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Profitability of Catfish Production in JOS Metropolis of Plateau State, Nigeria: A Profit Function Approach

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Abstract: The study examined the profitability of catfish production in JOS metropolis of Plateau state, Nigeria. Primary data were obtained from 60 respondents drawn from the list of members of catfish farmers association using simple random sampling technique. Data were analysed using net farm income and profit function models. Results showed that the average returns per farm of 1000 fish capacity was 246,343 per production cycle while the returns per naira invested was 2.3 times. The profit function analysis revealed that 83% of the variation in maximum variable profit was explained by the combined effects of the variable costs in the function. The t-statistics indicated that with the exception of labour, all other variable costs were positively significant in influencing profit, although the cost of drugs and veterinary care showed a negative significant relationship. The study recommends the investigation of the alleged detrimental effect of cold weather on fish growth and development in the study area by the National Institute for Fresh Water fisheries research with a view to advising the farmers appropriately.

Key words: Catfish production, profitability, net farm income, profit function, labour, Nigeria

INTRODUCTION

Inadequate supply of animal protein in Nigeria is due to the failure to expand fishery and livestock production (Arene, 2002). Out of 35 g of animal protein/day/person recommended by FAO (1991), <7 g is consumed on the average. Regrettably, Nigeria has become one of the largest importers of fish in the developing world, importing some 600,000 metric ton annually to solve the country's high demand for fish (Olagunju *et al*., 2007). In view of the limitations of production factors such as low grain production, diseases and other constraints to the production of livestock such as cattle, pig and poultry, it seems that the greatest opportunity lies with the exploration of increased production of catfish in the study area and its environs, since there is a thriving market both in the study area and the nearby federal capital territory, Abuja. Catfish farming had evolved as an alternative means of making fish available to man since quality and quantity of fish in the wild has been compromised by over fishing (Olakunle, 2002).

According to FAO (2003), fish is one of the best sources of protein because of its balanced amino acids and low cholesterol level and that animal protein that is needed for growth, especially among children has been in short supply. Consequently to enhance increased production of catfish in the study area, it becomes imperative to investigate catfish enterprise profitability as the result will help both those already in the business and prospective investors to make up their minds. The specific objectives of this study were to:

- Determine the profitability of catfish farming enterprises in the study area
- Estimate a profit function for catfish production in the study area
- Identify problems confronting the respondents in the area

MATERIALS AND METHODS

The study was conducted in JOS and Bukuru towns in Jos North and Jos South local government areas of Plateau state, Nigeria in March, 2010. The area has a population of 737,016 (National Population Commission, 2006). The area was selected because of the preponderance of new entrants into catfish production as well as the uniqueness of the climatic conditions characterized by relatively cool temperatures almost all year round.

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Sampling and data collection: The sample frame comprised all the catfish farmers belonging to the catfish farmers association in Jos North and Jos South local government areas. The sample size comprised 60 farmers; 30 each from each LGA. Reconnaissance survey was carried out to identify the farmers, know the nature of their inputs, outputs and problems encountered. A set of questionnaire was designed and administered to elicit information on household characteristics, farming experience, inputs and income from sale of table size catfish, sale of fry, fingerlings as well as value of fish consumed at home and that given out as gifts.

Analytical model: The generalized profit function was used to estimate the profitability levels of resource input in catfish enterprises. These inputs include variable inputs such as fingerlings, feed, labour, water, medications and fixed input such as ponds, concrete tanks and pumping machine. The use of the profit function was because of its importance in diagnostic analysis showing marginal resource profitability at mean levels on input price.

Following Sankhayan (1998) and Arene (2002), the linear profit function analytical model is as follows; let there be a production function where m variable inputs, $X_1, X_2..., X_m$; $Z_1, Z_2..., Z_n$ are related to output Y as follows:

$$Y = f(X_1, X_2..., X_m; Z_1, Z_2,..., Z_n) \quad (1)$$

In the short-run, the opportunity cost of the fixed input is zero. Therefore, the producer needs only to maximize the returns to variable inputs that is the sales value of output less the cost of the variable input called variable costs. The resulting returns also called the variable profits (Π) to variable inputs in respect of the production function given by Eq. 1 can thus be written as:

$$\Pi = P_y f(X_1, X_2,..., X_m; Z_1, Z_2,..., Z_n) - \sum_{i=1}^{m} P_i X_i \quad (2)$$

Where P_y is the price of output and P_i is the per unit price of the ith variable inputs, i = 1, 2,..., m. For maximization of Π in the short-run, take the 1st order partial derivatives with respect to the variable inputs and equate them to zero each. Thus, the partial derivative from Eq. 2 with respect to X_i, i = 1, 2...., m, equated to zero is given by:

$$\frac{\delta \pi}{\delta x_1} = P_y f_i = P_i \quad (3)$$

Where f_i denotes the first order partial derivative with respect to the ith input. Since from Eq. 1, $f(X_1, X_2,..., m; Z_1, Z_2..., Z_n)$ is equal to Y_1 (Eq. 3) can also be written as:

$$P_y \frac{\delta y}{\delta x_1} = P_i \text{ or } \frac{\delta y}{\delta x_1} = \frac{P_i}{Py}, \; i = 1, 2,....n \quad (4)$$

There would thus be m simultaneous equations in m unknown which can be solved to obtain the optimum input quantities, X_i, i = 1, 2..., m, given by:

$$X_1^* = X_i^*(P_y, P_1, P_2,..., P_m; Z_1, Z_2,..., Z_n)(i = 1,2,...,m) \quad (5)$$

Relation (Eq. 5) gives the demand function for the ith variable input. Substituting the demand function given by Eq. 5 and 2, what it results to is given as:

$$\Pi^* = P, f(X_1^*, X_2^*,..., X_m^*; Z_1, Z_2,..., Z_n) = \sum_{i=1}^{m} P_i X_1^* \quad (6)$$

Where X^* (i = 1, 2, ..., m) is the optimum quantity of the ith variable input and Π^* corresponds to the amount of maximum variable profits. Obviously therefore, Π^* in Eq. 6 is expressed as a function of the prices of output and variable inputs and the fixed input quantities. Thus:

$$\Pi^* = \Pi^*(P_y, P_1, P_2,..., P_m; Z_1, Z_2,..., Z_n) \quad (7)$$

gives the profit function.

Net Farm Income (NFI): NFI was employed to estimate the profitability of the average farmer:

$$NFI = TR - TC$$

where, TR is total revenue (₦) which constitute; sales from table size fish, naira value of home consumed fish and naira value of fish given out as gift:

TC (Total Cost) = TFC + TVC. TFC = a+b+c

Where:

a = Depreciation on pond

b = Depreciation on tanks/containers

c = Depreciation on pumping machine

TVC = a+b+c+d+e

Where:

a = Cost of fingerlings

b = Cost of feed

c = Cost of labour

d = Treatment

e = Cost of water

Returns per naira invested was calculated as TR/TC.

RESULTS AND DISCUSSION

Profit function analysis: The generalized profit function model used was as follows:

$$\Pi^* = \Pi^*\left(P_y, P_1, P_2, P_3, P_4; Z_1, Z_2\right)$$

Where:

Π^* = Amount of maximum variable profits (₦)
P_y = Price of output (₦)
P_1 = Per unit price of feeds (₦)
P_2 = Per unit price of fingerlings (₦)
P_3 = Per unit price of drugs/veterinary care (₦)
P_4 = Per unit cost of labour (₦)
Z_1 = Value of tanks/ponds/containers (₦)
Z_2 = Value of pumping machine (₦)

The resultant model shown in Table 1 revealed that:

$$\Pi^* = 32.667, P_y^{44.332} P_1^{80.019}, P_2^{7.140}, P_3^{23.055}, P_4^{-50.197} Z_1 Z_2$$

$$t = (3.29)^{***} (2.5337)^{**} (6.120)^{***} (1.859)^{*} (0.43)^{NS} (-1.646)^{*}$$

where, $R^2 = 0.8258$; $F = 26.082$; df = 59; *,**,***Significant at 1, 5 and 10%, respectively; NS: Not Significant. Note that Z_1 and Z_2 are fixed costs and are therefore not analysed since the analysis is based on the short-run effect of input costs (Arene, 2002).

Table 1 shows that the combined effects of the variable cost in the function explained 83% of the variation in maximum variable profit. The t-statistics indicated that with the exception of labour, all other variable costs were positively significant in influencing profit, although the cost of drugs and veterinary care showed a negative significant relationship. The reason why the labour variable showed insignificant relationship may not be unconnected with fact that catfish farming is not too labour intensive (Adegoke, 2000). The implication of this result is that the farmers are making profits in the rational area of the profit function using all the variable cost items. The Net Farm Income (NFI) (Table 2) estimated the costs and returns on 1000 fish for an average farmer in the immediate past production cycle in the study area. An average farmer invested ₦195,727 of which feed constituted 59% of the total cost of production. Rana (2005) had noted that feed is the most important single cost item associated with catfish production due to ever increasing cost of fish feed ingredients such as maize, wheat offal, premix and others. Total revenue amounted to ₦442,070. Interestingly, the net farm income was a robust figure of ₦246,343 and the return per naira invested was 2.3 times showing that catfish production is a rewarding venture in the study area. An analysis of the problems confronting the farmers (Table 3) revealed that high cost of feed, unfavourable cold weather conditions and poor marketing infrastructure in that order were affecting the farmers.

Table 1: Generalized profit function model output for catfish production

Variable	Coefficient	SE	t-value
Constant	32.667	9.99	3.29***
Price of output	44.332	17.472	2.5337**
Unit price of feed	80.019	13.076	6.120***
Unit price of fingerlings	7.140	3.841	1.859*
Unit price of labour	23.055	52.168	0.43^{NS}
Drugs/vet care	-50.197	30.490	-1.646*

R^2 = 0.8258; F = 26.082; df = 59; SE = Standard Error; ***,**,*Significant at 1, 5 and 10% respectively

Table 2: Average costs and returns of catfish productions per farmer/1000 fish capacity

Items/variables	Values (₦)
Revenue	
Sales from fish	417,600.0
Home consumed	16240.0
Gifts of fish to friends/relatives	8230.0
Total Revenue (TR)	442,070.0
Costs	
Fingerlings	44170.0
Feed	115177.0
Water bill	9000.0
Labour	11,190.0
Drugs	8223.0
Depreciation on pumping machine	2400.0
Depreciation on concrete tank	3160.0
Depreciation on plastic container/tank	2407.0
Total cost of production	195727.0
Net income	246,343.0
Returns per naira invested	2.3

Researchers calculations from survey data; US$1 = ₦140

Table 3: Problems facing the fish farmers*

Problems	Frequency	Percentage
Water supply	21	35
High cost of feed	53	88
Cold weather conditions	50	83
Poor marketing infrastructure	40	67

Field Survey, 2010; *Multiple responses were allowed

CONCLUSION

The study revealed that catfish production is profitable and that variable costs have positive significant influence on total profits.

RECOMMENDATIONS

Considering the potential and advantages of catfish enterprise in the study area, concerted efforts should be geared towards assisting the farmers in tackling their production problems. In this regard, the Nigerian institute for fresh water fisheries research should investigate the cold weather negative influence issue and proffer solution to the farmers. Secondly, since feed constituted almost 60% of total variable costs, efforts should be

geared towards reducing the cost of feeds as this will help increase the profitability level of the enterprise.

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