Journal Of Agriculture & Ecosystem Management
Journal homepage: www.jonages.com
Publishing Real Time
JOURNAL OF AGRICULTURE AND ECOSYSTEM MANAGEMENT

Resource Use Efficiency in Catfish Farming in South-East Nigeria.

Ochiaka, C. D. and Kaine, A.I.N

[1.] *Department of Agricultural Economics and Extension Enugu State University of Science and Technology, Enugu.*

[2.] *Department of Agricultural Economics, Management and Extension, national Open university of Nigeria, Kaduna, Nigeria.*

ARTICLE INFO

Article history:
Received February 15, 2022
Received in revised form March 2, 2022
Accepted March 20, 2022
Available online April 18, 2022

Keywords:

Efficiency
Catfish
Farming
Resource use

Corresponding Author's E-mail Address:
damian.ochiaka@esut.edu.ng
+2348035075128
https://doi.org/10.36265/jonages.2022.020104
ISSN– Online **2736-1411**
Print **2736-142X**

ABSTRACT

The study examined the resource use efficiency in catfish farming in Southeast Nigeria. Anambra, Enugu and Ebonyi states were randomly selected from the five states that make up the Southeast zone. All the registered fish farmers in the three states were selected for the study, giving a total sample size of 192. Data collected, which were from both primary and secondary sources, were subjected to statistical analysis. The efficiency level was estimated using the efficiency ratio. Regression analysis was used to determine if any significant relationship existed between the socio-economic attributes and the income of the farmer. Chi-square analysis was used to test the hypothesis. The result indicated that all the resources used in catfish farming in the area were efficiently utilized as their efficiency ratios were more than one. The multiple regression analysis results indicated an R^2 of 0.789 and an F-value of 98.21 with the level of education being significant while pond size and farming experience were highly significant. The hypothesis tested indicated that resource use efficiency in catfish farming has a significant effect on income.

1.0 Introduction

Nigeria is blessed with abundant land and water resources and with a favourable climate, which supports fish growth. According to Okorie (2003), Nigeria has a remarkable potential for fish production with about 800,000 km^2 of swamp and freshwater suitable for subsistence fish farming and over 400, 000km^2 ideal for commercial fish farming. Furthermore, Nigeria falls within the highest category of aquaculture productivity where two crops of fish per year are possible. This indicates that Nigeria has a high potential for fish production (Adikwu, 1999). Statistics available have shown that fish demanded by the over 100 million people of Nigeria far outstrips the supply (Abdul et al, 2003). Therefore an urgent need to efficiently increase local fish production to meet the shortfall in the demand is a priority. It becomes necessary to look inward for other processes of increasing domestic fish production towards achieving self-sufficiency and food security for Nigeria.

Fish farming, a process of increasing domestic fish production is also an efficient means of producing animal protein. Its role in improving human diets as well as generating rural employment has been recognized and is being pursued in Nigeria and most African countries.

The development of aquaculture in Nigeria, like most other countries in Africa, has been very slow for several reasons: which according to Okoye and Ayanda, (2003) include lack of feeds and high-quality seeds (fingerlings), inadequate access to credit, conflict with other sectors, environmental degradation, the poor experience of past attempts in developing aquaculture, inadequate and inappropriate research on aspects of aquaculture and the lack of economic viability studies (FAO, 2001). Yields continue to decrease as a result of inefficient production techniques manifested in technical and allocative inefficiencies, over-reliance on household resources, labour-intensive agricultural technology and rapidly declining soil productivity (Tanko, 2003). This requires improving the efficiency of food production to increase output to meet the increasing demand for food. This productivity can be enhanced by adopting improved technology and improved efficiency in resource use. Improving the efficiency and sustainability of Nigeria's aquaculture, especially fish farming will help boost overall production to some extent. To improve food production, and by extension, food security, in Nigeria, farmers should be reached with appropriate technologies that are economically viable and culturally accepted (Sokoya, 1998). A sustainable solution is to devise an appropriate technology capable of cultivating fish and enhancing its productivity. This modern method of fish farming can be achieved through aquaculture technology.

The challenge facing smallholder farmers is how to improve upon their allocation and technical efficiencies in production to increase profit through increased harvest or output. Efficiency, in general, describes the extent to which time, effort or cost is well used for the intended task or purpose. According to Rahji, (2003), measuring efficiency is an important issue in the use of scarce resources in production. This is because it is the first step in a process that might lead to substantial resource savings. These resource savings have important implications for both policy formulation and firm management. In general, efficiency is a measurable concept quantitatively determined by the ratio of output to input. Resource use efficiency generally starts with the assumption of profit maximization which is an ideal framework against which the various efficiencies can be adequately measured or tested (Aromolaran, 2000). . Another way to look at how efficiently a business operates is to look at productivity. Productivity measures the relationship between inputs into the production process and the resultant output. Productivity can be measured in several ways like output per worker or hour of labour; output per hour/day/week; output per machine and unit cost (i.e. Total cost divided by total output). Efficiency is dependent upon the company's resources and its ability to manage these resources and is efficient if it has the ability to combine the resources effectively to obtain optimal productivity.

Hypothesis of the study: Resource Use Efficiency in catfish farming hasa significant effect on the profit.

Research Problem

In Southeast Nigeria, fish farming is generally practised on a small scale, usually as simple, low input pond culture. The area's fish production has not satisfied domestic requirements due to inefficient and crude production methods. These have resulted in low income to the fish farmer; thus portraying fish farming as a -non-profitable venture. This has discouraged many fish farmers and intending fish farmers into venturing in large scale and efficient fish production methods. Despite this, the supply of fish in the area, is still dominated by small scale fish farmers.

Justification of the study

According to FAO, 2001, the development of aquaculture in Nigeria has been very slow because of inadequate and inappropriate research on the aspect of aquaculture and lack of economic viability studies. The findings of this research will provide valuable information which will assist farmers, policymakers, and government, especially in policy planning for future fish development projects. The findings of this study will equally serve as valuable research material for students.

2.0 Methodology

The study area is southeast Nigeria. The area is one of the six geo-political zones in Nigeria and consists of five states, namely: Abia, Anambra, Ebonyi, Enugu and Imo. It lies between latitude $5^0 55^1$ and $7^0 10^1$ North and longitude $6^0 50^1$ and $8^0\ 30^1$ East. The area has a population of 16.4 million people (NPC, 2006) and a landmass of approximately 58, 214.7 sq.km. The major language of the people is Igbo. Agriculture is its major industrial mainstay. The major crops cultivated in the area include yam, cassava, rice, cocoyam, maize, bambara nuts as well as a variety of fruits and legumes. Economically, the area is predominantly rural and agrarian, with a substantial proportion of its working population engaged in crop and fish farming as well as trading.

Three states, Anambra, Enugu and Ebonyi were randomly selected from the five states in the south-east zone. All the registered fish farmers in the three states were selected for the study. This gave a total sample size of 192 registered fish farmers. Data for the study were collected from both primary and secondary sources. Data collected were analysed using both descriptive and inferential statistics.

Efficiency ratios were calculated to determine the levels of efficiency of the various inputs used by the farmer i.e. land, labour, capital and management. Chi-square (x^2) analysis was carried out to test the effectiveness of the efficiencies of the resource use on profit in fish farming.

Multiple regression analysis was used to determine if arelationship existed between the income of fish farmers and the socio-economic variables i.e, age, household size, level of education, pond size, sex of farmer, marital status and farming experience respectively.

The efficiency ratios used can be stated as follows:

$$\text{Land Resource Efficiency} = \frac{\text{Total Output Obtained (₦)}}{\text{Cost of land utilized (₦)}}$$

$$\text{Labour Resource Efficiency} = \frac{\text{Total Output Obtained (₦)}}{\text{Cost of labour utilized (₦)}}$$

$$\text{Capital Resource Efficiency} = \frac{\text{Total Output obtained (₦)}}{\text{Cost of capital utilized (₦)}}$$

$$\text{Management Resource Efficiency} = \frac{\text{Total output Obtained (₦)}}{\text{Cost of management utilized (₦)}}$$

The Chi-square (X^2) model used is stated as follows:

$$\text{Chi} - \text{Square}\ (X^2) = \sum \frac{(Oi - Ei)^2}{Ei}$$

Where

O_i = Observed values

Ei = Expected values

∑ = Summation sign

The implicit form of the regression model used is stated as:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7)$

Where

Y = Income from fish farming (₦)

X_1 = Age of the farmer (years)

X_2 = Household size (number)

X_3 = Level of education (years)

X_4 = Pond size (ha)

X_5 = Sex (Male = 1, Female = 0)

X_6 = Marital Status (Married = 1 Single = 0)

X_7 = Farming experience (years)

The model was represented explicitly in four functional forms, namely: Linear, semi-logarithmic, Double logarithmic and Exponential functions to determine the relationship between the dependent variable Y and the independent variables;

$X_1, X_2, X_3, X_4, X_5, X_6, X_7$. The functional forms are:

Linear form:

$$Y = a+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5 + b_6x_6 + b_7x_7 + e$$

Semi logarithmic form

$$Y = a + b_1 \log x_1 + b_2 \log x_2 + b_3\log x_3 + b_4\log x_4 + b_5\log x5 + b_6\log x_6 + b_7\log x_7 + e$$

Double logarithmic form

$$\text{Log } Y = \log a + b_1\log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4\log x_4 + b_5\log x_5 + b_6\log x_6 + b_7\log x_7 + e$$

Exponential form

$$\text{Log } Y = a+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5 + b_6x_6 + b_7x_7 + e$$

Where

a = Intercept b = Regression coefficient e = Error term

3.0 Results and Discussion

Table 1: Efficiency of resource utilization in fish farming

Resource Use	Value of total output obtained (₦)	Cost of resources utilized (₦)	Rate of utilization (Efficiency) (₦)	Percentage efficiency
Land		500,000.00	3.20	25.85
Labour		202,000.00	7.92	63.97
Capital	1,600,000.00	1,273,550.00	1.26	10.18
Total		1,975,550.00	12.38	100.00

Source: Field data, 2021

$$\text{Land Resource Efficiency} = \frac{\text{Total Output Obtained}}{\text{Cost of Land Utilized}}$$

$$= \frac{1,600,000.00}{500,000.00}$$

$$= 3.2$$

$$\text{Labour Resource Efficiency} = \frac{\text{Total Output Obtained}}{\text{Cost of Labour Utilized}}$$

$$= \frac{1.600.000.00}{202,000.00}$$

$$= 7.92$$

$$\text{Capital Resource Efficiency} = \frac{\text{Total Output Obtained}}{\text{Cost of Capital Utilized}}$$

$$= \frac{1,600,000.00}{1,273,550.00}$$

$$= 1.26$$

According to table 1, when ₦1.00 worth of land is invested in fish farming, the value of the output obtained is ₦3.20. The efficiency value is more than ₦1.00, implying that the land input was efficiently utilized in fish farming in the study area. The percentage efficiency of land use in the fish production process is 25.85%. Also, every ₦1.00 spent on labour input in fish farming gave a corresponding output of ₦7.92. The high-efficiency value here indicates a good level of input (labour) utilization in fish farming. The percentage efficiency of labour used is 63.97%. The high

percentage efficiency indicates an efficient labour utilization which implies optimal utilization. According to the table, an output rate of ₦1.26 was obtained for every ₦1.00 invested in capital input by the fish farmer. The percentage efficiency of capital use is 10.18%. Since the efficiency level is greater than ₦1.00, capital could be said to be efficiently utilised. The entrepreneur or manager coordinates the other three resources i.e land, labour and capital. The management is efficient if he can combine these three resources to achieve a maximum level of output per unit input. Based on the data in table 1, the management could be said to be efficient considering the efficiency ratios of land, labour and capital.

According to table 2, the Chi-square (X^2) test for the effectiveness of the efficiencies of resource use on profit in fish farming was carried out. The results show that the calculated value of X^2 is 8.02 while the table value of X^2 at 5% level of significance and degree of freedom of 5 is 11.07. The decision rule is to reject the null hypothesis (Ho) when the calculated value of X^2 is greater than the table value at a given level of significance. Since X^2cal (8.02) is less than $X^2_{0.05}$ (11.07), the null hypothesis is accepted. The researcher, therefore, concluded that the efficiencies of the resource use in fish farming have a significant effect on the profit. This means that the greater the efficiency of the resources used in fish farming, the greater the profit and the lower the efficiency, the lower will be the profit. To return a profit, an industry needs to become efficient in whatever it does.

From the data in table 3, the exponential function, which is chosen as the lead equation, has a coefficient of multiple determinations, (R^2) of 0.874 which implies that about 87.4% of the variation in the income of the fish farmer was explained by the independent or explanatory variables included in the model.

The age of the fish farmer was not significant at a 5% level of probability. It has a marginal contribution of 0.004 with a t-value of 1.950. Age has a positive relationship with farm income which means that as the farmer grows older in his fish farming business, the more the experience he/she acquires and the more income he/she will be able to make from his/her fish farming activity.

Household size with a coefficient of -0.009 and a t-value of -2.301 was significant at a 5% level of confidence. Household size has an inverse relationship with farm income. This equally means that as the household size increase, the fish farmer's income will reduce. This is because of the extra people to care for

Table 2: Chi-square test for the effectiveness of resource use efficiency on the profit of fish farmers.

Efficiency / Scale	Land Efficiency	Labour Efficiency	Capital Efficiency	Mgt Efficiency	Total
Very effective	11(15.56)	29 (25.51)	25 (23.34)	18 (18.59)	83
Effective	15 (11.81)	16 (19.36)	20 (17.72)	12 (14.11)	63
Undecided	1 (1.31)	2 (2.15)	3 (1.97)	1 (1.57)	7
Ineffective	7 (4.88)	7 (8.00)	3(7.31)	9 (5.82)	26
Very ineffective	2 (2.44)	5 (4.00)	3 (3.66)	3(2.91)	13
Total	36	59	54	46	192

Source: Field data, 2021
X^2cal (8.02) < $X^2$0.05 (11.070),
Values in parentheses are expected values.

The level of education has a coefficient of 0.015 and a t-value of 6.949. It was highly significant at a 1% level of confidence. It was positively related to farm income which means that the higher the farmer's level of education and training, the greater the farm income.

The coefficient for pond size is 0.001 with a t-value of 8.101. It was highly significant at 1% level of confidence and positively related to farm income which means that the greater the pond size, the greater the farm income.

The sex of the farmer with a coefficient of 0.082 and a t-value of 3.951 was positively related to farm income. It was highly significant at 1% level of confidence. This means that sex has a significant effect on the income of the farmer.

The marital status with a coefficient of 0.048 and a t-value of 1.613 was not significant at a 5% level of significance. It has a positive relationship with the farmer's income. This means that marital status has no significant effect on the farmer's income.

The coefficient of farm experience was 0.017 with a t-value of 6.493. It has a positive relationship with farm income and is highly significant at a 1% level of confidence. This means that the more experienced the farmer is the more efficient and effective he uses the farm resources available to him/her to increase his/her farm income.

The F-ratio of 182.337 was significant at a 1% level of probability thus indicating a strong influence of the independent variables on the income of fish farmers.

Table 3: Multiple Regression Results showing the four functional forms tested

	LINEAR	SEMI-LOG	DOUBLE LOG	EXPONENTIAL
CONSTANT	-40659.423	-492281.954	4.098	4.805
	(-.603)	(-1.534)	(19.366)***	(90.446)***
AGE	-42.050	52387.332	.225	.004
	(-.018)	(.216)	(1.411)	(1.950)
HOUSEHOLD SIZE	-3258.691	-72919.537	-.082	-.009
	(-.659)	(-.767)	(-1.306)	(-2.301)**
LEVEL OF EDUCATION	5350.637	-155236.381	.022	.015
	(1.937)*	(-2.098)	(.445)	(6.949)***
POND SIZE	950.719	227487.392	.256	.001
	(9.491)***	(4.129)***	(7.034)***	(8.101)***
SEX	24364.289	207552.276	.157	.082
	(.925)	(1.246)	(1.022)	(3.951)***
MARITAL STATUS	-3379.315	167387.457	.346	.048
	(.090)	(2.678)	(1.008)	(1.613)
FARMING EXPERIENCE	18705.180	641196.343	.613	.017
	(5.680)***	(7.759)**	(11.241)***	(6.493)***
R	.888	.800	.922	.935
R^2	.789	.640	.850	.874
F-RATIO	98.218	66.122	210.013	182.337
SEE	133652.38	173593.78	.11450	.10534

***Highly significant (1%) **Significant at 5% *Significant at 10%
Figures in parenthesis are the 't' values
Source: computed from field data, 2021.

4.0 Conclusion

Fish farming in the southeast states is at various levels of intensification. The number of fish farmers in the area is still low and most of them operate on a subsistence scale. There should be more government intervention in aquaculture through the ministries of agriculture and other agriculture-related establishments. This will encourage more people to take up fish farming thus improving the food security and livelihood of the farmers. Appropriate policies to educate the farmers through effective agricultural extension services will help in increasing the level of efficiency in resource use in fish production. Fish farmers must remember that aquaculture is a high-risk business hence, business experience and knowledge are required in addition to hard work and a commitment to success.

References

Abdul, W. O. Omoniyi, I. T; Udolisa, R. E. K and Alegbeleye, W. O. 2003. "Economic Potentials of 'Iken' Brush Park Fishing Practice in Iwopin Lagoon Ogun State, Nigeria" *Proceedings of 18th Annual Conference of the Fisheries Society of Nigeria*, Owerri, Dec. 2003 pp 126-130.

Adikwu, I. A. 1999. "Aquaculture in Nigeria: Prospects and Constraints. *Journal of Fisheries Technology* 1: 10 16 – 27.

Aromolaran, A.B. 2000." Analyzing Resource Use Efficiency on fish farms: A case study of Abeokuta zone, Ogun state, Nigeria". *Aquafield* 1(1), 12 – 21

F.A.O. 2001. Report of the eleventh session of the committee for Inland Fisheries of Africa. Abuja, Nigeria. FAO Fisheries Report No. 644. 24 – 27 Oct. 2000. RAFI/R644 (Bi).

Haque, T. 2006. Resource Use Efficiency in Indian Agriculture. *Indian Journal of Agricultural Economics* Vol. 61 (1) Jan. 2006 pp. 65 – 76.

Heck, S; Bene, C; and Reyes – Gaskin, R. 2007. "Investing in African Fisheries: Building Links to the Millennium Development Goals". *Fish and Fishers* 8: 211 – 226.

Murat, D., Ebru, Y., and Metin, G. 2011. "General Structure and Economic Analysis of fish farms in Ordu province – Turkey". Kafkas Univ. Vet Fak Derg 17 (5):699 - 706

National Population Commission of Nigeria NPC 2006. National Population Figures. Abuja.

Okorie, U. P. 2003. "Nigerian Fisheries at a Time of Economic Paradigm Shift." *18th Annual Conference of the Fisheries Society of Nigeria,* Dec. Owerri

Okoye, F. C. and Ayanda, J. O. 2003. "Economics of Commercial Fish Farming in Earthen Ponds in Nigeria: Privatization of Fish Farms." *Proceedings of the 18th Annual Conference of the Fisheries Society of Nigeria*, Dec. Owerri.

Rahji, M. 2003. "Analysis of the Production Efficiency of broiler Firms in Ibadan Area of Oyo State, Nigeria." *Tropical Journal of Animal Science* 6(2): 103 – 109

Sokoya, O. G. 1998. Extension in the Service of the small scale Farmer in Nigeria: a Participatory Approach for Sustainable Agricultural Extension. Paper presented at the 4th Annual National Conference of Agricultural Extension Society of Nigeria (AESON) Kaduna.

Tanko, L. 2003. Optimum Combination of Farm Enterprises in Kebbi State, Nigeria. A Linear Programming Approach. An unpublished PhD. Dissertation, Dept. of Agricultural Economics, Michael Okpara University, Umudike.