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# The Economics of Catfish Production in Anambra State, Nigeria: A Profit Function Approach

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## ABSTRACT

The study which was conducted in Anambra State, Nigeria, assessed the profitability of catfish farming without neglecting constraints that could retard profitability. It utilized non-parametric statistics, enterprise budgeting and the profit function model in data analysis. Data were obtained from 204 farmers selected via multistage random sampling technique. Results indicated mean gross margin of ₦ 734,850.39, mean net farm income of ₦712,659.89 and net return on investment of 0.61, implying that catfish farming is profitable in the study area. Furthermore, cost of catfish feeds and production unit negatively and significantly influenced profit, while output price exerted a positive and significant influence on profit. Profitability could be increased by tailoring policies towards the setting up of commercial pelleted and floating catfish feed mill and modern hatcheries in the State, the provision of adequate infrastructure, cheap and available credit facilities and expansion of extension services. These would go a long way to solving the most serious constraints to catfish production in the study area - high cost of feeds, lack of quality fingerlings and inadequate capital. 

**Key Words:** Catfish farming; Enterprise budgeting; Profit function; Constraints to catfish production

## INTRODUCTION

The growth of a country's population is usually accompanied by increases in the demands for the basic necessities of life including water, food and shelter. This is the case with the unrestricted increases in the demand for protein rich food items of animal origin especially. The Food and Agriculture Organization (FAO, 1991), recommended that an individual takes 35 grams per caput of animal protein per day for sustainable growth and development. However, the animal protein consumption in Nigeria is less than 8 g per person per day, which is a far cry from the FAO minimum recommendation (Niang & Jubrin, 2001). The major animal protein sources in the country include cattle, goats, sheep, poultry and fish. Out of these sources fish and fish products provide more than 60% of the total protein intakes in adults especially in the rural areas (Adekoya, 2004). Therefore, the importance of the fishing industry to the sustainability of animal protein supply in the country cannot be over-emphasized.

Regrettably, the supply of food fish has been on the decline. This is due to consistent declines from the country's major source of food fish, the artisanal fisheries, from 90% in 1990 (Tobor, 1990) down to 40% in 2006 resulting to about 300,000 metric tonnes (Global Agriculture Information Network GAIN, 2007). Currently, domestic fish production is put at 551,700 metric tonnes as against the present national demand of about 1.5 million metric tonnes estimated for 2007 (Osawe, 2007). The shortfall is said to be bridged by the importation of 680,000 metric tonnes annually consuming about ₦ 50 billion in foreign exchange (Odukwe, 2007). It has been asserted by Adediran (2002) and Ugwumba (2005) that the only way of boosting fish production and thereby move the country towards self-sufficiency in fish production is by embarking on fish farming especially catfish farming. This has prompted the Federal Government of Nigeria to package the Presidential Initiative on fisheries and aquaculture development in 2003 to provide financial and technical assistance to government programmes and projects encouraging fish production. Similarly, the Anambra State government initiated an agricultural microcredit support scheme with fisheries bais in order to compliment the Federal Government effort.

Regardless these efforts of Government, fish production has remained low in the country as well as in Anambra State. This has been attributed to inadequate supplies from the local catfish farmers due to the use of poor quality catfish seeds, inadequate information, high cost of feeds, traditional techniques, small size of holdings, poor infrastructural facilities and low capital investment (Ugwumba *et al*., 2006; Adeogun, 2007; Ugwumba & Nnabuife, 2008). Greater improvement in catfish production can be achieved with a proper analysis that will lead to knowledge of the level of profitability of catfish farming and constraints to production which constitute the basis for this study.

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## MATERIALS AND METHODS

Anambra State is one of the 36 States that make up the Federal Republic of Nigeria. It occupies an area of 4,416 $km^2$, 70% of which is arable land. The State is made up of 21 Local Government Areas (L.G.A.s). Six LGAs that shared boundaries with the Anambra-Niger river complex banks were purposely dropped. This is because they are noted for artisanal activities and lacked observable evidence of serious catfish farming. A multistage random sampling technique was used to select 256 catfish farmers for the study, however, 204 of them returned useful questionnaires. The multistage random sampling method involved sampling 8 LGAs out of the remaining 15 LGAs, 4 communities from each of the 8 LGAs and then 8 farmers from each of the 4 communities to arrive at the 256 respondents. Data collection was through primary sources using interview instruments, observations and memory recall. Data collection was for a production period of 12 months and in this case January to December, 2009.

Data were collected on socio-economic characteristics of the farmers, production units (concrete or earthen pond), production system (intensive or semi-intensive feeding system), water supply system (flow-through or stagnant), output and inputs (i.e., farm size (number of fingerlings stocked), farm area, labor, capital & catfish feeds) figures. Data collected were analyzed by means of non-parametric statistics, enterprise budgeting technique and the normalized profit function model. The enterprise budgeting technique used to assess the profitability of the catfish farming enterprise is as given below:

Gross margin (GM) = TR – TVC……(1)
NFI = GM –TFC OR TR - TC…….(2)
NROI = NFI / TC……..(3).

Where:
GM = Gross margin
TR = Total revenue
TVC = Total variable cost
NFI = Net farm income
TC = Total cost
TFC = Total fixed cost
NROI = Net returns on investment.

The Profit Function Analysis was also used to test the effect of prices of individual resource inputs and socio-economic variables on maximum variable profit (Arene, 2002). The profit function model is explicitly specified as follows:

$$\Pi^* = \beta_0 + \beta_1 PPO + \beta_2 PPS + \beta_3 PPF + \beta_4 PPL + \beta_5 PPD + \beta_6 AGE + \beta_7 EDU + \beta_8 EXP + \beta_9 HOS + \beta_{10} PDU + e \ldots\ldots (4)$$

Where:
$\Pi^*$ = amount of maximum variable profit (₦)
PPO = price of output (₦)
PPS = per unit price of catfish seed (₦)
PPF = per unit price of catfish feed (₦)
PPL = per unit price of labor (₦)
PPD = per unit price of fuel (₦)
AGE = farmer's age in years
EDU = farmer's educational level in years
EXP = farmer's farming experience in years
HOS = farmer's household size in units
PDU = production unit (Dummy: concrete=1, earthen=0)
Beta 0 to Beta 10= parameters to be estimated
e = stochastic error term

## RESULTS AND DISCUSSION

**Cost structure for the catfish farms:** The catfish farmers incurred several costs in the course of catfish production. In the short run, these costs include both variable and fixed costs of production. The variable costs involved in catfish production as articulated by Ocmer (2006), Phonekhampheng (2006), Ugwumba (2005), Ugwumba and Nnabuife (2008) include catfish seeds (fingerlings), catfish feeds, labor, fuel, water, electricity, transportation and miscellaneous costs. The fixed cost items are made up of depreciation values of water pumps (electric or fuel), borehole, concrete pond, earthen pond, farm structure, machinery and equipments and interest on loans.

The overall cost structure for the catfish farmers is presented in Table I. The total cost of production for all the farms amounted to ₦236,470,732. Out of this amount, the total variable costs accounted for ₦231, 903, 860 or 98.06%, leaving only 1.91% to be shared by the fixed cost items. Again, cost of feeds alone constituted about 73.56% of this total cost figure, corroborating the findings of Stoneville (2005), Nathan (2006), Ugwumba *et al*. (2006) that cost of catfish feeds accounted for over 60% of the total cost of production. By implication, catfish feed stands as the major ingredient required for catfish farming. This is distantly followed by labor costs13.07%, while the least is the cost of water/electricity 0.38%. This finding is also in tandem with Gamel *et al*. (2006) who concluded that feed costs represented 68.9% of the total production costs of fish in the Behera Government of Egypt.

**Enterprise budgeting analysis for catfish farms:** The enterprise budgeting analysis was one of the methods deployed to determine the profitability of catfish production in the study area. The analysis indicating total cost (TC), total revenue (TR), total variable cost (TVC), total fixed cost (TFC), gross margin (GM), net farm income (NFI), net return on investment NROI) are presented in Table I below.

The farms generated total gross margin of ₦149,909,480 and net farm income of ₦145,382,618 during the production period. Gross margin is the difference between TR and TVC, while net farm income is the difference between GM and TFC and the outcome signifies the profitability of an enterprise. A positive NFI shows that an enterprise is a profitable one and worth continuing with.

A negative NFI signifies otherwise, that is, a loss and a business not worthy of emulation or one that requires a total overhaul. Thus, in the study area catfish farming having recorded a positive NFI is a profitable one. Catfish farming has equally been adjudged a profitable venture in the studies conducted in, Lagos, Oyo and Kaduna States of Nigeria (Adeogun *et al*., 2007); Olagunju *et al.* (2007) and Kudi *et al.* (2008). In addition, net returns on investment was 0.61 for the farmers, indicating that they returned on the average ₦0.61 for every ₦1.00 naira invested in the business, thus further confirming the profitability of catfish production in the study area.

**Profitability of catfish production: The profit function analysis:** The profit function is used to estimate the contributions of prices of individual resource inputs and output as well as the effects of socio-economic factors on maximum variable profit MVP (Sankhayan, 1998). The variables used in this study include per unit price of output (PPO), per unit price of seeds (PPS), per unit price of feeds (PPF), per unit price of labor (PPL), per unit price of diesel (PPD). Others are the socio-economic factors including age (AGE), education (EDU), experience (EXP), household size (HOS) and production unit (PDU). Details about results of the analysis are presented in Table II.

It could be observed from the table that the coefficient of output price is positive in according with a priori expectations. It is also statistically significant at 5% level of probability. This suggests that high output price would enhance income and profit of catfish production.

The coefficient of per unit price of feeds is statistically significant at 5% level (T = 8.03, P = 0.000) and negative. This result is in consonance with a priori expectations and implies that high cost of catfish feeds would lead to large increases in total cost of production and drastic reduction in revenue and net farm income (profit). The result of cost analysis for this study (Table II) indicated that cost of feed alone accounted for 73.56% of total cost of farming catfish and further confirms the above claim.

Production unit is negatively correlated with maximum variable profit and significant at 5% level of probability. This is in accordance with a priori expectations. It implies that what matters in catfish production is not pond type (concrete or earthen) per say, but stock size, intensive feeding and sound management practices.

Per unit price of catfish seed, per unit price of labor, age and experience had positive relationship with maximum variable profit as expected. However, their effects on it were insignificant. This implies that, though prices of catfish seed and labour had positive effects on maximum variable profit, the variables should be engaged at a level that is cost effective.

Others such as per unit price pf diesel, education and household size had negative relationship with maximum variable profit and insignificant at 5% level of probability. This is contrary to a priori expectations. Education and household size have been proved to have positive relationship with output, income and profit (Nwaru, 2005; Chukwuji, 2006; Giroh & Adebayo, 2007).

The F-ratio was statistically significant at 5% level of probability. This implied that the independent variables had good impact on the dependent variable and thus the estimated profit function is adequate and can be used for further analysis. More so, the Durbin-Watson statistic value of 1.92 shows evidence of absence of positive autocorrelation and brings to rest the problem of multicollinearity. The R-sq and R-sq (adj) values of 38.1%

**Table I: Estimated cost and benefits for the catfish farms (₦)**

| Variable | All farms | Percentage |
|---|---|---|
| Total Revenue: VC | 381,813,350 | |
| Catfish seeds | 12,178,300 | 5.29 |
| Catfish feeds | 173,968,650 | 73.56 |
| Labor | 30,925,400 | 13.07 |
| Fuel | 3,229,800 | 1.36 |
| Water/electricity | 915,300 | 0.38 |
| Transportation | 7,391,150 | 3.12 |
| Miscellaneous | 3,295,270 | 1.39 |
| TVC: | 231,903,870 | 98.06 |
| TFC | 4,526,862 | 1.91 |
| TC (TVC+TFC): | 236,430,732 | 100.00 |
| GM (TR-TVC): | 149,909,480 | |
| NFI(GM-TFC): | 145,382,618 | |
| NROI(NFI/TC): | 0.61 | |

**Table II: The profit function analysis**

| Predictors | Coefficient | SD | T | P |
|---|---|---|---|---|
| Constant | 24.01 | 47.08 | 0.51 | 0.61 |
| RPO | 0.438535 | 0.05459 | 8.03 | 0.000* |
| PRS | 0.3679 | 0.8483 | 0.43 | 0.065 |
| PRF | 0.30489 | 0.8534 | 3.52 | 0.000* |
| PRL | 0.01377 | 0.01137 | 1.21 | 0.227 |
| PPD | -0.1382 | 0.1792 | -0.7 | 0.442 |
| AGE | 0.1266 | 0.4554 | 0.28 | 0.781 |
| EDU | 0.1737 | 0.5921 | 0.29 | 0.770 |
| EXP | 0.7180 | 0.5724 | 1.25 | 0.211 |
| HOS | -1.986 | 1.789 | -0.55 | 0.582 |
| PDU | -24.272 | 7.46 | -3.45 | 0.001* |
| R-sq = 38.1% | | | | |
| R-sq(adj) = 35.5% | | | | |
| F-statistic = 10.79 ( P = 0.000) | | | | |
| Durbin-Watson = 1.92 | | | | |

*significant at 5% level of probability

**Table III: Problems of catfish production**

| Problem | Calculated Mean | Rank |
|---|---|---|
| High cost of feed | 3.85* | 1st |
| Lack of capital | 3.18* | 2nd |
| Scarcity of seeds | 2.95* | 3rd |
| Lack of modern technologies | 2.25 | 4th |
| High cost of transportation | 2.11 | 5th |
| High cost of labor | 2.06 | 6th |
| Lack of land | 1.94 | 7th |
| Poaching | 1.190 | 8th |
| Inadequate water supply | 1.764 | 9th |
| Mortality of fish | 1.759 | 10th |
| Poor storage facilities | 1.33 | 11th |

Source: Field survey, 2009
Note: multiple responses recorded

and 35.5% seem rather low, but they might be typical of cross-sectional data, because of the diversity of the units in the sample (Gujarati, 2004). This result is better than the 19% value for R-sq recorded by Ogunbadejo *et al*. (2007) in their study on Labor artisanal fish farming in Nigeria. They concluded that the 81% of variation in fish production, which could not be explained by labor and capital should be accounted for by other factors such as weather conditions and lunar cycle. Other factors including water supply system (i.e., flow-through, re-circulatory or stagnant) and water quality management recorded by Osawe (2007) and Ugwumba and Orji (2007) could be reasons for the remaining portion.

**Constraints to catfish production:** Catfish farmers encountered many problems during the production process. These problems include scarcity of quality seeds (fingerlings}, high cost of feeds; high cost of labor; inadequate water supply; lack of land for pond establishment; lack of capital; lack of modern technologies; poor storage facilities; high cost of transportation, mortality of fish due to diseases and water pollution; poaching by birds, reptiles and snakes. Analysis of the problems was done by means of a four point Likert Scale that produced a critical mean of 2.50. Results of the analysis are shown in Table III.

High cost of feeds was indicted by the respondents as the most serious constraint to catfish production with mean scale of 3.85. This situation was equally the case in the cost and returns analysis, where cost of feeds constituted 73.56% of total cost of production of the respondents. The importation of most commercial feeds into the country and problems associated with importation and distribution could be the main reasons for the hike in feed prices. These commercial feeds possess floating and high protein qualities and are therefore preferred by fish farmers. This result is in consonance with the records of Ocmer (2006). Ugwumba and Nnabuife (2008) also identified high cost of feed as very serious draw back to profits realizable from catfish farming. The second serious problem was the problem of lack of capital (3.18). Catfish farming is capital intensive and thus requires big capital investment for reasonable profit to be made. This is the reason why about 88 percent of the respondents were small-scale farmers. This reason was indicated by Kudi *et al.* (2006) to lead the problems encountered by fish farmers in Kaduna State, Nigeria.

Scarcity of seeds had a mean score of 2.95 in order to become the third serious problem encountered by the respondents. This was due to inadequate local supplies of catfish seeds attributed to abandoned government hatcheries and few private ones in the study area. Farmers were therefore compelled to import most of their seeds from neighboring States. A similar reason was given by Adeogu *et al.* (2007) to have affected fish farming in Lagos State negatively. Other constraints not asterisked which were below the critical mean of 2.50, that is – lack of modern technology (2.25), high cost of transportation (2.11), high cost of labor (2.06), lack of land (1.94), poaching (1.90), inadequate water supply (1.764), mortality of fish (1.759), were perceived as moderately serious problems. However, poor storage facilities (1.33) posed no problem to catfish farming.

## CONCLUSION

Catfish farming was a profitable business given by the total gross margin value of ₦149,909,480 and net farm income of ₦145,382,618. Net returns on investment was 0.61, implying that the farmers on the average returned ₦0.61 for every ₦1.00 invested in the business, which is a confirmation of the enterprise profitability in the area. However, farmers' profits would have been higher, outside very high cost of feeds, which constituted over 70% of the total cost of production. Further analysis of determinants of profitability using profit function again implicated cost of feeds as negative and most significant determinant of profitability, followed by production unit. Output price was a significant determinant of profitability. Constraints to catfish production in the study area arranged in descending order of seriousness were, high cost of feeds, lack of capital, scarcity of fingerlings, lack of modern technologies, high cost of transportation, high cost of labor, lack of land, poaching, inadequate water supply, mortality of fish and lastly poor storage facilities. It is recommended that policies be directed to establish of commercial pelleted and floating feed mills, modern hatcheries, provision of credit facilities, provision of adequate infrastructural facilities and intensification of extension services.

## REFERENCES

Adediran, I.A., 2002. Super-Intensive Fish Culture Using Water Re-circulating System. *Proceedings of Seminar on Fish Farming, Success Attitude Development Centre (SADC)*, pp: 1–4. Lagos, Nigeria

Adekoya, B.B. and J.W. Miller, 2004. Fish Cage Culture Potential in Nigeria-An Overview. National Cultures. *Agric. Focus*, 15: 10

Adeogu, O.A., H.K. Ogunbadejo, O.A. Ayinla, A. Oresegun, O.R. Oguntade, Alhaji Tanko and S.B. William, 2007. Urban Aquaculture: Producer perceptions and practice in Lagos State, Nigeria. *Middle-East J. Sci. Res*., 2: 21–27

Arene, C.J., 2002. Profit Function Analysis of Small Ruminant Enterprises in Nsukka Local Government Area of Enugu State, Nigeria. *Econ. Affairs*, 47: 209–214

Chukwuji, C.O., 2006. Resource Use Efficiency in Cassava-Based Food Crop Production Systems in Delta State, Nigeria. *Ph.D. Dissertation.* Delta State University, Asaba, Nigeria

Food and Agriculture Organization (FAO), 1991. *Fish for Food and Employment*. Food and Agriculture Organization, Rome, Italy

Gamel, E., N. Ahmed and R.O. Kereem, 2006. *Economic Analysis of Fish Farming in Behera Government of Egypt.* http://ag.arizona.edu/azaqua/ista/ISTAB/Abstract

Global Agriculture Information Network (GAIN) 2007. *Nigeria Fishery Products, Nigeria's Fish Market, 2007,* pp: 5–11. GAIN Report Number N17026. Lagos, Nigeria

Giroh, D.Y. and E.F. Adebayo, 2007. *Comparative Analysis of Permanent and Non-permanent Rubber Tappers in State Rubber Farms of Nigeria*. Retrieve from http://www.fspublishers.org

Gujarati, D.N., 2004. *Basic Econometrics,* 4th edition. Tata McGraw-Hill, New Delhi, India

Kudi, T.M., F.P. Bako and T.K. Atala, 2008. Economics of Fish Production in Kaduna State, Nigeria. *ARPN J. Agric. Biol. Sci.,* 3: 17–21

Nathan, S., 2006. *Small-scale Catfish Production: Introduction*. Retrieved from: http://www.uaex.edu/aquaculture2/FSA/Small%20scale% 20 catfish%20sproduction

Niang T. and S. Jubrin, 2001. *Quarterly Newsletter of the Nigeria Agriculture Question and Answer Service*, Vol. 1, pp: 1–7

Nwaru, T.C., 2005. Determinants of-Farm and Off-Farm Incomes and Savings of Food Crop Farmers in Imo State, Nigeria. *Nigerian Agric. J*., 36: 26–42

Ocmer, R., 2006. *Raising and Production of Catfish (Hito).* Retrieved from: http://www.mixph.com/2006/06/raising-and-production-of-catfish-hito-html

Odukwe, A., 2007. *Fish Farming in the Tropics: A Functional Approach.* Maxiprints, Awka, Nigeria. Book Review

Ogunbadejo, H.K., T. Alhaji and S. Otubusin, 2007. Productivity of Labour Artisanal Fish Farming in Nigeria. *African J. Appl. Zool. Environ. Biol.,* 9: 74–77

Olagunju, F.I., I.O. Adesiyan and A.A. Ezekiel, 2007. Economic viability of catfish Production in Oyo State, Nigeria. *J. Hum. Ecol.,* 2: 121–124

Osawe, M., 2007. Technical know-how of Catfish Grow-out for Table size in 4-6 months. *Proc. Seminar on Modern Fish Farming by Dynamo Catfish Production*, pp: 1–14. Lagos, Nigeria

Phonekhampheng, O., 2006. *On-farm Feed Resource for Catfish (Clarias gariepinus) Production in Laos*. Retrieved from http://diss-epsilon.slu.se/archive/00001915/01 General Discussion 00.pdf

Sankhayan, P.L., 1998. *Introduction to the Economics of Agricultural Production.* Prentice Hall of India Private Limited, New Delhi, India

Stoneville, M.S. (2005). *Optimizing Catfish/Water Quality Interactions to Increase Catfish Production.* http://www.ars.usda.gov/research/projects/htm

Tobor, J.G., 1990. *The Fishing Industry in Nigeria–Status and Potential for Self-sufficiency in Fish Production*, p: 19. Nigerian Institute for Oceanography and Marine Research (NIOMR)

Ugwumba, C.O.A., 2005. The Economics of Homestead Concrete Fish Pond in Anambra State, Nigeria. *African J. Fish. Aquacult.*, 4: 28–32

Ugwumba, C.O.A., M.O. Ugboaja and E.C. Orji, 2006. Sustanable Catfish Seeds Production in Anambra State. *In*: Asumugha, Olojede, Ikeorgu, Ano and Herbert (eds.), *Repositioning Agriculture for Sustainable Millenium Development Goals in Nigeria: Proc. Agricultural Society of Nigeria (ASON) 40th Annual Conference*, pp: 512–514. Umudike, Umuahia, Nigeria

Ugwumba, C.O.A. and E.C. Orji, 2007. Comparative Study on Financial Implications of Flow-through and Re-circulating Aquaculture Practices in Anambra State, Nigeria. *Nigerian J. Res. Prod.,* 10: 62–68

Ugwumba, C.O.A. and E.L.C. Nnabuife, 2008. Comparative Study on the Utilization of Commertial Feed and Home-made Feed in Catfish Production for Sustainable Aquaculture. *Multidiscipl. J. Res. Dev.,* 10: 164–169

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