ECONOMIC EFFICIENCY OF AQUACULTURE PRODUCTION IN EDO STATE, NIGERIA.

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ABSTRACT

The study examines economic efficiency of aquaculture production in Edo State. The data for the analysis were obtained from the fish farmers through the administration of structured questionnaire, using multistage sampling technique and leading to the selection of 100 respondents. Data were analyzed, using stochastic frontier production function as in Frontier Version 4.1, applying the maximum likelihood estimation technique. The result of the analysis shows that the fish farmers were operating at the positive increasing returns to scale (RTS = 2.055). The study shows that if the amount of fingerlings, hired labour, family labour, quantity of feeds and annual cost of materials were increased by 100% in aquaculture production, total fish output in the aquaculture farms will increase by 40.2%, 136.9%, 6.5%, 26.5%, and 7.6% for each of the increase in the input respectively.. This establishes the fact that these resources were under utilized in aquaculture production in Edo State. The mean technical efficiency estimated at about 63% is suggesting that the aquaculture farmers were only 63% efficient in the use of the combination of their inputs. The study concludes that aquaculture production and its efficiency can be increased in Edo State in Nigeria by increasing the stocking density, increase access to credit and extension services. If these are done, the contribution of aquaculture fishery to total fish supply in Nigeria that was about 5% in 1991, and then increased to 12% in 2007, can increase faster to about 40% in the nearest future.

Keywords: Economic, Efficiency, aquaculture, production, Nigeria.

INTRODUCTION

One of the most serious challenges facing the country today is the attainment of self-sufficiency in animal protein requirement of the teeming population of Nigeria. Animal protein is a vital food nutrition which is critical to the growth repairs and development of the body. Nigeria is believed to be one of the most protein deficient nations of the world. According to Hussain (2001), while Nigeria attained a paltry per capita value of 9.3g/day, the United States, Australia, New Zealand and the Philippines respectively, attained per capita values of 113.7g/day, 111.3g/day, 102.9g/day and 45.2g/day. More worrisome, is that the 9.3g/day attained in Nigeria is seriously below the minimum requirement of 34g/day recommended by the FAO (Esobhawan *et al* 2008). Table 1 elaborate more on this; demonstrating low protein production and consumption in Nigeria compared with other countries[1]. The country is able to secure only about 27% of the minimum standard animal protein requirement (Esobhawan, 2007). The insidious

[1] The table reveals the sorry-state of the Nigerian Livestock sub-sector whose pre capita protein intake of 4.4kg is only 47.3% of the Africa's average and 6.5% of North America's average. According to CBN (2004) the relative decline in the supply of protein from the livestock sources is traceable to the prevalence of diseases and parasites, poor climatic condition, reduction in forage lands due to desert encroachment and low genetic potential of indigenous breeds.

effect of this problem is the deterioration of health and physique of the average Nigerian without even realizing it.

The attainment of self-sufficiency of animal protein requirement must involve the expansion of investments and the increase in the productivity and efficiency in the use of factors involved in the domestic production of animal food protein capable of eliminating the demand deficit. In this regard, the aquaculture remains the best fishery producing unit of the fisheries sub-sector with capacity to produce enough fish to meet national demand and also for export[2]. This is because of the enormous resource potentiality available in the aquaculture fishery unit in the country. Aquaculture (fish farming), which according has an estimated annual yield of 2.5 million metric tonnes with available land area for its development of 1.7 million hectares in Nigeria (Jayarama (1999); Agbebi (2008); NIOMR, 2004). According to Ojo *et al* (2006), Nigeria has a potential land area of about 600,000Km^2 and 400,000Km^2 for subsistence and commercial aquaculture respectively. The present production output level of 76,300 metric tonnes of fish per annum; representing 11% of the total domestic fish output in the country is unsatisfactory (Table 2). Therefore if aquaculture is to play its expected roles of solving the problem of low domestic output of fish, thereby solving the problem of animal protein deficiency in the country, the ways of expanding the output of fish in an economically viable and environmentally sustainable manner need to be defined. In this connection, increasing the productivity and efficiency in the utilization of factors in aquaculture production are the attractive options because they have the ability of generating output growth without increasing the quantities of inputs[3]. Therefore, this study intends to determine the technical efficiency of aquaculture production in Edo State, Nigeria, with the aim of determining the factors that contribute to efficiency of production and productivity of aquaculture in the state. The rest of the paper is divided into four sections, section 2 reviews the analytical framework, section 3 deals with the methodology employed in analyzing the relevant data, section 4 presents and discusses the results, while section 5 concluded the paper with policy recommendations.

Table I. Protein Consumption in From Livestock in Nigeria in Comparison with the rest of the World

	Number of Animals/100 persons				Animals protein
Area	Cattle	Sheep	Goats	Pigs	Per Capita (Kg)
North America	56	16	6	30	68.0
Europe	26	32	5	24	52.0
South America	125	91	17	38	23.0
Asia	191	12	11	7	11.9
Africa	45	59	40	2	9.3
Nigeria	28	14	38	1	4.4

Source: Nigerian Institute for Oceanography and Marine Research (NIOMR), 2004.

[2] The problems facing the livestock sub-sector signaled immediate shift to the fishery sub-sector which is the alternative source of animal protein supply and whose product (fish) is not known to be prone to calamitous diseases as avian flu and pandemic influenza.

[3] Hence, any self-sufficiency policy in animal protein requirement in Nigeria that will have the expected impact on the nutritional status of the people on a sustainable basis should be based on improving the productivity and efficiency of aquaculture production.

Table 2: Percentage Contribution of Aquaculture to Total Fishery in Nigeria 1971 to 2007

Period	Aquaculture	Artisanal	Others
1971-1980	0	98	2
1981-1990	5	93	2
1991-2000	5	86	7
2001-2003	6	88	6
2004-2007	11	81	8

Source: Esobhowan(2007)

ANALYTICAL FRAMEWORK

Stochastic Frontier Production Function.

The Stochastic Frontier Production function (SFPF) in efficiency studies is becoming increasingly popular because of its flexibility and ability to closely marry economic concepts with modeling reality. Hence, the model is employed in this study to provide the basis of measuring farm-level technical and allocative efficiencies which are the basis for estimating the efficiency of aquaculture production enterprise of the farmers in the study areas. The modeling, estimation and application of stochastic frontier production function to economic analysis have assumed prominence in efficiency studies following the pioneering work of Farrell in 1957. He identified three types of efficiencies, which are technical, allocative and economic efficiencies. According to him, technical efficiency (TE) is the ability of firms to produce maximum possible output with a given quantity of inputs under a given technology, which is ability to produce on the isoquant frontier. Allocative efficiency (AE) is the ability of a firm to choose optimal inputs level for a given factor prices, that is, the ability to produce a given level of output, using the cost-minimizing input ratios. In Farrell's view, economic efficiency (EE) is an overall performance measure and it is equal to the product of TE and AE (that is, EE = TE · AE). However, over the years, Farrell's methodology had be applied widely while still undergoes many refinements and improvements. Such improvement is the development of Stochastic Frontier model that enables one to measure firm's level efficiency, using maximum likelihood estimation procedure (MLE).

In the stochastic frontier production function (SFPF) the error term is assumed to have two components parts, V_i and U_i. The V_i deals with the random effects on the production which result from factors that are outside the control of the decision unit (farmers). The U_i measures the technical inefficiency effects which result from the behaviour of factors that come under the control of the decision unit. These factors are controllable under efficient management. The SFPF model is specified as: $Yi\ f(X_i\beta) + V_i - U_i$

Where, Y is the output in a specified unit, X is the input vector, β is the vector of production function parameters to be estimated, V is a two-sided normal random variable that is independently and identically distributed with zero mean and constant variance, (σv^2). It is introduced to capture the white noise in the production which are due to factors that are not within the influence of the producers. It is independent of U. The U is a one-sided non-negative random variable having truncation at zero with a normal distribution (Tadesse and Krishnamoorthy, 1997). It measures technical inefficiency in production, relative to the frontier production function which is attributed to controllable factors (technical inefficiency). It is half normal, independently and identically distributed with zero mean and constant variance. The variances of the random errors (σv^2) and that of the technical inefficiency effect (σu^2) and the overall model variance (σ^2) are related thus, $\sigma^2 = \sigma v^2 + \sigma u^2$ which measures the goodness of fit of the production function. The ratio, $\sigma u^2/\ \sigma^2$, called gamma (γ), measures the total variation of observed output relative to frontier output which can be attributed to technical inefficiency. The SFPE model is estimated, using the maximum likelihood estimation (MLE) procedure which is a maximization technique (Olowofeso and Ajibefun, 1999). The technical efficiency (TE) of an individual firm, is defined in terms of the observed output (Y_i) to the corresponding frontier output (Y_i*) which is the maximum output achievable, given the existing technology and assuming 100% efficiency. It is denoted as: $TE = Y_i/Y_i^*$

$$= \frac{\exp\,(X_i\beta + Vi - Ui)}{\exp\,(X_i\beta_i + V_i)}$$

$$= \exp\,(-\,U_i).$$

So that $0 \le Y_i/Y_i^* \le 1$, that is TE lies between 0 and 1. Thus, the above transformation constrains the technical efficiency of each farmer to a value of between zero and one. This is related in inverse proportion to technical inefficiency.

MATERIALS AND METHODS

The study area

The data used in this study were collected from a cross sectional survey of aquaculture farmers in Edo state, Nigeria. Edo state is one of the 36 states in Nigeria and has three distinct ecological zones. These are the mangrove swamp forest to the south, the tropical rainforest in the middle and the guinea savannah to the north. The state shares boundaries with Delta State in the South and South east, Kogi state in the north and northeast, River Niger in the East and Ondo state in the west. The state occupies an area of 19,283.93Km^2 with a population of 3,218,332 people, made up of 1,640461 males and 1,577,871 females by the 2006 national population census. The annual rainfall varies from 2500mm in the southern parts to 1500mm in the northern parts with high annual temperature of about 30^{o}c. It is drained by many rivers which empty into the sea through the Bight of Benin in Delta State. The people are predominantly farmers, growing mainly food crops such as, yam, cassava, plantain, maize, melon, paper and cash crops such as pineapples, pawpaw, palm produce, cashew and rubber. Fishing is also a prominent occupation of the people, engaged in artisanal capture fishing and aquaculture.

Data Collection and Sampling Technique

The data were from the secondary and primary sources. The secondary data were obtained from the Central Bank of Nigeria (CBN) and the Nigeria Institute of Oceanography and Marine Research (NIOMR). The primary data were obtained through the administration of questionnaire on 100 fish farmers, using multi-stage sampling technique. The first stage was the purposive sampling method to select five local government areas with preponderance of fish farming business. The selected local government areas are: Egor, Ikpoba-Okha, Oredo, Ovia Northeast and Ovia Southwest. The second stage was the simple random selection of 20 fish farms from each of the Local government area (LGA), making a sample size of 100 fish farms. Information was collected on the following variables.

- Quantity of fish harvested (kg)
- Value of fish harvested (₦)
- Pond size (M^2)

- Stocking in number of fingerlings
- Fixed cost such as depreciation charges on durable items such as land, pond construction, water supply, farm building fishing gears and interest payment.
- Operating expenses such as cost incurred on variable items like, feeds, liming materials, fertilizers, procurement and repairs of equipments whose life span did not exceed one year.
- Labour use (hired and family) in mandays
- Wage rate (₦)

100 copies of questionnaire distributed were retrieved and analysed.

Method of Data Analysis

Descriptive statistics and stochastic frontier production function were used to analyze the data collected. Descriptive statistics such as the mean, standard deviation and percentages were used to analyse the production performance data. The stochastic frontier production function was used to:

- Estimate the coefficients of the parameters of the production function model that were used for further economic analysis, such as productivity analysis of the variables involved in aquaculture production, returns to scale (RTS) and the production status analysis of aquaculture production in the study area.
- Test for the presence of technical inefficiency in aquaculture production and to predict the TE level of the aquaculture farmers. That is, to test to what extent the aquaculture farmers were using the given scarce resources involved in aquaculture production at their disposal to achieve maximum output without wastages of the resources.
- Estimate the marginal value productivity of resources, inputs that were used as basis for determining allocative efficiency of the resources.

The production function model of the aquaculture production functions was algebraically specified by the Cobb-Douglas function form because of its unique characteristics that are very useful in empirical analyses. These characteristics include: the elasticities of production used in the productivity analysis are equal to the estimated coefficients of the parameters (βi) of the production function and the summation of these elasticities of production gives the types of returns to scale obtained, that is, ($\Sigma\beta i$) = RTS.

- When RTS = 1 there is constant return to scale.
- When RTS is between zero and one, that is, $0 < RTS < 1$, there is a positive decreasing return to scale. Here, input allocation and output production are optimal and efficient. Any increase in allocation of input will result in increase in the total output but at a decreasing rate. This is known as stage II of production function that the aquaculture farm strives to attain.
- When RTS > 1, there is an increasing return to scale, where output increases at increasing rate with any increase in input. This is the stage I of the production function. The farmer needs to expand production by allocating more of the variable input to get to stage II where production is optimal and efficient.
- When RTS < 0, this is a negative decreasing returns to scale or stage III of the production function where any increased allocation of input for output production results in the decrease in the total output. Here the farmer needs to reduce the allocation of inputs so as to get back to stage II.

Model I specification

Production model

The production technology of the aquaculture farmers was implicitly specified as

$InY_i = \beta_0 + \beta_1 InX_1i + \beta_2 InX_2i + \beta_3 InX_3i + \beta_4 InX_4i + \beta_5 InX_5i + \beta_6 InX_6i + Vi – Ui$

Where: Y = Output of the fish harvested (Kg), i = Number of respondents for i = 1,2,3……100, X_i = Value of fingerlings in (₦), X_2 = Hired labour (Md), X_3 = Family labour (Md), X_4 = Quantity of feeds (Kg), X_5 = Depreciated fixed cost (₦), X_6 = Operating cost (₦), V = Random error as previously defined, U = Technical efficiency effects also previously defined,

Inefficiency Model: The technical inefficiency effects (U) was defined as:

$Ui = a_0 + a_1 z_1 + a_2 z_2 + a_3 z_3 + a_4 z_4$

Where, σ_0 = constant term, Z_1 = Educational level (years in school), Z_2 = fish farming experience (years so far spent in the business), Z_3 = Access to extension agents (a dummy 1 = Access, 0 = no access), Z_4 = access to credit (a dummy with 1 = access, 0 = no access). β_s and a_s, variances of V (σv^2), U (σu^2), the model variance (σ^2) and the gamma (γ) are the unknown scalar parameters to be estimated.

The estimates of the parameters of the stochastic frontier production function (SFPF) were obtained, using the program Frontier Version 4.1c (Battese *et al* 1996).

For the purpose of this study, two different models were specified to determine the appropriate model to use for further economic econometric analyses of the result. These are: Model I and Model II. In the model I using the Ordinary Least Square (OLS) estimation technique, the gamma (γ) was assumed not to be significantly different from zero, that is, $\gamma = 0$ and that there were no technical inefficiency effects in aquaculture production process. Hence the traditional response function was an adequate representation of the stochastic frontier model. In the Model II, however, using the maximum likelihood estimation (MLE) technique, the gamma was assumed to be significantly different from zero, that is, $\gamma \neq 0$ and that there were technical inefficiency effects in the aquaculture production process. Hence, the traditional response function was not an adequate representation of the stochastic frontier model. The two models were estimated and tested, using generalized likelihood ratio test. This test is defined by chi-square distribution as: $\chi_c^2 = - 2in [L Ho)/L(Ha)]$. The χ^2 has a mixed chi-square distribution with the degrees of freedom (df) equals to the number of parameters restrictions. The decision rule is that if the chi-square computed is greater than the chi-square tabulated in absolute terms, the null hypothesis (Ho) is rejected and it is accepted if otherwise.

Allocative efficiency determination.

The marginal analysis is used as the basis for determining the allocative efficiency of resources in aquaculture production. At the point of efficient allocation of resources, the ratio of input-output prices must equal the marginal physical production of each of the input used. For a given enterprise, the criterion is expressed as : $dY/dX_i = Px_i/Py$

Where dY/dX_i = marginal physical product of input used by i^{th} aquaculture farmer

P_{xi} = The unit price of the input

Py = Market price per kg of fish output

$dY/dX_i = MPPxi$

:. $MPPxi = Px_i/Py$

Cross multiplying, we have,

$MPPxi \cdot Py = P_{xi}$

But $MPPxi \cdot Py = MVP_{xi}$

:. $MVP_{xi} = P_{xi}$

or $MVP_{xi}/P_{xi} = 1$

Therefore, the equality of marginal value product of an input to the unit price of the input or the attainment of a unit value for the ratio of MVP and Px is the basic condition for achieving efficient resource allocation. Thus:

- When $MVP_x/P_x = 1$, it indicates efficient resource allocation.
- When $MVP_x/P_x > 1$, it indicates under utilization of the input and inefficiency.
- When $MVP_x/P_x < 1$, it indicates over utilization of the input and inefficiency.
- When $MVP_x/P_x < 0$, it indicates over utilization and gross inefficiency.

For the Cobb-Douglas functional for used in this study,

RESULTS AND DISCUSSIONS

The summary of the two frontier models is presented in the Table 3. In the two models, the estimated coefficients of all the variables with the exemption of operating cost were positively related to fish farm output, thereby agreeing with *a priori* economic expectation that these variables would contribute in a positive manner to the output of fish farms. The estimated coefficient of operating cost, however, was negatively signed thereby, negating *a prior* expectation of its positive relationship with fish farm output. In the models also, the value of fingerlings stocked, hired labour used, quantity of feeds used and annual cost of materials were significant at 5% level of probability using students t-ratio test, indicating that they were very important variables in aquaculture production process.

Table 3: The estimates of stochastic frontier production function

Variables	Model I Coefficient	Model II coefficient
	General model	
Constant	7.193* (0.549)	7.705* (0.658)
Value of fingerlings stocked	0.399* (0.056)	0.402* (0.057)
Hired labour	1.459* (0.372)	1.369* (0.382)
Family labour	0.086 *(0.086)	0.065 (0.088)
Quantity of feeds	0.253* (0.099)	0.265* (0.097)
Fixed Cost	0.093* (0.027)	0.076* (0.028)
Operating cost	- 0.125 (0.077)	- 0.122 (0.073)
	Inefficiency model	
Constant	0	0.439 (0.654)
Educational level	0	0.008 (0.028)
Fish farming experience	0	-0.019 (0.021)
Access to extension agents	0	-0.001 (0.116)
Access to credit	0	-0.099 (0.149)
Sigma squared	0.258	0.237* (0.033)
Gamma	0	0.784* (0.046)
Log likelihood function	-70.558	-49.873

Source: Computed by the Authors (2008)

* Estimate is significant at 5% level

Note: The figures in parentheses are the standard errors of estimates.

Presence of Technical Inefficiency effects.

To decide which of the two models to select for further econometric and economic analyses, a generalized likelihood ratio test was carried out, using the test statistic defined by the chi-square distribution. The result as presented in Table 4 showed that the computed chi-square was 41.37 while the tabulated chi-square at 5% level of significance and 6 degrees of freedom was 12.59. The computed chi-square was greater than the tabulated chi-square. Therefore, the null hypothesis (Ho) that there were no technical inefficiency effects in aquaculture production was rejected while the alternative hypothesis (Ha) that there were technical inefficiency effects and that the observed variations in the output of aquaculture production in the study area were due mainly to technical inefficiency effects (U) and not the random or stochastic variable (V) was accepted. This means that inefficiency factors are significant in the stochastic frontier model and that the classical normal regression model of production function based on Ordinary Least Square (OLS) estimation technique would have been inadequate representation of the data. Thus, the results of the diagnostic statistics confirmed the relevance of the stochastic frontier production function, using the maximum likelihood estimation (MLE) technique for further econometric and economic analyses. Table 4: The generalized likelihood ratio test of technical inefficiency effects in aquaculture production

Parameters	Estimates
LH_o	-70.56
LH_a	-49.87
χ^2 Calculated	41.37
χ^2 Tabulated at 5% Significant level	12.59
Decision	Reject H_o

Source: Computed by the Authors (2008)

Productivity Analysis

The sigma squared (σ^2) which is an indication of the goodness of fit, is statistically significant at 5% level showing a 'goodness of fit' of the survey data with the model and the correctness of the specified distributional assumption of the composite error term. The estimated coefficients of parameters of the variables involved in aquaculture production are also the elasticities of production of these variables. It showed that the elasticities of production with respect to value of fingerlings, hired labour, family labour, quantity of feeds and annual cost of materials are 0.402, 1.369, 0.065, 0.265 and 0.076 respectively and hence 100% increases in the employment of the variables would increase the total fish output by 40.2%, 136.9%, 6.5%, 26.5%, and 7.6%. For operating cost, however, 100% increase in its employment would reduce total fish output by 12.2. The return to scale (RTS) analysis which serves as a measure of total resource productivity is given in Table 5. The RTS of 2.055 obtained from the summation of the coefficients of the estimated inputs (elasticities) indicates an increasing return to scale and it implies that aquaculture production was in stage 1 of the production function. Allocating more of the variables in the production and with the productivity of the variables, will expand fish output.

Table 5: Elasticity of production and returns to scale

Variables	Elasticity of production
Value of fingerlings	0.402
Hired labour	1.369
Family labour	0.065
Quantity of feeds	0.265

Annual cost of materials		0.076
Operating cost		-0.122
Returns to scale (RTS)	= 2.055	

Source: Computed by the Authors (2008)

Technical efficiency analysis

The value of gamma (γ) of 0.784 obtained was highly significant at 5% level of significance and it implies that 78.4% variation in the output of aquaculture production was due to technical inefficiency effects. The deciles of technical efficiency shown in Table 6 revealed that the predicted TE of the fish farmers ranged between 0.579 and 0.855 with a mean TE of 0.626. It revealed that only 5% of the fish farmers had TE of 0.70 and above while majority of them, 73% had TE within the range of the mean TE level. Thus, the result of TE analysis indicated that fish farmers in the study area were technically inefficient. There is, therefore, the need for the fish farmers to improve on their technical efficiency by adopting better management techniques that will reduce the sources of technical inefficiency effects.

Table 6: Frequency distribution of Technical Efficiency (TE).

Decile Range of TE	Frequency	Percentage
0.500 – 0.599	22	22.0
0.600 – 0.699	73	73.0
0.700 – 0.799	4	4.0
≤ 0.800	1	1.0
Total	100	100.0
Maximum TE	0.855	
Mean TE	0.626	
Minimum TE	0.579	

Source: Computed by the Authors (2008)

Allocative efficiency analysis

The marginal value productivity analysis was used for the basis of determining allocative efficiency of aquaculture production business in the study area. In this analysis, the ratio of the marginal value product (MVP_x) of each resource input used, to its market price or the input acquisition price (P_x) was computed. The ratios as computed are shown in Table 7. It is observed from the table that no optimization condition for allocative efficiency of resources was obtained for the resources used in aquaculture production in Edo state. The ratios obtained were greater than unity, indicating that they were under utilized in the production of fish (except for operating cost which was over utilized). Allocating more of these resources in the production of fish would increase the output of fish from aquaculture business. Hence, the fact that the resources used were found to be underutilized and that the fish farmers were operating at increasing returns to scale imply that there is a bright future for aquaculture production in Edo state to produce enough fish to take care of the domestic demand and for export.

Table 7: Marginal value Production Analysis

Variables	APP	MPP	Py	MVPxi	Px	$\frac{MVP_{xi}}{P_{xi}}$
Value of fingerlings	26.94	10.83	377.36	4086.80	10.37	394.1
Hired labour	26.49	36.27	377.36	13686.85	540	25.4
Family labour	139.60	9.07	377.36	3422.66	540[++]	6.3
Quantity of feeds	6.23	1.65	377.36	622.64	94.50	6.6
Annual cost of materials	19.38	1.47	377.36	554.72	17.48	31.7
Operating cost	8.93	-1.09	377.36	-411.58	10	-41.16

Source: Computed by the Authors (2008)
[++]: Imputed wage rate for family labour.

CONCLUSION AND RECOMMENDATIONS

The study revealed that the stochastic frontier production function based on MLE technique was the preferred model for estimating the parameters of aquaculture production on efficiency studies as there were presence of inefficiency effects in the production process. Four of the variables used, that is, value of fingerlings stocked, hired labour, quantity of feeds and annual cost of materials were found to be the significant and hence, the very important variables applied in the business. The returns to scale (RTS) showed that the fish farmers collectively were operating at the stage I of the production surface or the zone of positive increasing returns to factors. The farmers were found to be technically inefficient with a mean technical efficiency of 0.626 and with only 5% of the farmers having technical efficiency of 0.70 and above. The study further revealed that the allocation and utilization of the variables involved in aquaculture production were allocatively inefficient as there was no optimization condition obtained for resource use efficiency or in the allocation and utilization of the resources.

The study concludes that aquaculture production and its efficiency can be increased in Edo State in Nigeria by increasing the stocking density, increase access to credit and extension services. If these are done, the contribution of aquaculture fishery to total fish supply in Edo State can become substantial. Fisheries development strategy in Edo state should emphasize aquaculture as the study has discovered that there is a bright future for increasing fish production from the business in the state which will ensure the attainment of self-sufficiency in animal protein requirement of the people as well as serving as business venture for engaging the unemployed school leaders productively.

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