RESOURCE USE EFFICIENCY AND DETERMINANTS OF CATFISH PRODUCTION OUTPUT IN ANAMBRA STATE, NIGERIA

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Abstract

This study which was conducted in Anambra State, Nigeria, examined the efficiency of resource use and determinants of catfish production output. Data were obtained from 204 catfish farmers selected by means of multistage random sampling technique. It utilized descriptive and parametric statistics in data analysis. Results indicated that farmer's age, cost of feed, stock size and farm size were significant determinants of catfish production output. Returns to scale value of 1.06 showed that the farms were operating at increasing returns to scale. Resource use efficiency values were 12.78, 1.12, 0.15, 4.70 and 14.47 for stock size, feed, labour and fuel respectively. This implies over utilization of labour input and under utilization of the other ones. Policy must be directed towards measures that would ensure the availability of the under utilized inputs and at cheaper rates.

Key words: Catfish production inputs, Resource use efficiency, Income, Econometrics.

Introduction

The importance of fish farming especially catfish farming to the sustainability of the fishery industry cannot be over emphasized. According to Central Bank of Nigeria (CBN) (2003), majority of domestic food fish supply (81.6%) has been through artisanal activities. Regrettably, supplies from the artisanal sub-sector has been on the decline. For instance, from 90% in 1990 (Tobor, 1990) to 84.2% in 1994 (CBN,1994), 81.6% in 2003 (CBN, 2003) and down to 40% in 2006 (Global Agriculture Information Network (GAIN), 2007). This drop was primarily attributed to insecurity along Nigeria's coasts and waterways, higher energy costs and over-fishing (Adekoya, 2004; Inoni, 2006).

The only way to curb this ceaseless drop in supply from capture fisheries, ensure self-sufficiency in food fish production and bridge the widening gap between the demand and supply of food fish is to embrace fish farming. Fish farming preferably catfish farming has been proved by Adediran (2002), Ugwumba (2005) and Nwosu (2009) to be the only way of boosting fish production and there by move the country towards self-sufficiency in food fish supply.

It is note worthy that the culture of African catfish has been on the increase (Ugwumba, 2005). This is due to encouraging Government and private interests through various fish production support initiatives such as the Federal government of Nigeria's Presidential Initiative on fisheries and aquaculture development of 2003 and the Anambra State government's year 2008 micro credit scheme for starter-catfish farmers. All these efforts hinged on the realization by the people of the importance of fish and fish farming. Fish culture provides lucrative returns to the farmers, employment opportunities, besides supplying good quantity and quality protein diet for the people (Njoku, 2000; Onoja, 2005). Fish products constitute more than 60% of the total protein intakes in adults especially those living in the rural areas (Adekoya, 2004). Food fish is cheaper and posses nutrient profile superior to all terrestrial meat (beef, pork, chicken, e.t.c.) being an excellent source high quality protein and high digestible energy (Nwuba and Onuoha, 2007; Lawal et al, 2008).

There is therefore the need to increase productivity and output of food fish by catfish farmers in order to meet the challenges posed by dwindling supplies, To achieve economic optimum output and thus profitability, resources have to be optimally and efficiently utilized. The efficiency of input utilization by all categories of farms enhances the profitability of such farms. The determination of efficiency status in the utilization of catfish production inputs and the influence of socio-economic factors on production output would enable the advocacy of policy for improvement and attainment of optimization. This is the genesis of the study.

Methodology

The study was conducted in Anambra State, which is one of the 36 States of the Federal Republic of Nigeria. It is comprised of 21 Local Government Areas (L.G.A.s) and 4 Agricultural Zones. The predominant language and religion are Igbo and Christianity respectively. The vegetation is tropical, climate humid with substantial rainfall and mean temperature of 87^{o}F. The State was chosen for the study because of the preponderance of fish farms in most Communities occasioned by the existence of big daily food fish markets (Ugwumba and Obiekezie, 2008).

Six out of the 21 L.G.A.s were purposely excluded from the survey as a result of observable evidence of artisanal activities and are not involved in fish farming. A multistage random sampling technique was employed to sample 256 respondents from 8 of the remaining 15 L.G.A.s. Data were collected by means of respondent's memory recall and interview instruments. At last, 204 copies of useful questionnaire were utilized in articulating data for analysis. Data were collected on socio-economic characteristics of the farmers, stock size, feed, lab our, capital, fuel, output quantities and prices. Data were analyzed by means of descriptive and parametric statistics.

The implicit form of the regression models used to examine the effects of socio-economic factors of the respondents on production output as well as to
determine the magnitude of input parameters employed to calculate the respective marginal value product of the inputs is given as:

$$Y = f(X_1, X_2, ..., X_n; e)$$

Where:

Y = dependent variable

X_1, X_2,……., X_n = independent variables

e = error term

Four functional forms were tried and their explicit expressions are stated as:

$$Linear \quad : Y = b_0 + b_1 X_1 + b_2 X_2 + ... + b_n X_n + e$$

$$Exponential : \ln Y = b_0 + b_1 X_1 + b_2 X_2 + ... + b_n X_n + e$$

$$Semi-\log: Y = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + ...+ b_n \ln X_n + e$$

$$Double-\log: \ln Y = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + ...+ b_n \ln X_n + e$$

For the effects of socio-economic variables on output, the variables were represented as:

Y = output (kg)
X_1 = gender (Dummy: male = 1; female = 0)
X_2 = age (years)
X_3 = marital status (Dummy: married = 1; single = 0)
X_4 = household size (number)
X_5 = educational attainment (years)
X_6 = access to credit (Dummy: accessed credit =1; otherwise = 0)
X_7 = cost of feed (₦)
X_8 = stock size (number)
X_9 = farm area (m^2)
X_{10} = experience (years)

The estimation of resource use efficiency parameters was done with the dependent and independent variables represented as:

Y = output (kg)
X_1 = stock size (number)
X_2 = feed (kg)
X_3 = labour (man-day)
X_4 = capital (number)
X_5 = fuel (litre)

b_o = constant in each case
b_i = regression coefficients
e = error term

Output of the regression model found best fit for each set of data, that is, data for the influence of socio-economic factors on output or data for resource use efficiency parameters' estimation, was adopted for results presentation. The criteria used for the selection were:

- the number, signs and magnitudes of significant estimators.
- the magnitude of R^2, the coefficient of determination, showing the percentage of variation in output explained by the independent variables.
- the F-statistic value showing the overall significance of the regression parameters.
- the Durbin-Watson statistic value indicating the existence or non-existence of multicollinearity.

At last, the linear regression model was selected for estimating the influence of socio-economic factors on output, while the Cobb-Douglas functional form came out best for the estimation of resource use efficiency parameters. Further analysis to derive the Marginal Value Products (MVPs)

of the production inputs was done using coefficients of the inputs from the estimated Cobb-Douglas output. The MVP was computed for each input as the product of its regression coefficient and the geometric mean value of farm revenue and the farm input. That is:

$$MVP = b_i \times \frac{\overline{Y}}{\overline{X}_i} \times P_y$$

Where: MVP and bi are as defined earlier

$\overline{Y}$ = mean of output

$\overline{X}_i$ =mean of input

P_y = per unit price of output

A given resource was optimally allocated when there is no divergence between its MVP and its acquisition cost (i.e. marginal factor cost (MFC)). The MFC is the opportunity cost / market price of each input in a competitive market.

A firm maximizes its profit with respect to an input if the ratio of its MVP to its MFC is unity. A ratio less than unity shows over utilization of that resource and profit would be increased by decreasing the quantity used of that input. Resource under utilization is indicated by a ratio greater than one and profit would be increased by increase in the rate of its use. Mathematically:

If, $\frac{MVP}{MFC} = 1$, use of the resource is at optimum (optimum utilization)

$\frac{MVP}{MFC} < 1$, use of the resource is above optimum (over utilization)

$\frac{MVP}{MFC} > 1$, use of the resource is below optimum (under utilization)

Results and Discussion

Effects of Socio-Economic Characteristics of the Respondents on Output

A total of ten regressors were included in the linear regression model. The regression output is shown in Table 1. Four (4) of the variables, age of the farmer, cost of feed, stock size and farm size were significant and the other six (6) insignificant. Farmers' age (AGE) is positively correlated with catfish production output and statistically significant at 5% level of probability. This implies that older farmers are more likely to generate bigger output than younger ones. The reason could be that the older farmers might have accumulated resources and experience with which to risk investing in large production outfits and thus turn out bigger outputs.

Cost of feed (COF) has a coefficient that is statistically significant at 5 % level of probability and positive. This is against a priori expectations that cost of feed should have negative influence on output. However, it might be that the farmers utilized mainly home-made feeds which are more cost effective and of comparable quality when well compounded than the expensive imported feed brands.

Further result of the analysis shows that farm size (FAS) is positive and significant at 5% level of probability. This means that farmers with large farm sizes who have adopted good management strategies are more likely to produce more from catfish production business.

The coefficient of farm area (FAA) is positively related to output and significant ($P \leq 0.05$). This implies that farmers with bigger farm areas are expected to produce more output than those with small farm areas bearing in mind the application of adequate stocking density, water quality sensitivity and other favourable management practices.

The overall significance of a regression is usually assessed by the F-statistic value. In this case the F-statistic value of 590.56 indicates that the socio-economic characteristics of the catfish producers significantly influenced their output. The R^2 value of 97.6% implies that actually 97.6% of the variation in catfish output is explained by the 10 predictors with FAS exerting the highest significant influence on production output.

Table 1: Effect of Socio-Economic Characteristics of Respondents on Production Output.

Predictor	**Coefficient**	**Standard Deviation**	**T**	**P**
Constant	-339.3	388.4	-0.87	0.384
GEN	20.6	177.8	0.12	0.908
AGE	16.427	7.024	2.34	0.020**
MAS	26.5	212.7	0.12	0.901
HOS	-13.15	31.25	-0.42	0.674
EDU	-13.777	9.961	-1.38	0.168
EXP	3.655	9.892	0.37	0.712
ACC	-90.4	110.7	-0.82	0.416
COF	0.00194	0.0018	10.76	0.000**
FAS	0.625	0.458	13.65	0.000**
FAA	0.986	0.245	4.03	0.000**
F-statistic =	590.56			
R^2 =	97.8%			
R^2(adj) =	97.6%			
Durbin-Watson statistic =		1.97		

Source: Field survey, 2009. ** significant at $P \leq 0.05$

Resource Use Efficiency of the Respondents

Result of the Cobb-Douglas regression analysis and resource use efficiency computations are represented in Tables 2 and 3 respectively. Table 2 shows that the coefficients of stock size, feed, capital and fuel were positive and significant at 5% level of probability. Only the labour input coefficient had positive but insignificant influence on output. More so, returns to scale value of 1.06 indicated that the farms were operating at increasing returns to scale and were at Stage I of the traditional production function. The catfish farmers should continue to increase output by increasing the use of resources and adopting improved management practices and technologies. This result is in consonance with Obasi (2004) who posted an increasing returns to scale value of 1.245 for extensive and intensive fish farming systems in Imo State, Nigeria. It equally corroborates Ogunbadejo et al, 2006 who recorded increasing returns to scale for inputs used in artisanal fish farming in Ogun State, Nigeria.

Table 2: Estimated Cobb-Douglas Production Function

Variable	Parameter	T-statistic	Probability
Constant	0.057	1.76	0.080**
Stock size	0.398	13.06	0.000**
Feed	0.558	16.95	0.000**
Labour	0.012	0.57	0.572NS
Capital	0.054	2.57	0.011**
Fuel	0.039	4.62	0.007**
R2 = 0.966			
R2 (adjusted) = 0.956			
F-statistic = 1409.825			
Burbin-Watson statistic =	1.956		

Source: Field survey, 2009. **: significant at 5% level of probability.
NS: not significant.

The estimated resource use efficiency ratios were 12.78, 1.12, 0.15, 4.70 and 14.47 for stock size, feed, labour, capital and fuel respectively. This implies that the labour input is over utilized contrary to stock size, feed, capital and fuel inputs that are under utilized. The reason for over utilization of the labour input could be due to its availability at cheap rates especially in the rural areas. There is need for the catfish farmers to reduce their usage of labour in order to increase output and profitability. This finding is at variance with Fashola (2000) who noted under utilization of labour in the analysis of resource use and productivity of fish in Owerri Agricultural Zone of Imo State, Nigeria. On the other hand, stock size, feed, capital and fuel were under utilized. The reason could be the problems of high cost of feeds, financial incapacitation of the farmers, scarcity of fingerlings and high cost of fuel as reported by Ugwumba (2010). The farmers should endeavour to increase usage of these 4 resources to increase their output and realize more income.

Table 3: Estimated Resource Use Efficiency in Catfish Production

Variable	MVP	MFC	MVP/MFC	DECISION
Stock size	278.11	21.76	12.78	under utilization
Feed	247.09	219.82	1.12	under utilization
Lab our	2,257.12	1,495.83	0.15	over utilization
Capital	4,552	925.15	4.90	under utilization
Fuel	1,031.04	71.27	14.47	under utilization

Source: Field survey, 2009.

Recommendations and Conclusion

Catfish production output in the study area was positively and significantly influenced by farmer's age, stock size, farm size and cost of feed. Mean while, the impacts of gender, marital status, household size, education, experience, and access to credit were insignificant.

The farmers were operating at increasing returns to scale, that is, increasing the inputs would increase the output by more than 100%. The labour input was over utilized, while stock size, feed, capital and fuel inputs were under utilized. Output could be improved by employing more of stock size, feed, capital and fuel inputs in the catfish production process and reducing labour usage. Policy should be tailored towards measures that would ensure the availability of fingerlings, feeds, capital and fuel at cheaper rates. Such measures should include the establishment of feed mills, hatcheries, provision of credits and subsidization of energy cost.

In conclusion, catfish production inputs in the study area were not efficiently utilized. There still exist opportunities for farmers to increase output and income by employing more of the under utilization inputs and reducing the quantity of the over utilized labour input..

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), Lagos. Pp 1- 4.

Adekoya, B. B. & J. W. Miller. (2004). Fish cage culture potential in Nigeria-an overview. National cultures. Agriculture Focus, 1(5): 10.

Central Bank of Nigeria (CBN) (1994). Annual report and statement of account, for the year ended,31st December, 1994.CBN Publication, Abuja, Nigeria.

Central Bank of Nigeria (CBN) (2003). Agricultural credit guarantee scheme fund. Annual report & statement of accounts. CBN Publication, Abuja, Nigeria.

Fashola, M. A. (2000). *Management and production economics and macro economic theory.* Concept Publication Limited, Lagos, Nigeria.

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

Inoni, O. E. (2007). Allocative efficiency in pond fish production in Delta State, Nigeria: A production function approach. *Agrcultura Tropica Et Subtropica,* 40 (4): 127-134.

Lawal, W. L., E. O. Idega & F. O. Ogbanje (2008). Analysis of fish marketing in Markurdi Local Government Area of Benue State, Nigeria, in Ume, Obinne and Lawal(eds), Prospects and challenges of adding value to agricultural products. *Proceedings of FAMAM* 22nd annual national conference, Markurdi, Nigeria. Pp 348-354.

Njoku, P. C. (2000). Nigerian agriculture and challenges of the 21st century, Agro-Science, *Journal of Tropical Agriculture, Food Environment and Extension.* 1(1): 22 – 27.

Nwosu, C. S. (2009). Analysis of resource use and productivity of fish farmers in Owerri agricultural zone of Imo State, Nigeria in Muhammed et al (eds), Sustaining agricultural growth to meet national economic development goal. *Proceedings of the 23th Annual Conference of FAMAN*, Sokoto, Nigeria. Pp 655-661.

Nwuba, L. A. & E. Onuoha (2006). *Fish Farming in the Tropics*: A *functional approach.* Maxiprints, Awka, Nigeria.

Obasi, P. C. (2004). Economics of fish farming in Imo State, Nigeria. *Journal of Agriculture, Forestry and the Social Sciences,* 2 (1): 40-46.

Ogunbadejo, H. K., T. Alhaji & S. Otubusin (2006). Productivity of labour artisanal fish farming in Nigeria. *African Journal of Applied Zoology and Environmental Biology*. 9:74-77.

Onoja, G. O. (2005). Fish and poverty. *Agribusiness Today*: 1(8): 5 – 7.

Tobor, J. G. (1990). The fishing industry in Nigeria – status and potential for self-sufficiency in fish production. Nigerian Institute for Oceanography and Marine Research (NIOMR). *Technical Paper* No. 54, Pp.19.

Ugwumba, C. O. A. (2005). The economics of homestead concrete fish pond in Anambra State, Nigeria. *African Journal of Fisheries and Aquaculture*, 4 (2005): 28-32.

Ugwumba, C. O. A. & A. A. Obiekezie (2008). Impediments to the development of live-catfish retail markets in Anambra State, Nigeria. *Nigerian Journal of Research and Production* (NIJOREP),13(1):173-178.

Ugwumba, C. O. A. (2010). Profitability and technical efficiency of catfish production in Anambra State, Nigeria. *Ph.D Dissertation*, Delta State University, Abraka, Nigeria.