Economic Analysis of Fish Farming in Osun State, South-Western Nigeria

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ABSTRACT

Information on economic viability of aquaculture is crucial for investors when assessing the feasibility of an aquaculture investment. Unfortunately, such information has been scarce in Nigeria. The economic analysis of fish farming in Osun State, South-Western Nigeria was therefore carried out using data collected from seventy two randomly selected fish farms. Data were analyzed using descriptive statistics, costs and returns, as well as multiple regression analysis. The relationship between fish output and five inputs: feed, fertilizer, lime, labour and fingerlings were measured using Cobb-Douglass production model. Results suggest that a unit increase in fertilizer application contributed 46 percent increase to the profitability of the fish farms and this was significant at $p<0.01$. Also, labour was significant at $p<0.05$ as the results suggest that a unit increase in labour contributed 60 per cent increase to the profitability of the fish farms. The model explained 81% of the variation in total output. On the whole, fish farming was found to be profitable with a benefit-cost ratio of 1.65 and profit–cost ratio of 0.65. It is recommended that fish farmers in the study area should increase their use of feed, lime and fingerlings and decrease their use of fertilizer and labour.

Data on the socio-economic characteristics of farmers revealed that most fish farmers (58.3%) in the State were males, aged between 31-50 years old. About 91.7% of fish farmers were married and 95.8% had formal education. About 86.1% owned land either by inheritance or purchase, 8.3% operated on leased land and 5.6% rented the land upon which they operated. About 75% of the respondents got their capital from personal savings, 11.1% from cooperatives, and only 5.6% had access to bank loans. About 52.8% were regularly visited by extension agents 16.7% were occasionally visited while 30.5% were seldom visited. Only 27.8% belonged to farmers' association.

Keywords: Economic analysis, Aquaculture, Fish farming, Cobb-Douglass model, Nigeria.
Number of words: 302.

Introduction

The increase in human population and reports of large numbers of undernourished or starving people, especially in the developing countries, have made the need for food production a major worldwide issue of concern (Okechi, 2004). There are three main groups of activities that contribute to food production: agriculture, aquaculture and fisheries. Recent knowledge shows that the world's natural stocks of fish and

shell fish, though renewable, have finite production limits, which cannot be exceeded even under the best management regimes (Okechi, 2004). The increasing in population coupled with the decline in the world's major wild fisheries has led to an increase in demand for aquatic foods. Increasing demand for fish products has resulted in the growth of fish farms worldwide to meet a substantial part of the world's food requirement, of which China contributes a major portion. Nigeria is one of the countries in Sub-Saharan Africa with great potential to attain sustainable fish production, via aquaculture considering extensive mangrove ecosystem available in the country (FAO 2005).

Fish farming provides important services including supporting nutritional well-being, providing feedstock for the industrial sector, making contributions to rural development, increasing export opportunities, more effective administration of natural resources and conservation of biological diversity (Dağtekin *et al.,* 2007). Fish culture is an efficient means of animal protein production. It provides essential nutrition for over one billion people, including at least 50 percent of animal protein for 400 million people from the poorest countries (WBG, 2011). According to Ayinla (2009) the most reliable source of protein for many people in the developing economies is and must continue to be fish. Fish farming provides important services including supporting nutritional well-being, providing feedstock for the industrial sector, making contributions to rural development, increasing export opportunities, more effective administration of natural resources and conservation of biological diversity. Aquaculture is an agricultural activity competing with livestock and other crops for the same basic inputs- land, water, labour, nutrients, management etc. (FAO, 1984) and it is currently one of the fastest growing food production systems in the world (Albert 1996, FAO 2009). This is due in part to the fact that biologists have focused and are continuing to focus on ways to overcome constraints and/or intensify traditional system.

However, in spite of this ever increasing biological activity, inadequate attention has been devoted to the viability of the business itself. According to Mwangi (2007) aquaculture production involves more than the biological processes of fish growth. It also includes paying critical attention to the financial aspects of the production. Efficient financial management of aquaculture can make the difference between profits and losses. The poor regard of aquaculture as an economic activity has made it difficult to promote its commercialisation, as investors were not convinced that aquaculture could be a profitable enterprise (Gitonga *et al.* 2004). Lack of economic information on the feasibility of aquaculture has adverse effects. It affects decision making when evaluating possible investment options, accessibility to financing needed for investment and it makes insurance of such investments difficult (Pillay and Kutty 2005). These factors will impact negatively on aquaculture investment and therefore development (Mwangi, 2007).

Smith and Peterson (1982) reported that aquaculture profitability is commonly measured through an analysis of the costs and revenues of the enterprise. Engle and Hatch (1986) and Hatch and Engle (1987) used financial analytical techniques to show that Panama's resource-limited farmers benefited from the adoption of fish farming. Through the development of enterprise budgets, Hishamunda and Moehl (1989) demonstrated that Rwandan aquaculture, in correctly managed ponds, is a profitable activity that competes favorably with red bean, sweet potato, and rice production. Moehl (1993) used enterprise budgets to compare the profitability of four levels of fish production in Rwanda.
This paper examines the economic analysis of fish farming in Osun State South-Western Nigeria with a view to determine its viability or otherwise.

Methodology

The study area

This study was carried out in Osun State, South-Western Nigeria. The state lies within latitudes 6^{o} and 9^{o} N of the equator and approximately between longitudes 2^{o} and 7^{o} E of Greenwich meridian (Anamayi, *et al.,* 2010). It is one of the land-locked states of the Federal Republic of Nigeria. It covers an estimated area of 8,062 square kilometres (Olasunkanmi *et al.*, 2012). The State runs an agrarian economy with a vast majority of the populace taking to farming. The state is a typical rain forest with mean annual rainfall varying between 880mm and 2600mm (CBN, 2000) and is characterized by the forest vegetation. It is limited to freshwater fisheries (Macmillan, 1992). Osun state, according to the state Department of fisheries is divided into six fisheries zones with a total of over one hundred fish farms (Personal Communication).

Data collection and analysis

Seventy two fish farms were randomly selected using the method described by Olawumi *et al,*. 2010 from the six fisheries zones of the state. Structured questionnaire were administered to the fish farmers and data on social and economic characteristics of their operations were collected.

Data were analyzed using descriptive statistics, profit analysis, benefit-cost ratio analysis, resource use efficiency, as well as multiple regression analysis (Lee, 1997).

In profit analysis,

$\pi = TR - TC$

Where

π = profit which is positive otherwise loss

TR = total revenue (calculated from total fish output (kg) x unit price (in Nigerian Naira (₦))

TC = total cost (calculated from summation of total variable cost and total fixed cost in ₦).

The Benefit-cost ratio analysis was measured using

$ROR = TR/TC$

Where

ROR = Benefit-cost ratio

TR = total revenue (calculated from total fish output (kg) x unit price (in Nigerian Naira (₦))

TC = total cost (calculated from summation of total variable cost and total fixed cost in ₦).

ROR must be greater than 1 for the investment to be worthwhile.

The relationship between fish output and five inputs: feed, fertilizer, lime, labour and fingerlings were measured using Cobb-Douglass production model (Shu'aib *et al., 2010*). In the Cobb-Douglass model, the dependent variable (Y) is related to the independent variables X_1, $X_{2...}$ $X_{5,}$ by

$Y = AX_1^{ß_1} X_2^{ß_2} X_3^{ß_3} X_4^{ß_4} X_5^{ß_5}$. This was linearized by taking log of the equation to become:

$\text{Log } A = ß_1 \log X_1 + ß_2 \log X_2 + ß_3 \log X_3 + ß_4 \log X_4 + ß_5 \log X_5$

Where

A is a constant term

Y is the total fish output in kg

X_1 = quantity of feed used in kg/ culture time

X_2 = quantity of fertilizer used in kg

X_3 = quantity of lime used in kg

X_4 = labour in man-hour

X_5 = number of fingerlings stocked

$ß_{1...}$ $ß_5$ = regression coefficients

The production function exhibits increasing, decreasing or contract return to scale as

$ß_1 + ß_2 + ß_3 + ß_4 + ß_5 > \mathbf{1,}$ $ß_1 + ß_2 + ß_3 + ß_4 + ß_5 < 1$ or $ß_1 + ß_2 + ß_3 + ß_4 + ß_5 = 1$ respectively

Results and Discussion

Table 1 shows the socio-economic characteristics of fish farmers in Osun State. The mean age of fish farmers was 40 years. This finding agrees with the work of Fakoya and Daramola (2008) who reported that the mean age of fish farmers in Ogun State of Nigeria was 42.9 and that of El-Naggar *et al* (2010) who found out that the average age of fish farmers in Egypt was 43 years. The age bracket 31-50 years is usually innovative, motivated and adaptive individuals (Yunusa, 1999). By implication, most of these farmers are still in their active age and therefore, have the tendency to be more productive in fish farming in the study area (Olasunkanmi *et al*. 2012). Only few women (8.3%) were involved in fish farming in the state. Veliu *et al.,* (2009) reported that women were not major players in agricultural production in the northern part of Nigeria. There is therefore the need for extension services that will encourage more women to be involved in fish farming so that similar mistake made in Chibote, Zambia where, according

to Mbozi, (1991), fish farming was seen as an activity for male youth will not occur in the state. This could be by way of organizing skill trainings in aquaculture for them as observed by Pillay (1977) that successful aquaculture calls for higher personal attention and specific levels of skills. Meanwhile, women are often motivated than men to adopt new technologies that provide nutritional benefit such as fish farming. Werby (2001) and Moehi (2003) reported that it is well acknowledged that women are key players in Africa's agricultural sector and that their participation is critical to achieving food security and economic well being. Generally, fish farmers in Osun State Nigeria, are well educated (52.8% having tertiary education) and were mostly married (97.2%). Good education is believed to enhance innovation as well as enhance proper documentation in farm business (Olasunkanmi *et al.*, 2012). Most farmers (86.1%) owned the land on which they operated. About 75% of the farmers were able to raise their capital from personal savings and only 5.6% had access to bank loans. Most of the fish farmers (72.2%) did not belong to any fish farmers association. The fish farmers were confronted with one problem or the other and most of the farmers identified more than one problem (Table 2). The most important problem identified in this study is that of cost of feed (66.7%). However, marketing fish produced was not a serious problem as only 5.6% of the farmers indicated that they had problem with it.

It is therefore recommended that fish farmers should join any of the existing fish farmers associations and form cooperatives in order to strengthen their financial capabilities so that they could access funds (through this means) from financial institutions which prefer to deal with body corporate than private individuals.

The benefit-cost ratio for fish production in the state was found to be 1.652874 while profit analysis showed that fish farming was profitable with a profit margin of ₦1,596,603.00. Investment in fish farming is therefore worthwhile.

The Cobb-Douglass production model revealed that the effects of fertilizer and labour were significant at 1% ($p<0.01$) while the effects of fingerlings were significant at 5% ($p<0.05$) (Table 2). The effects of feed and lime were not significant at any level. The coefficient of determination (R^2) was about 0.81 which means that 81% of the output is explained by the estimated model. This is significant and it agrees with the findings of Chong and Lizarondo (1982) on input-output relationship of Philippine milkfish aquaculture and that of Olawumi *et al.* (2010) on homestead fish pond in Ogun State, Nigeria. The summation of all the production coefficients for the function is greater than 1 meaning an increasing return to scale. Thus, if all the inputs specified in the function are increased by a certain percentage, fish production will increase by a larger proportion.

The input-output ratio for feed, fertilizer, lime, labour and fingerlings were 0.1333, 0.5556. 0.2778, 0.081 and 0.0278 respectively and the values of Marginal Physical Product (MPP) for each of them are 2897.647264, -1873.840435, 51746.85119 and -621.3052456 respectively. None of the resources measured was efficiently used: whereas some of them were under-utilised others were over-utilised. If farmers in the state could increase their use of feed, lime and fingerlings, there could be an increase in the quantity of fish produced in the state. Conversely, the quantity of fertilizer and labour invested in fish production in the state is not justified by the quantity of fish produced. Thus, a lesser investment in these

resources could equally bring about equal or similar results. This observation corroborates the

Table 1: Socio-economic Characteristics of Fish Farmers in Osun State

	Range/Classification	Frequency	Percent (%)	Cumulative percentage
Age (years)	Below 20	0	0	0
	21-30	8	11.1	11.1
	31-40	26	38.9	50.0
	41-50	16	22.2	72.2
	51-60	14	16.7	88.9
	Above 60	8	11.1	100.0
	Total	72	100	
Sex	Male	66	91.7	91.7
	Female	6	8.3	100
	Total	72	100	
Education	Non-formal	3	4.2	4.2
	Primary	6	8.3	12.5
	Secondary	25	34.7	47.2
	Tertiary	38	52.8	100
	Total	72	100	
Marital status	Single	2	2.8	2.8
	Married	70	97.2	100
Source of capital	Personal savings	54	75	75
	Relatives and friends	4	5.5	80.5
	Cooperative society	8	11.1	91.6
	Bank loan	4	5.6	97.2
	Loans from individuals	2	2.8	100
	Total	72	100	
Membership of farmers' association	Yes	20	27.8	27.8
	No	52	72.2	100
	Total	72	100	
Experience in fish Farming	Less than 5 years	18	52.8	52.8
	5-10 years	26	36.1	61.1
	More than 10 years	28	38.9	100
	Total	72	100	

Table 2: Problems encountered by Fish Farmers in Osun State

Problem	No of Farmers	%
Cost of Feed	24	66.7
Predators	17	47.2
Theft	16	44.4
Labour	16	44.4
Scarcity of fingerlings	14	38.9
Transportation	8	22.2
Marketing	2	5.6

Table 3: Summary of Regression Analysis Results

Functional forms	Constant Terms	Regression Coefficients						
		X_1	X_2	X_3	X_4	X_5	R^2	F
Double log	-2.843276	-0.044439 (-0.321808)	*** 0.459320 (3.926748)	-0..223508 (-1.382339)	*** 0.624396 (3.766413)	** 0.380988 (2.130685)	0.81	27.081
Semi-log	-12859.39	-534.7353 (-1.605664)	263.5120 (0.9334115)	-154.9085 (0.934115)	1462.178 (-0397264)	*** 782.9714 (3.657215)	0.63	10.526
Linear	-165.5363	-0.262413 (-1.087759)	-8.289701 (-2.921331)	-82.289701 (-2921331)	*** 0.329699 (3.519480)	*** 0.138611 (4.281117)	0.84	33.739
Exponential	4.924719	* 0.000352 (1.750785)	0.001285 (2.397066)	-0.003685 (-1.558833)	9.08×10^{-5} (1.163905)	2.02×10^{-5} (0.749618)	0.69	10.809

( ) = t-statstic

* significant at 10% ($p<0.1$)

** significant at 5% ($p<0.05$)

***significant at 1% ($p<0.01$)

Conclusion

There is a wide acceptance of fish farming in Osun State, Nigeria and the fish farmers are in their active age brackets but few women were involved. The fish farmers needed to be encouraged to join fish farmers associations like Catfish Farmers Association of Nigeria (CAFAN) and form cooperatives in order to improve their financial base for fish farming business. Since the study revealed that fish farming in the state is profitable, the government should encourage more people to invest in it by making inputs used in farming available to farmers at subsidized price and by creating awareness through the use of extension agents on both television and radio programmes, and the print media such as the daily newspapers.

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Figure 1: Map of Nigeria showing Osun State