low productivity, elevated mortality rates, water scarcity, exorbitant feed costs, and suboptimal management practices (Abasiekong, Ogban, and Idiong, 2021; Agom and Okon, 2024), there is also significant challenges arising from the global impact of climate change, which threatens sustainable food production amidst a growing population (Okon *et al.*, 2024). Furthermore, high production costs and limited financial support are considered as primary constraints for catfish farmers (Ohamesi *et al.*, 2024). Despite the sector's importance, the full potential of fisheries in Akwa Ibom State remains untapped. Several factors, including socio-economic, environmental, and institutional challenges, have hindered optimal fish production. Understanding the critical determinants of fish output in this region is crucial for developing effective policies and strategies to enhance productivity and sustainability. Hence, this study aimed to identify and examined the key determinants of pond fish output in Akwa Ibom State, Nigeria.

Research Methodology

Study Area

The study was carried out in Akwa Ibom State, Nigeria. Akwa Ibom State is located in the Niger Delta region of Nigeria. It has an estimated population of 5.451 million (NBS, 2016) and a land area of 6,900 sq. Km. It lies between latitudes 4032'N and 5033'N and longitudes 7025'E and 8025'E. It is bordered on the east by Cross River State, west by Rivers State and Abia State, and on the south by the Atlantic Ocean. It is currently the highest oil-producing State in Nigeria. Agriculture is one of the major economic activity of the people and it supports 75% of households of the State's population (Frank, Okon and Obot, 2018). The various agricultural products include palm oil, cassava, yam, cocoyam, plantain, maize, rice, rubber,

aquaculture, seafood such as varieties of fish, shrimps, crayfish, oysters, etc., poultry eggs and meats, pork, and lately snail farming.

Sampling Procedure and Sampling Size

The study was carried out in Akwa Ibom State. A list of pond fish farmers in the state was obtained from the Department of fisheries in the State Ministry of Agriculture. From the list, a multi-stage sampling techniques was used to randomly select respondents for the study. In the first stage, the three (3) senatorial districts were chosen namely: Eket, Ikot Ekpene and Uyo. The second stage involves the purposive selection of three (3) L.G. Areas from each of the senatorial districts making a total of nine L.G.As, namely: Uyo, Itu and Ibesikpo (from Uyo senatorial districts), Abak, Ikot Ekpene and Essien Udim (from Ikot Ekpene Senatorial districts), and Eket, Onna and Mkpat Enin (from Eket Senatorial districts). In the third stage, thirteen (13) pond fish farmers were randomly selected from each of the 9 L.G.As to give a total of 117 respondents for the study. However, questionnaires from 110 respondents were retrieved and used for the analysis.

Analytical Techniques

The study employed descriptive statistics and multiple regression analysis, using three functional forms (linear, semi-log and double log regression).

The equation was explicitly stated as;

$$Y= b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + U$$

Where:

Y = Fish Output (kg)
X_1 = Age (in years)
X_2 = Gender (dummy Male =1, Otherwise =0)
X_3 = Education Qualification (in years)
X_4 = Fishing Experience (years)
X_5 = Pond Size (in m^2)
X_6 = Household Size (number of persons)
X_7 = Expenses on Feed (naira)
X_8 = Medication (Dummy, if used =1, otherwise =0)
X_9 = Labour Cost (naira)
X_{10} = Stock Size (Number of fingerlings procured)
b_0 = Coefficient of determinant
$b_1 – b_{10}$ = Coefficient of regression
U= Stochastic error term

Results and Discussion

Summary Statistics of the Continuous Variables

Table 1 presents the summary statistics of the continuous variables. The Table shows that the mean output and the mean stock size were 2,290.73kg and 1,718kg respectively. The mean age was 51.69 years, and a mean household size of about 6 persons. On the average, the pond fish farmers had at least secondary education with 8.59 being the mean years of formal schooling. The mean feed costs (₦ 663.310) and the mean labour cost (including cost of pumping water) was ₦ 292.6

Table 1: Summary statistics of explanatory variables

Variables	Mean	Std. Dev	Min	Max.
Output of fish in kg	2,290.73	1787.34	200	8008
Age	51.69	11.83	26	73
Educational Level	8.59	3.40	4	16
Household size	5.94	1.990	3	11
Feed cost	664.31	518.33	58	2322.32
Labour Cost	292.6	137.45	80	600
Stock size	1718	1340	150	6006

Source: field survey, 2022

Determinants of Fish Output in the Study Area

The results in Table 2 showed that the linear function had the highest R^2 value (85.36); indicating that 85.36% of the variations in the fish output is explained by the significant variables incorporated in the model as compared to the double-log function (53.09), and semi-log (48.53) which was the least. Secondly, the linear function had the highest F-statistics value (57.73) compared to the double-log (11.2), and semi-log (9.34), indicating the strongest overall fit. This suggests and it explains the variability in the output more effectively compared to the other

models. Hence, the output of the linear model is used to derive and inference of this objective.

The coefficient of experience (0.0375) was positive and significant at the 10% level of probability, suggesting that more experienced pond fish farmers have honed their skills and gained knowledge that contributes to higher fish output. This means that fish farmers with more experience tend to have significantly higher fish output due to the accumulation of knowledge, skills, and best practices over time. This is in line with the findings of Esiobu *et al.,* (2022) who observed that, highly experience farmers will be very cost effective, having better knowledge of climatic conditions, better knowledge of efficient allocation of resources and market situation. The coefficient of pond size (0.119) was positive and significant at 10% level of probability. This means 10% increase in pond size will likely increase the fish output by 1.19%. This implies that larger pond size is associated with higher fish output, because the fish will have freedom of movement, hence, faster growth. This corroborates the findings of Esiobu *et al.* (2022) who opined that, farmers with large pond size had higher output than farmers with small pond size. However, Ucha *et al.* (2018), and Asa and Solomon (2015) reported a negative relationship between pond size and fish output reporting the high cost of constructing larger ponds.

The coefficient of feed expenses (0.2353) is positive and significant ($p<0.01$), suggesting a strong relationship between increased feed expenditure and higher fish output. It means that a unit increase in feed expenditure will lead to a 0.235 increase in fish output. This implies that investing in quality feed is crucial for boosting fish production. This is corroborated by the findings of Esiobu *et al.,* (2022) who noted that farmers who have access and financial capacity to quality fish feeds will realize huge output than their counterparts. On the contrary, Asa and Solomon (2015) reported a negative relationship between feeding expenses and fish output. Similarly, the coefficient of labour cost (0.001) had a positive and significant relationship ($p<0.01$) with fish output. This implies that increased labour input is associated with higher fish output. This could be attributed to the intensive nature of fish farming, which requires constant attention and care. This agrees with the findings of Esiobu *et al.* (2022) who reported that access to labour increased the output of pond fish.

Table 2: Regression Result of Determinants of Fish Output

Variable	Linear (L)		Semi log		Double log	
	Coeff	**Std. Er.**	**Coeff**	**Std. Er.**	**Coeff**	**Std. Er.**
Intercept	-0.7958	0.4751*	-0.6136	0.1497***	-1.9144	0.7523**
Age	0.0043	0.0108	0.0114	0.0034***	0.7030	0.4054*
Sex	-0.0859	0.2165	0.0950	0.0682	0.0520	0.0217**
Educational level	-0.0001	0.0215	0.0039	0.0068	-0.0425	0.0567
Experience	0.0375	0.0197*	-0.0060	0.0062	-0.1934	0.155
Pond Size	0.1190	0.0708*	-0.0062	0.0223	0.2176	0.1347
Household size	0.0866	0.0603	0.0158	0.0190	0.0486	0.2618
Expenses on Feed	0.2353	0.0735***	-0.0574	0.0232**	-0.0067	0.017
Medication	-0.3891	0.4737	0.1187	0.1492	-0.0447	0.0192**
Labour Cost	0.0070	0.0009***	0.0009	0.0003***	0.3338	0.1617**
Stock Size	0.0018	0.0007**	0.0004	0.0002	0.1993	0.0947**
Diagnostics						
R^2	0.8536		0.4853		0.5309	
Adj. R^2	0.8388		0.4333		0.4835	
F (10, 99)	57.73***		9.34***		11.20***	
RMSE	0.7808		0.2459		0.2348	
No of observations	110					

Source: Authors' computation from field survey, 2022; *** $p\leq0.01$, ** $p\leq0.05$, * $p\leq0.1$.

Furthermore, stock size (0.0018) had a significant and positive relationship ($p<0.05$) with fish output. This means that 10% increase in stock size will lead to 0.18% increase in fish

output. This is expected as larger stock size allows for greater potential fish output. Esiobu *et al.*, (2022), and Asa and Solomon (2015) corroborated this finding, asserting that higher stocking capacity of farmers give higher output overtime in fish production.

Conclusion and Recommendation

Factors such are experience in the fish business, pond size, costs of feeding, labor costs, and stock size were the major determinants of pond fish output in the study area. Experienced fish farmers demonstrated superior production outcomes, highlighting the role of knowledge and skill acquisition in the sector. It is recommended that investment in capacity-building programs and training initiatives could enhance the skills and knowledge of fish farmers.

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