Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.4, No.28, 2014

Determinants of Output and Profitability of Aquaculture Fish Farming in Burutu and Warri South West Local Government Areas of Delta State, Nigeria

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Abstract
The study analyzed the determinants of output and profitability of aquaculture fish farming in Burutu and Warri South local government areas (LGAs) of Delta State, Nigeria. A multi-stage sampling procedure was adopted for this study. Eight communities were randomly sampled from the two LGAs and twenty aquaculture fish farmers were sampled from each of the selected communities to give 160 respondents that were utilized for analysis. Data were collected from both primary and secondary sources. The primary data were obtained using structured questionnaire and interview schedules and analyzed through the use of descriptive statistics (mean, percentages and tables) and inferential statistics (Ordinary Least Square (OLS) Regression Analysis and Farm Budget Analysis). The enterprise proved to be a profitable enterprise from the positive mean gross margin and mean net incomes recorded. Cost of feeds was the most sensitive cost item in aquaculture fish production. Maximum variable profit would be increased by the adoption of measures that would reduce the price of feed. The age of farmers, level of educational attainment, and farming experience as well as farming status were significant variables that affected output of fish. As aquaculture fish farming has been found to be a profitable enterprise, the Delta State government should increase the budgetary provisions to provide more funds through her already existing microcredit programme to accommodate more entrepreneurs interested in aquaculture fish farming. Through this way, more new investors will be attracted into aquaculture business. This will ultimately lead to mopping up of the teaming unemployed youths in the State and making the State the hub of fish production in the country.
Keywords: Aquaculture, Determinants, Output, Profitability, Burutu and Warri South

INTRODUCTION

Nigeria is blessed with abundant natural and human resources, with numerous water bodies as one of the most important natural resources bequeathed to the country by nature. The hunting, catching and marketing of edible fresh water and ocean fishes largely dominate fishing industry in Nigeria. Basically, Fish production in Nigeria is either by capture fisheries, aquaculture fish farming or by importation. Capture fisheries involve the harvesting of naturally existing stocks of wild fish. This can be done either by small scale/artisanal fishers or by industrial/commercial trawlers. In artisanal fisheries, production is achieved by individual or by small groups through the use of labour intensive gears. Characteristically artisanal fishers operate from dugout, wooden canoes that are more often than not unmotorized (Coates, 2000; Anene et al., 2010).

Aquaculture or a way of fish farming is the art and science of controlled rearing of fish in ponds, farms and some instances natural water bodies from hatchlings to mature size. It is an underwater agricultural production of fish species in which production cycles such as breeding, feeding, cultivation and protection are virtually controlled by humans in contrast to capture fishery where the wild stocks of fish are harvested. The practice is regarded as being uniquely placed to reverse declining supplies from capture fisheries. The activity has a notable potential for new livelihood opportunities providing the mechanism for lower priced fish, enhanced nutritional security and employment for both rural and urban communities. In Nigeria, the most commonly cultured fish species include catfish (*Clarias gariepinus)*, the imported *C. (lazera*, *Heterobrachus spp),* and the imported *C. (hollandica*), tilapia and carp.

Many fish farms in Nigeria focus on catfish, as they can have a market value of two to three times that of tilapia .The African catfish from a biological perspective is said to be one of the most ideal aquaculture species in the world because it thrives in diverse environments. It can also survive on natural food or artificial food, which it accepts readily in captivity. It can be cultured in different culture systems such as ponds, cages, tanks, water re-circulatory system and whether through intensive or extensive fish culture system. Besides, catfish grows fairly fast and can be cross-bred to enhance certain favourable traits such as better body conformation (smaller head, more flesh), more hardiness, higher fecundity, improved survival of fry, and adaptation to supplementary feed. For example, catfish which is naturally a bottom feeder, now readily accepts floating feed, which makes it easy to observe the fish for behavioural patterns, growth rate and disease outbreak .

Aquaculture is regarded as being uniquely placed to reverse declining supplies from capture fisheries (mean caput fish availability in Africa declined 20% between 1990-1996 and has declined further) and the

activity has notable potential for new livelihood opportunities, providing the mechanism for lower priced fish, enhanced nutritional security and employment for poor communities by servicing urban markets (Bada, 2005). For instance, aquaculture production in Nigeria is currently about 40,000 metric tones contributing 6% of domestic fish production.

The substantial expansion in aquaculture production is an indication that the sector could be a major player in augmenting the supply of fish protein for consumption and a major source of income for farmers and for foreign earnings. This also supports an earlier observation that fresh water aquaculture would become a major source of growth for the sector. Given the proper environment for growth, the country can still accelerate the expansion and development of its aquaculture industry. The country has large natural resources to support aquacultural development: inland freshwater of 14 million hectares and available land area of 1.7 million hectares for aquaculture development (Federal Department of Fisheries, 2005).

Fish culture provides lucrative returns to farmers, employment in rural areas, besides supplying good quality protein diet for people (Njoku, 2000; Reddy and Ram, 2004; Onoja, 2005). The National Poverty Eradication Programme (NAPEP) estimated in 2004 that the employment in the fisheries sector is up to 100,000 people who are in various fields of engineering, vessel operation, marketing and management only. In addition to fish protein which is ranked cheapest among the animal protein sources (Nwuba and Onuoha, 2006), fish provides high quality calories, fats and vitamins (Samson, 1997). In recognition of this cardinal importance of fish and allied products in the diet and nutrition of man, the need to develop fisheries, as a tool for the provision of adequate fish supply for human consumption was identified very early in the life of Nigeria as a nation (Adikwu, 2001). Furthermore, it has been noted that fish culture generates income for all categories of people involved in it as well as foreign exchange for the nation. When compared with livestock, it requires less space, time, money and has a higher feed conversion rate. Among the culturable fish in Nigeria (carp, tilapia and catfish), catfish (*clarias heteobronchus*) is the most sought after fish, very popular with fish farmers and commands a very good commercial value in Nigerian markets (Samson, 1997). Consequently, the catfish is very important for the sustainability of the aquaculture industry in the country.

The performance of the fisheries sector in Nigeria is below expectation with low supply. This is evident in the fact that Nigeria still imports fish into the country to supplement fish production. According to the proceedings of the fisheries society of Nigeria (FISON), about 50% deficit supply of requirement is met through importation, which constitutes a huge avoidable drain of Nigeria's scare foreign exchange (Anko and Eyo, 2001). The contribution of domestic fish production to the country's fish sector as well as the income of the fish farmers cannot be over emphasized. Aquaculture fish farming has the potential of contributing to domestic fish production and reducing the amount of money spent on fish importation. The contribution to total income of the family for livelihood sustainability can also not be overlooked. It is with this utmost importance that this study was carried out to investigate the profitability of aquaculture fish farming in the study area. In order to do so, the study sought to find out the socioeconomic characteristics of the fish farmers as well as the effect of these variables on output, It also established the relevant costs and returns in aquaculture fish farming so as to determine the profitability or otherwise of aquaculture business in the area.

METHODOLOGY

Area of Study

This study was carried out in two local government areas of Delta State. These are Burutu and Warri-South West Local Government Areas. Burutu Local Government Area lies on the coast of the Forcados river, a channel of the River-Niger, 20 miles (32km) upstream from the bight of Benin and has a population of 207,977 (NPC, 2006). The LGA comprises of 31 communities. Warri-South West LGA has its headquarters in Ogbe-Ijoh. It has an area of 1,722km^2 and a population of 116,681 (NPC, 2006). The LGA comprises of 22 communities.

Sampling Procedure/Data Collection

A multi-stage sampling procedure was adopted for this study. Firstly, four communities were selected from each of the two local government areas under study. This gave a total of eight communities. The eight communities sampled were Burutu, Ogulagha, Odimodi and Obotobo from Burutu local government area and Ogbe-Ijoh, Kunu-Kunuama, Kurutiyei, and Oporoza from Warri south local government area respectively. The list of aquaculture fish farmers in the eight communities was compiled to form the sampling frame. The second stage involved a random sample of twenty aquaculture fish farmers from each of the selected communities. This gave a total of one hundred and sixty aquaculture fish farmers that were selected for the study.

Data were collected from both primary and secondary sources. The primary sources of data were obtained using structured questionnaire and interview schedules. The questionnaire was designed to seek information on the socioeconomic characteristics of the fish farmers as well as the revenue profile of the fish farming business. Secondary sources of data will be collected from textbooks, journals, seminar papers and conference papers, annual reports from banks, publications, and internet resources.

Data Analysis

Data collected for this study were analyzed through the use of descriptive and inferential statistical tools. Descriptive statistical tools used were mean, percentages and tables. These were applied to analyse the socioeconomic variables of the fish farmers while inferential statistical tools that were utilized are the Ordinary Least Square (OLS) Regression Analysis and Farm Budget Analysis. The Ordinary Least Square (OLS) Regression Analysis was used to estimate the effect of the fish farmers' socioeconomic characteristics on output of fish in the area while the Farm Budget Analysis was applied to establish the profitability or otherwise of aquaculture fish production in the area.

Model Specification

i. Farm Business Analysis:

The farm business analysis measures the strength and weakness of the farm (Olukosi and Erhabor, 1987). The indicators used in this work were the Net Farm Income (NFI) and Profitability Index. NFI is a difference between total revenue and total cost (i.e. sum of variable and fixed costs). The item of revenue was total from catfish sales. The cost items considered were; and medication, labour and miscellaneous costs. The average prevailing market prices of inputs and output were used to derive the relevant monetary values of output and input. The total return was estimated by multiplying the total weight of fish by the prevailing market prices. The model used was represented by the equation:

$$NFI = \sum_{t=1}^{n} P_i Y_i - \sum \left(\sum_{j=1}^{m} P_{xi} Y_j - \sum_{k=1}^{k} F_k \right)$$

Where;

NFI = Net farm Income

Y_i = Fish output (total weight in Kg)

P_i = Unit price of the fish/per kg

X_j = Quantity of variable input (where j = 1, 2, 3, ……, m) (catfish seed, feeds and medication and labour)

P_{xj} = Price/Unit of variable input (N)

F_k = Cost of fixed inputs (where k = 1, 2, 3 … k fixed input) (depreciation of water pump, depreciation of equipments, depreciation of pond structure and interest on capital)

$\sum$ = Summation (addition) sign.

The Net Farm Income (NFI) is gross receipt less total cost.

ii. Ordinary Least Square (OLS) Regression Analysis:

The Ordinary Least Square (OLS) Multiple Regression was used to ascertain the effect of socioeconomic characteristics of the fish farmers on output. Four functional forms of the multiple regressions were fitted. These are linear, semi-log, double log and exponential functions. The lead equation was chosen based on *apriori* theoretical expectations, magnitude of the coefficient of multiple determinations (R^2) and statistical significance of the coefficient.

The multiple regression model is implicitly specified as:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, e)$. The model was explicitly specified and tried in four functional forms of linear, semi-log, double-log and exponential forms;

Where:

Y = Output of fish in kg

X_1 = Age of the fish farmers in years

X_2 = Level of educational attainment (Number of years spent in school)

X_3 = Farming Experience in years

X_4 = Gender of the fish farmers(dummy variable:1 if male, 0 otherwise)

X_5 = Marital status (dummy variable: 1 if married, 0 otherwise)

X_6 = Mode of farming (dummy variable: 1 if full time, 0 otherwise)

X_5 = Household size

e = Stochastic error term

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Aquaculture Fish Farmers

The summary of the socioeconomic characteristics of the respondents considered in this study are presented in Table 1. The entries indicate that over 70% of the respondents are aged between 31 and 50years. This age range is the most active stage in a man's life as farmers in this age bracket are highly energetic and productive than the older farmers. As has been observed in literature, farmer's age is an important determinant of productivity. The

gender distribution shows that there is male dominance in aquaculture fish farming in the area with over 74% being the male folks. This finding supports earlier studies by Ele *et al* (2013) that found male dominance in fish farming with 81% males and 19% females involved in fish farming in Calabar, Cross River State. The analysis of marital status of the respondents indicates that over 66% are married while 25% are single. It has been observed in literature that farmers generally need spouse in order to raise children to support family labour.

Result shows that majority of the respondent aquaculture fish farmers have household size of between one and eight persons (83.2%). Over 49% of this number has household sizes ranging from 8 to 5 to 8 persons. The implication of a large household in the field of agriculture can be viewed from two angles. It can provide a cheap source of labour as it can bring about the use of small amount of hired labour while it can as well negatively affect the family if most of the household members are not of productive age and hence cannot contribute to family labour in farming activities. In such a situation there will be high consumption expenditure on food and this is one of the predisposing factors to poverty. The level of educational attainment of the respondents indicates that over 91% of sampled aquaculture fish farmers in the area are literate with only about 8% of them not having acquired western education through the formal process.

Table 1: Socioeconomic Characteristics of Respondent Aquaculture Fish Farmers

Variable	Frequency	Percentage (%)
Age		
21 – 30	31	19.4
31 – 40	80	50.0
41 – 50	33	20.6
51 and above	16	10.0
Gender		
Male	119	74.4
Female	41	24.6
Marital Status		
Married	106	66.3
Single	40	25.0
Divorced	8	5.0
Widow/Widower	6	3.7
Household Size		
1 -4	54	33.8
5 – 8	79	49.4
9 and above	27	16.8
Education		
No formal education	13	8.1
FSLSC	25	15.6
SSCE	80	50.0
NCE/OND	19	11.9
Degree	23	14.4
Farming Experience (Years)		
1 – 3	56	35.0
4 – 6	84	52.5
7 – 9	11	6.9
10 and above	9	5.6
Mode of Farming		
Part time	99	61.9
Full time	61	38.1

This implies that the knowledge applied by this few aquaculture fish farmers without formal education has been acquired through non-formal educational process or probably on the job training. Half (50%) of the entire sampled respondents attained school certificate level which implies that education is a necessary tool in aquaculture practices. The result of the experience of the respondents indicates that majority (87.5%) have been into aquaculture fish farming for the periods ranging from 1 to 6 years. Specifically, 52.5% of the respondents have been in the business between 4 and 6 years. Only a few (5.6%) of the farmers have been on the job for 10 years and above. In most cases the experience acquired over time improves the production skills of farmers.

The mode of farming which defines whether a respondent is a full time or part time aquaculture fish farmer shows that 61% of the respondents are engaged in aquaculture farming on part time basis while 38% are engaged on full time basis. With a high percentage of the farmers practicing on part time basis, it implies that aquaculture fish farming job can be carried out alongside other activities such as civil service, marketing, arable

crop farming among other enterprises. Hence, aquaculture fish farming is a good enterprise for livelihood sustainability.

Effect of Socioeconomic Characteristics of the Aquaculture Fish Farmers on Output

For the factors determining the output of aquaculture fish farmers in the study area, four functional forms of the ordinary least square multiple regression model were tried and the results of analysis are presented in Table 2. The result of the regression shows that the Semi log model has the highest value of the coefficient of multiple determination (R^2), the highest number of significant variables and conformed to *a priori* expectations. The test of significance of the R^2 produced an f-value of 19.059 which was significant at 1%, implying that the Semi log model function gave a good fit to the data. The coefficient of multiple determination was 0.982, implying that about 98.2% of the variations in output of aquaculture fish farmers were jointly accounted for by the independent variables investigated in the regression model. The multiple regression coefficients for age (X_1), educational attainment (X_2) and Farming experience (X_3) were significant at 1%, implying that these variables are important factors determining the output of aquaculture fish farmers in the study area.

Table 2: Result of Multiple Regression on Effect of Socioeconomic Characteristics of the Aquaculture Fish Farmers on Output of Fish

Explanatory variables and important statistics	Functional Forms			
	Linear	Semi-log	Double log	Exponential
Constant	4.51215	1.927864	17.5269	7.142414
	(2.5731)**	(9.5867)***	(3.1547)***	2.1674)**
Age (X_1)	1.44887	0.327629	0.11227	1.45E-05
	(1.34646)*	(6.34646)***	(2.94116)**	(1.65122)
Education (X_2)	0.540387	68158.66	0.050477	0.00018
	(0.299554)	(4.283192)***	(2.82636)**	(2.54686)**
Farming experience (X_3)	791.0466	30792.5	2.901915	0.007086
	(16.35268)***	(4.626796)***	(4.710015)***	(2.814662)**
Gender (X_4)	4007.797	50771.17	1.21963	0.075808
	(3.485045)*	(0.927274)	(2.405965)**	(1.716755)
Marital status (X_5)	-1.86872	-56746.6	-0.08522	-1.24E-05
	(-1.56984)	(-1.21476)	(-0.35927)	(-0.96295)
Mode of farming (X_6)	6.200085	3154.589	0.24217	5.5E-05
	(1.110404)	(2.10130)**	(0.83999)	(0.25665)
Household size	-18.8975	-732.309	-0.01675	-0.69683
	(-1.53017)	(-1.72184)	(-1.21223)	(-1.72184
R^2	0.962	0.982	0.859	0.815
F-value	15.621	19.059	17.278	12.114

Figures in parenthesis are t-values; ***= significant at 1% **= significant at 5%, * = significant at 10%

The coefficient for age (X_1) was significant at 1% and positively related to output of fish. This shows that age has a direct relationship to fish output in aquaculture farming, indicating that older fish farmers are more experienced in managing aquaculture business.

The coefficient of level of educational attainment (X_2) was significant at 1% and had a positive sign. This implies that an increase in number of years spent on acquiring formal education as denoted by level of educational attainment improves fish production. The coefficient of Farming experience (X_3) is 30792.5 and has a t-value of 4.626796. It is significant at 1%. This implies that an increase in the experience of the farmers in aquaculture business leads to an increased output of fish by the farmers. The coefficient for mode of farming (X_6); which describes whether a farmer is a full time or part time farmer was positively signed and significant at 5% level. This implies that output in aquaculture fish farming is higher when a farmer is operating on full time basis than on part time basis.

Profitability of Aquaculture Fish Farming in the Study Area

The determination of the profitability of any business enterprise always involves the consideration of the cost structure as well as the revenue accruable in the business. The overall cost structure of an average aquaculture fish farmer is as presented in Table 3. The total cost of production amounted to N294,207.15. Out of this amount, the total variable costs accounted for N288,297.82 or 97.99%, leaving only 2.01% to be shared by the fixed cost items. The findings of Stoneville (2005) and Nathan (2006) showed that the cost of cat fish feeds accounted for over 60% of the total cost of production. On a similar note, the result of this study revealed that cost of fish feed ranked highest with 79.43% of the total cost of production. By implication, fish feed is the major ingredient for aquaculture fish farming. This is distantly followed by labour (7.37%) and fish fingerlings (6.55%). This finding is also in agreement with Ugwumba (2011) who concluded that feed's cost represented 73.56% of the total

production cost of catfish in Anambra State of Nigeria.

Table 3: Summary of Cost Structure of an Average Aquaculture Fish Farmer

Variable	Costs (N)	Percentage
Variable Costs:		
Fingerlings	19,259.38	6.55
Feeds	233,687.50	79.43
Labour	21,687.50	7.37
Fuel	4,252.19	1.45
Water/Electricity	686.25	0.23
Transportation	7,106.25	2.42
Miscellaneous	1,618.75	0.50
Total Variable Costs (TVC)	**288,297.82**	**97.99**
Fixed Costs:		
Water pump/borehole	1,209.90	
Concrete /Earthen pond	1,397.50	
Farm structure	667.50	
Machinery/Equipment	478.18	
Interest on loans	2,156.25	
Total Fixed Cost (TFC)	**5,909.33**	**2.01**
Total Cost (TVC + TFC)	**294,207.15**	**100.00**

Enterprise Budget Analysis for Small Scale Aquaculture Fish Production

The enterprise budgeting analysis (Table 4) is one of the methods deployed to determine the profitability of aquaculture fish farming in the study area. The analysis as presented shows the total revenue (TR), total cost (TC), total variable cost (TVC), total fixed cost (TFC), gross margin (GM), net farm income (NFI), net return on investment (NROI). The average small scale aquaculture fish farmer generated gross revenue of N484,140.63 with gross margin of N195,922.82 and a net farm income of N190,013.48. Gross margin is the difference between total revenue and total variable cost, while net farm income is the difference between gross margin and total fixed cost and the outcome signifies the profitability of an enterprise.

Table 4: Profitability of an Average Aquaculture Fish Farmer

Variable	Amount (N)
Total Revenue	**484,140.63**
Variable Costs:	
Fingerlings	19,259.38
Feeds	233,687.50
Labour	21,687.50
Fuel	4,252.19
Water/Electricity	686.25
Transportation	7,106.25
Miscellaneous	1,618.75
Total Variable Costs (TVC)	**288,297.82**
Fixed Costs:	
Water pump/borehole	1,209.90
Concrete /Earthen pond	1,397.50
Farm structure	667.50
Machinery/Equipment	478.18
Interest on loans	2,156.25
Total Fixed Cost (TFC)	5,909.33
Total Cost (TVC + TFC)	294,207.15
Gross Margin GM (TR – TVC)	195,922.82
Net Farm Income NFI(GM – TFC)	190,013.48
Net Return on Investment NROI (NFI/TC)	0.65

A positive net farm income shows that an enterprise is a profitable one and it is worth continuing with while a negative net farm income signifies otherwise, that is, a loss and a business not worthy of emulation or one that requires total overhaul. Thus in the study area aquaculture fish farming having recorded a positive net farm income is a profitable one. The studies of Adeogun *et al* (2007) and Kudi *et al* (2008) as well as Ugwumba (2011) have catfish farming to be profitable in Lagos, Kaduna and Anambra states respectively.

Net return on investment (ROI) of an average small scale aquaculture fish farmer is 0.65. This means that on the average small scale aquaculture fish farming returned N0.65 for every N1.00 invested by the farmer during the production period in the study area.

CONCLUSION

The study analyzed aquaculture fish farming in Warri South and Burutu local governments of Delta State, Nigeria. The enterprise proved to be a profitable enterprise from the positive mean gross margin and mean net incomes recorded. Cost of feeds was the most sensitive cost item in aquaculture fish production. Maximum variable profit would be increased by the adoption of measures that would reduce the price of feed. The age of farmers, level of educational attainment, and farming experience as well as farming status were significant variables that affected output of aquaculture fish farmers in the study area. As aquaculture fish farming has been found to be a profitable enterprise, the Delta State government should increase the budgetary provisions to provide more funds through her already existing microfinance programme to accommodate more entrepreneurs interested in aquaculture fish farming. Through this way, more new investors will be attracted into aquaculture fish farming. This will ultimately lead to mopping up of the teaming unemployed youths in the State and making the State the hub of fish production in the country.

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