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Determinants of Output of Small Scale Fish Farmers in Ikorodu, Nigeria

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Abstract

Aquaculture has been identified as the major mean of balancing the huge import deficit resulting from the need to meet national fish protein consumption requirements and reducing pressure on already over fished captured environment. The growth in Nigeria aquaculture is however far less than the expected potential. Therefore, to properly understand the factor impinging on the aquaculture growth dynamics in Nigeria various factors influencing aquaculture outputs need to be well studied. This paper, investigated the determinants of output of small-scale fish farmers in Ikorodu Local Government Area of Lagos State. Ikorodu Local Government was purposively selected because of the presence of fish farming estate hosting 250 fish farmers which serves as the sampling frame. From the 250 fish farmers, 101 fish farms where randomly selected using structured questionnaire and scheduled interviews. Data obtained from the respondents include socioeconomic characteristics, type and quantity of fish stocked, quantity harvested and sold, cost of production, profit realized among others. The data obtained were analysed using descriptive statistics, budgetary analysis, Gini Coefficient and production function analysis. Majority of the fish farmers are male (65.3%), married (54.5%) and have tertiary education (69.3%). The mean age, household size, pond size, years of farming experience are 36.44±10.28 years, 4.03±1.98, 39.78±0.98ha and 2.67±2.13years, respectively. There is wide variation as measured by Gini Coefficient in the output of fish farmers with about 88.5% disparity in their output. Mean profit made per fish sold in the study area is N186.24*. Factors that positively determine the output of fish farmers are quantity of feed used (p-value 0.001), number of fingerlings stocked (p-value 0.005), years of experience in fish farming (p-value 0.001) and volume of credit obtained (p-value 0.001) Fish farming, in the study area is a profitable business with varying degree of output. In order to improve the output of fish farmers, government and relevant stakeholders in the aquaculture sub-sector should ensure that fish farmers do not only have access to credit facilities but in required amount. In addition, feed is an important determinant of output of fish production, therefore fish feed of high quality should be made available and affordable to fish farmers.

Keywords: Fish output, Gini coefficient, Production volume, Small scale fish farmers.
*1 dollar – 306 Naira

Introduction

Aquaculture is the fastest growing food producing industry in the world. Global aquaculture production has quadrupled over the past twenty years and it is likely to double in the next fifteen years, as a result of wild fisheries approaching their biological limits and the world demand for cultured fish continuing increase (Ayinla, 2012).

Aquaculture is the fastest livestock production

sector in Nigeria, with a growth of about 29% in 2006 alone, and with prospects of continued growth (Adeyeye *et al.,* 2015). Fish consumption accounts for about 35 percent of animal protein consumption in Nigeria (FAO, 2012).

The Nigerian Government has recognized the importance of the fishery sub-sector and it has made several attempts over the years to increase their productivity through institutional reforms and the various economic measures. Some of these measures include provision of subsidy for inputs and exemption from tax for fishermen. Although aquaculture activities in Nigeria started about 50 years ago (Olagunju *et al.,* 2007), yet Nigeria has not been able to meet domestic demand. The demand for fish in Nigeria mostly outstrips the local production (Ozigbo *et al*, 2014). Nigeria has a population of about two hundred million and has her national fish demand at over 2.7 million metric tonnes. The current annual aquaculture production hovers around 300,000 metric tonnes (Adewumi, 2015, FMARD, 2016). These, combined with ever decreasing catch (sometimes due to over exploitation) from the capture fisheries have not been able to meet the ever-increasing protein demand of the country (Msangi Siwa and Batka Miroslav, 2015). This is coupled with the capture yield which is already highly stressed by excessive fishing pressure resulting from increased population, rising organic pollution, toxic contamination, coastal degradation and climate (Serge and Andrew, 2010).

Fish is an important source of protein rich food resource and there has been sharp increase in the demand for fish products due to increasing population pressure (Bhatnagar and Devi, 2013).

Thus the total demand for fish in Nigeria is expected to increase since the population is increasing, thus resulting in a huge increase in demand for animal protein and other nutritional requirements (Barange and Blanchar, 2012, Olaniyan, 2015). This has necessitated importation of stock fish, frozen fish, meat and other protein products to forestall an impending food crisis (Osugiri *et al*, 2007). Nigeria is one of the largest importers of fish with a per capita consumption of 7.52kg per annum. This is a far cry from the FAO recommended 35gm per day (FMARD, 2011-Atanda, 2012). Fish importation makes up about two-third of the total consumption. According to FMARD (2018), in 2015 alone, Nigeria spent $1,126,428,414.41* on importation of 806,000 metric tonnes of fish in spite of all the endowed marine resources, rivers, lakes and creeks of the nation. This huge sum is a drain on the foreign exchange of the country thus the need to strengthen and increase local production from aquaculture sector. It is expedient to identify the factors that determine the output of fish farmers in order to generate workable policies that can increase the output of the fish farming industry to meet up the demand of fish in Nigeria. Identification of factors that determines output of fish farmers will help policy makers to design intervention programme that will enhance the output of fish farm operators in order to realize one of the sustainable development goals to reduce hunger.

Ikorodu Local Government is well endowed with a lot of water bodies, thus making it a potential hub for culture fish production if well enhanced. It shares its boundary with Lagos Lagoon and has a lot of fisheries and aquaculture activities carried out in this Local Government Area which is one of the reasons why this local government was selected as the study area. In addition, there is a fish farming estate in Ikorodu, created by the government of Lagos State, in order to increase the number of entrepreneurs in fisheries and aquaculture in the state as well as to increase the provision and adequate supply of fish in the state and also to increase the income of the state as well as the country.

This paper therefore, seeks to determine the (i) level of variation in the output of fish farmers in the study area and, (ii) profit obtained from fish farming and factors that determine the output of fish farmers in the study area.

Materials and Methods

Study Area: The selected local government is Ikorodu Local government area of Lagos State.

*1 dollar – 306 Naira

Located along the Lagos Lagoon, Ikorodu is a city that shares boundary with Ogun State. As of the 2006 Census, Ikorodu had an enumerated population of 689,045 (Lagos Bureau of Statistics, 2012). Ikorodu has a land mass of 394 kilometres square and is on latitude of 6° 38' 31" N and a longitude of 3° 31' 18" E.

Sampling Technique: Two-stage sampling technique was adopted in the selection of the respondents. Stage one is the purposive selection of the fish farm estate in Ikorodu local government as the study area. Stage two is the random selection of 101 respondents from the list of the 250 farmers (sampling frame) in the Ikorodu fish farming estate. Structured questionnaire and scheduled interviews were used to collect information from the respondents.

Analytical Technique: The data obtained were analysed using the following analytical methods: Descriptive statistics, Regression (using OLS), Gini coefficient and Budgetary Analysis.

The descriptive statistical tools employed are percentages, tables, mean and frequency distribution.

Gini coefficient was used to examine the variation in fish output in the study area.

The budgetary analysis was used to determine the profitability of fish farming in the study area

The budgetary analysis is specified as:
Profit = TR –TC
Where TR = PQ
TR = Total Revenue (₦)
TC = Total Cost (₦)
P= Unit price of output (₦)
Q = Total quantity of output (Kg)

Regression Analysis: In order to identify the factors that determine output of fish farmers, production function was analysed. Following Olayemi (1998), the relationship between endogenous variables and each of the exogenous variables were examined using Linear, exponential, Logarithm and quadratic functional forms. Based on the value of the coefficient of determination, statistical significance and economic theory that supports fish production, the lead functional form which was the Cobb Douglas production function form was chosen.

The Cobb Douglas Functional form is expressed as:

$$\text{Ln } Y = \ln b_o + b_1 \ln b_1 + b_2 \ln b_2 + b_3 \ln b_3 + b_4 \ln b_4 + b_5 \ln b_5 + \ldots\ldots\ldots\ldots bn \ln b_n + \ln e$$

Where Y = dependent variable which is the quantity of fish harvested (kg)

a = coefficient for the intercept
b =regression coefficient which intercepts the effect of X on Y
e = error term

Empirically, the model is stated as:

X_1 = Quantity of feed (Kg)
X_2 = Number of labour/ manhour (In mandays)
X_3 = Pond Size (Sq Metres)
X_4 = Cost of fingerlings (In Naira)
X_5 = Cost of medication (In Naira)
X_6 = Experience in fish farming (In years)
X_7 = Water source (1 = Underground water, 0 = otherwise)
X_8 = Volume of credit acquired (actual amount in Naira)
X_9 = System of farming (1 = Monoculture 0 = otherwise)

Results

Socio-economic Characteristics of Respondents

Table 1 presents the socio-economic characteristics of the respondents. Majority (65.3%) of the respondents are male. The age distribution of the respondents indicates that 67.3% of the respondents are less than 40 years of age. This implies that the respondents have the physical strength and are agile to engage in fish farming activity since they are still in their active age. The result of the socioeconomic analysis further shows that about 69.3% of the respondents have tertiary education which implies that most of the respondents will have the

Table 1: Socio-economic Characteristics of Fish Farmers in Ikorodu LGA., Lagos State

Variables	Frequency	Percentage
Gender		
Male	66	65.3
Female	35	34.7
Total	101	100.0
Age		
< 41 years	68	67.3
41-60 years	31	30.7
> 60 years	2	2.0
Total	101	100.0
Educational Status		
None	6	6.0
Primary	22	21.7
Secondary	70	69.3
Tertiary	3	3.0
Total	101	100.0
Marital Status		
Single	41	40.5
Married	55	54.5
Divorced/Widow	5	5.0
Total	101	100.0
Household size		
< 5	56	55.4
5-8	39	38.6
> 8	6	6.0
Total	101	100.0

technical know-how to engage in fish farming as a result of their high literacy level. Furthermore, they will be able to apply their education to the administration and managerial roles required in fish farming. This is expected to enhance their productivity. In addition, Table 1 shows that higher percentage of the respondents are married (54.5%). This means that they likely depend on fish farming for the sustenance of their family. The distribution of the household size reveals that most of the respondents (55.4%) have households with less than five members. This is likely to reduce the availability of family labour that will be available which will mean that households may have to depend on hired labour. On the other hand, small household size will imply a higher mean per capita household expenditure which is likely to improve the household's standard of living.

Farm Characteristics of Respondents

Findings on the farm characteristics of the respondents reveal that about 87.1% of the respondents have ponds that are less than 51 m^2 indicating that most of the respondents are small holder farmers. Operating at a small scale level will not give the respondents the opportunity of economics of scale which may increase their production cost. The result of the farms characteristics also shows that most of the respondents (76.2%) also make use of concrete pond. Table 2 further reveals that majority (45.5%) of the respondents source their fingerlings from private firms. Monoculture is the major type of system of fish farming adopted by

Table 2: Farm Characteristics of Respondents

Farm Characteristics	Frequency	Percentage
Size of Ponds		
1-50m^2	88	87.1
51-100m^2	3	3.0
101-200m^2	7	6.9
> 200 m^2	3	3.0
Total	101	100.0
Type of culture structure		
Concrete tank	77	76.2
Earthen pond	10	10.0
Collapsible pond	9	8.9
Plastic Tank	5	4.9
Total	101	100.0
Source of fingerlings		
Government owned	3	3.0
Hatchery	46	45.5
Private hatchery	38	37.6
Own hatchery	14	13.9
Friends	101	100.0
Total		
System of Fish farming		
Integrated	14	13.9
Monoculture	79	78.2
Poly-culture	8	7.9
Total	101	100.0
Years of experience		
< 5 years	52	51.5
5-8 years	37	36.6
> 8years	12	11.9

most of the respondents (78.2%). Majority of the respondents (51.5%) have less than five years of experience in fish farming.

Variation in output of Fish Farmers

The Gini coefficient shows the estimated value of 0.885. This implies that the level of variation in the output of the fish farmer is 88.5% and this indicates that there is a wide variation in the quantity of output of fish that is produced by the fish farmers in the study area.

Profitability of Fish Farming Enterprise

The profitability of fish farming enterprise was estimated using the budgetary analysis (Table 3). The average total cost expended on a total of 9973kg fishes is ₦4,126,428.48 with cost of feeding contributing the highest (55.1%) to the cost structure of fish production. The total revenue realized from the sales of the fishes at an average cost of ₦600 per fish is ₦5, 983,800 and the total profit realized from the production cycle is ₦1, 857,371.52 from 9973Kg of fishes. The average profit realized on a total of 9973kg fishes is ₦186.24.

Total Revenue = 600× 9973 = ₦5,983,800
Profit = Total Revenue – Total cost
= ₦5,983,800 - ₦4,126,428.48 = ₦1, 857,371.52

Table 3: Cost Analysis of Fish Production

Item	Cost (?)*	Percentage Contribution
Fingerlings	323,600	7.9
Feeding	2,273,715	55.1
Medication	117,320	2.8
Labour	917,820	22.2
Transportation/marketing	273,525	6.6
Miscellaneous	220,448.48	5.4
Total	**4,126,428.48**	**100.0**

Average profit per fish = ₦1, 857,371.52÷ 9973
= ₦186.24.

*1 dollar – 306 Naira

Determinant of Output of Fish Farmers

The result of the ordinary least square regression analysis is presented in Table 4 based on the econometric and statistical criterion, the double logarithm was chosen as the lead equation and it is presented in Table 4. Outcome of the analysis shows that 51.7% of variation in the output of fish farmers is explained by changes in the quantity of feed, number of fingerlings stocked, years of experience in fish farming and volume of credit obtained. Quantity of feeds administered has a positive and significant effect on the output of the fish farmers (p-value 0.001). The result further shows that a percentage change in the quantity of feed given to the fish will increase the output of the fish farmers by 36.6%.

Table 4: Determinant of Fish output

VARIABLES	Coefficient	Standard Error	T-Ratio	Significant Level
Constant	4371.339	3277.021	1.334	0.186
Quantity of feed	0.366	0.052	7.025	0.00***
Number of labourers	234.906	784.399	0.299	0.765
Pond size	28.363	114.091	0.249	0.804
Number of fingerlings	115.125	51.742	2.225	0.029**
Cost of medication	329.217	232.224	1.418	0.160
Experience in fish farming	390.800	137.492	2.842	0.006***
Water source	261.543	385.683	0.678	0.499
Volume of credit	0.010	0.000	3.202	0.002***
System of farming	108.602	403.719	0.269	0.789

Source: Computer print-out for Field survey data, 2013.
*** = 1% significant, ** = 5% significant, * = 10% significant

Number of fingerlings stocked also has a positive and significant effect on the output of farmers (p-value 0.005). A percentage increase in the amount of fish stocked will increase the output of the fish farmers by 115%. Years of fish farming experience is significant and has a positive effect (p-value 0.001) on the output of the fish farmers i.e., a unit increase in years of fish farming experience will increase the output of the fish farmers by 391%. Volume of credit obtained also has a significant and positive effect on the output of the fish farmers (p-value 0.001). This implies that a unit increase in the volume of credit obtained by the fish farmers would increase the quantity of fish harvested by 1%.

Discussion

Socio-economic Characteristics of Fish Farmers in Ikorodu LGA, Lagos State

The dominance of men in fish production was reported by Fregene *et al*. (2011), Omitoyin and Fawehinmi (2016). This is in concord with the report of Agboola (2011) who stated that the higher number of male participation in fish farming indicated the extent of gender sensitivity in occupation like farming, which could be attributed to the fact that agricultural production is faced with a lot of risk and uncertainties and women are risk averse, so is the result of drudgery that aquaculture business is involved in. This marked difference in gender could be attributed to the common believe that fish farming is a man's vocation which involves close supervision and monitoring. The findings agree with that of Ugboma (2010), that the nature of fish farming involves close monitoring of daily activities.

Majority of the respondents (67.3%) in the study area are in the active age of under 40 years. This indicates that aquaculture practices is dominated by youths that are agile and have the physical strength to cope with the rigours of fish farming. This also implies that they are productive, innovative and can take risk in investments. They can also easily adopt new technology to improve their production and utilise resources more efficiently. This is different from the observation of Omitoyin and Fawehinmi (2016) that found that 31years and above dominated the fish farming space in Osun State. However, this is in line with Ogunmefun and Achike (2014) who are of the opinion that with the current high rate of unemployment in the country, most young people has been reported to resort to fish farming.

Education is an important factor which has influence on farm productivity. With 69.3% of the respondents having tertiary education, it can be inferred that most of the respondents will have the technical know-how to engage in fish farming as a result of their high literacy level. Furthermore, they will be able to apply their education to the administration and managerial roles required in fish farming. Educated fish farmers can also easily adopt innovations in their methods of production which is expected to enhance their productivity. This is in agreement with an earlier study by Ogunmefun and Achike (2014) that fish farming requires a lot of technicalities which would at least require the fish farmer to be enlightened in order to understand the requirements of the venture such as feed type, feeding rate, feed quality, fertilizer requirement/measurement, treatment and measurement of fish weight gain versus feed intake and so on. Olaoye *et al* (2013) concluded that fish farming is dominated by the educated class and mostly by those armed with high level of education. This could be due to the fact that high literacy level is required for technical and scientific knowledge which would enhance the productivity level and enhance farmer's income thereby increasing their standard of living (Ayandiji and Oke, 2016).

Marriage is believed to saddle people with responsibilities that could make them to seek innovations that will enhance production so as to increase their income earning capacity and improve their standard of living. Most (54.5%) of the respondents are married, which shows that the respondents are permanent settlers in the area and their economic activities revolve around the area, thus they are likely to depend on fish farming for the sustenance of their family. They are also likely to have access to family labour in their fish farming business since family members serve as readily available labour force as affirmed by Williams *et al.,* (2012) and Nkamigbo and Okeke (2013). This concurred with the work of Adewuyi *et al.,* (2010) who indicated that married farmers could easily make use of family labour to perform critical farm tasks. Olusola and Ige (2015) were however of the opinion that they will incur higher household

expenditure that will reduce the quantum of income realizable from the enterprise. The household size reveals that most of the respondents (55.4%) have households with less than five members. This is likely to reduce the availability of family labour that will be available which will mean that households may have to depend on hired labour. This agrees with the observations of Onemolease *et al.,* (2000; 2011) that fish farmers with large household are believed to constitute an important labour source. On the other hand, small household size will imply a higher mean per capita household expenditure which is likely to improve the household's standard of living.

Farm Characteristics of Respondents

The farm characteristics of the respondents reveal that most of the respondents are small scale farmers. Operating at a small scale level will not give the respondents the opportunity of economics of scale which may increase their production cost. This agrees with PIND (2011) who observed that a considerable large population of the fish farmers are small farmer holders and are fragmented despite the vast opportunities in this enterprise. Therefore, this makes it so difficult to harmonize the opportunities and integrate these farmers to work together. This small farm size may be due to the fact that the farmers do not have access to credit facilities to purchase adequate land for large farms operation as indicated by Adeoti *et al.,* (2011) who concluded from their work that fish farm sizes were small because most of the farmers had no access to credit funds to invest in the enterprise. Moreover, Lagos is a very congested city which may cause limited availability of affordable land for fish farmers.

The result of the farms' characteristics also showed that most of the respondents (76.2%) make use of concrete tanks. The use of concrete might be due to its convenience, it is easy to clean and manage and easy to harvest and drain (Williams *et al.,* 2012). This does not fall in line with Ele *et al.,* (2013) who submit that though concrete tanks have the advantage of lasting over ten years and have lower dependence on climatic conditions (i.e., not drying up during the dry season when the water table is low), the fish farmers in Calabar prefer earthen ponds with cheap sources of underground water from the inundated swamps.

The availability of fingerlings within the reach of fish farmers is of economic importance in fish farming. Fingerlings are production factor which can either be raised on the farm or purchased from other sources such as private farms or government farms. The findings of this work revealed that majority (45.5%) of the respondents source their fingerlings from private farms. This may be due to the fact that these sources are very close to them and the sources are trustworthy. It could also be due to the fact that the fish farmers do not have adequate money to expand the scope of their business to hatchery production.

Monoculture is the major type of system of fish farming adopted by most of the respondents (78.2%). This is in agreement with the findings of Adewuyi *et al.,* 2010. The reason might be because majority of fish farmers in Nigeria as a whole prefer rearing of catfish which is a species that commands a large market, tasty in whatever form prepared and has high nutritional values and also yield more income to fish farmers as compared to other cultivable fish species in the nation.

It has been reported that ability to manage fish pond efficiently depends on the years of experience Majority of the respondents (51.5%) have less than five years of experience in fish farming, meaning that majority of the respondents in the study area are relatively new in fish farming by experience. This shows that most of the respondents have not been into the business for a long period and invariably they will still be learning on the job which is expected to enhance their efficiency level over time. This is in line with the work of Onemolease, and Oriakhi (2011) who noted that experience is highly needed in the enterprise of fish farming.

Variation in Output of Fish Farmers

Variation in output is expected due to the fact that productive resources available for each household differs, their experience and managerial capacity vary. All these will be expected to have effect on the outcome of each of the respondents. This is similar to the findings of Onumah, *et al.*, (2010) in Ghana, Tan, *et al.,* (2011) in Philippines and Tsue, *et al.,* (2013) in Nigeria who concluded that farm specific variables and socio-economic factors such as experience, farm size, culture, age, pond type, extension services and education

have influence on technical efficiency which invariably determines the output of the farmers. There is, therefore, the need to bridge the high variation in the output of the farmers by enhancing their access to productive inputs and improved managerial skills through improved contact with extension agents and membership of fish farmers association. Also, access to credit availability and timely delivery of such fund can help fish farmers to expand their scale of operations which might invariably help increase their output.

Determinant of Output of Fish Farmers

The result from the regression analysis revealed that quantity of feed fed to the stocked fish, number of fingerlings stocked, years of experience and the volume of credit obtained by the fish farmers are all positively significant to output of the fish farmers in the study area. This denotes that a unit increase in any of these inputs will lead to an increase in the value of output as noted by Agboola (2011).

Quantity of feeds administered has a positive and significant effect on the output of the fish farmers (p-value 0.001). The result further shows that a percentage change in the quantity of feed given to the fish will increase the output of the fish farmers by 36.6%. This means that farmers who are able to feed their fish very well with adequate quantity and quality fish feeds will have good yield. This is in line with the findings of Oluwasola and Ajayi (2013) and Ele *et al.,* (2013) who indicated that as feed (Kg) used increases, output increases.

Number of fingerlings stocked also has a positive and significant effect on the output of farmers (p-value 0.005). A percentage increase in the amount of fish stocked will increase the output of the fish farmers by 115%. This means that farmers who are able to stock more fingerlings will also be able to have greater yield of production. This is in line with the findings of Ugwumba (2011).

Years of fish farming experience is significant and has a positive effect (p-value 0.001) on the output of the fish farmers, i.e., a unit increase in years of fish farming experience will increase the output of the fish farmers by 391%. This result is in agreement with the findings by Adesiyan and Idowu (2011) and Oluwasola (2011), but contradicts the findings of Olusola and Ige (2015) who indicate that a unit increase in the experience of catfish farmers will depress income by 13%.

Volume of credit obtained also has a significant and positive effect on the output of the fish farmers (p-value 0.001). This implies that a unit increase in the volume of credit obtained by the fish farmers would increase the quantity of fish harvested by 1%. Income and credit obtained by the farmers have positive relationship but they have only yielded constant return to scale. Credit which is an indispensable factor for fish production plays a vital role in enhancing productivity. It has been recorded that acquisition and proper utilization of capital for any agricultural purpose enhances the production capacity of a farmer Innocent, (2014) and this is in line with the work of Isitor *et al*, 2014. High levels of inequality contribute to high levels of poverty in several ways. First, for any given level of economic development or mean income, higher inequality implies higher poverty, since a smaller share of resources is obtained by those at the bottom of the distribution of income or consumption. Second, higher initial inequality may result in lower subsequent growth and, therefore, in less poverty reduction. The negative impact of inequality on growth may result from various factors. For example, access to credit and other resources may be concentrated in the hands of privileged groups, thereby preventing the poor from investing. Third, higher levels of inequality may reduce the benefits of growth for the poor because a higher initial inequality may lower the share of the poor's benefits from growth. At the extreme, if a single person has all the resources, then whatever the rate of growth, poverty will never be reduced through growth.

Conclusion

The determinant of output of small scale fish farmers was examined in this study. The outcome of the analysis indicates that there is a wide variation in the output of the fish farmers and that fish farming is a profitable venture. The result further shows factors that determine the output of fish farmers as age of respondents, years of experience in fish farming, volume of credit obtained and quantity of feed given to the fishes.

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