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Full Length Research Paper

Analysis of technical, allocative and economic efficiency of different pond systems in Ogun state, Nigeria

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The study was carried out in Ogun State. The study investigated the costs and returns analysis of the respondents and the stochastic frontiers production analysis was applied to estimate the technical, allocative efficiency and economic efficiency among the fish farmers using concrete and earthen pond systems in the State. The results of the returns to Naira invested shows that earthen pond system yielded N8.0 while concrete pond system yielded N6.5. The results of economic efficiency also revealed an average of 76% in concrete pond system while earthen pond system made as high as 84% economic efficiency level. The results of the analysis of the mean technical efficiency for both systems revealed that concrete pond system with 88% while earthen pond system was 89%. Similarly, the allocative efficiency results revealed that concrete pond system was 79 percent while earthen pond had 85%. Stochastic frontier production function models revealed that pond area, quantity of lime used, and number of labour used were found to be the significant factors that contributed to the technical efficiency of concrete pond system while pond, quantity of feed and labour are the significant factors in earthen pond system. The results therefore concluded that only years of experience is the significant factor in concrete pond system in the inefficiency sources model. On the basis of the findings, the study suggested that government of Nigeria should provide a conducive environment for the establishment of both concrete and earthen pond system;, encourages more citizenry, mostly youth to set up both pond systems in a bid to alleviate poverty status and un-employment rate in the State and the country at large.

Key words: Fish farming, technical efficiency, allocative and economic efficiency.

INTRODUCTION

The significant imbalance between food production and the expanding population has resulted in an ever-increasing demand for fish consumption. This concern has been prompted about the efficient performance of fish farming production systems. Over the years, several people including government have always emphasized the need to increase fish production as priority without due consideration to the particular type of production environment in which to invest on with particular reference to economic analysis of the common concrete and earthen pond methods. One of the basic requirements of an investment decision is to get acquainted with the best system, which can give the maximum profit to resource use. One of the greatest problems confronting millions of Nigerian today is lack of adequate protein intake both in quality to feed the nations ever-growing population. This inadequacy results in problem of malnutrition. The resultant effect of serious deficiency in the amount of protein intake is that people's health is adversely affected; particularly the mental capability, working productivity and eventually, the overall national economic growth (Okoruwa and Olakanmi, 1999).

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Fish farming is the growing of fish in ponds, allows feeding, breeding, growing, and harvesting the fish in cultured environment (James, 1989). Meanwhile, the place of fish in the domestic food basket and industrial needs of Nigerians cannot be over-emphasized. Also, Nigeria is believed to be the largest consumer of fish and fish products in Africa, reflecting its population size, economic status and dietary habits of the populace (Oderinde, 1998). It has also been observed that one of the most serious constraints of agriculture growth in Nigeria is the inefficient use of productive resources and that considerable growth can be achieved by simply improving the level of efficiency in resource use (Fabiyi and Adegboye, 1978; Ogunfowora, 1975). Therefore, fish being one of the water resources is being targeted as a way of improving the protein intake of the Nigerian populace as well as improving the economic base of the country. A study conducted by Central Bank of Nigeria (CBN, 1998) revealed that household fish production level had declined since SAP, despite increase in fish price. According to the study, decline in domestic production of fish in the post Structural Adjustment Programme (SAP) era was as a result of policy measures adopted under SAP, which had brought about an increase in the cost of inputs. In view of the above facts, research questions now arise;

1. Are fish farmers really operating at efficiency level?
2. What are the sources of technical and allocative inefficiency in the fish farming enterprises in the study area?

Efficiently combining inputs to yield output is the primary task of farm management. When two firms in an industry use the same inputs and employ the same technology, yet produce different quantities of output, the implication is that at least one firm is producing inefficiently. The technical efficiency indicates the producer's ability to achieve maximum output from given quantities of inputs and existing technology. Most recent studies have failed to critically examine the importance of the different pond systems with a view to ascertain the most economically viable method. If aquaculture is to play a vital role in ensuring future fish availability for food security and nutrition in the country, this sector has to develop and expand in an economically viable and environmentally sustainable manner. Among many other factors, increasing efficiency of resource use and productivity at the farm level is one of the pre-requisites for sustainable aquaculture (FAO, 1997). Measuring technical efficiency at the farm level, identifying important factors associated with the efficient production systems would serve as a panacea to assessing potential for developing sustainable aquaculture. Economic efficiency is thus is derived from a cross product of the technical and allocative efficiency (that is, Technical efficiency x Allocative efficiency). The technical efficiency of an individual firm is defined in terms of the ratio of the observed output to the corresponding frontier output, given the available technology, while the allocative efficiency reflects the ability of firm to use inputs in optimal proportions, given their respective prices (Ajibefun and Daramola, 1999). Despite several studies being conducted in fish farming in the state, a stochastic production frontier has not been applied to determine the production efficiency of the fish farmers in the study area.

The objectives of this research are to: (1) find the socio-economic characteristics of the fish farmers, (2) estimates the technical, allocative and economic efficiency among the fish farmers using concrete and earthen pond systems and (3) identifying the farmers' specific factors affecting the fish farming enterprise in Ogun State.

Research hypotheses will now address the followings:

Ho: whether the explanatory variables in the inefficiency effect sources model do not have zero coefficients.

H_1: the explanatory variables in the inefficiency effect sources model have zero coefficients.

The Stochastic Frontier Model

Following Farell's (1957) article on efficiency measurement which led to the development of several approaches to efficiency and productivity analysis, among these is the data envelopment analysis (DEA). As noted by Coelli et al. (1998), the stochastic frontier is considered more appropriate than DEA in agricultural applications especially in developing countries where the data is likely to be influenced by measurement errors and the effects of weather conditions, diseases etc. This equally applies to the applications of frontier techniques to aquaculture, including fish farming. However, the modeling and estimation of stochastic frontier production function has been a subject of considerable interest in econometrics and applied economic analysis during the last two decades. Review of frontier production are given by Forsund, Lovell and Schmidt (1980), Bauer (1990) and Battese and Coelli (1992). The Stochastic frontier production proposed by Battese and Coelli (1992) assumed that a random sample of farms is observed over T period such that the production of the N farms over time is a given function of input variables and random variables which involve the traditional random error and non-negative random variables which are associated with technical inefficiencies of production. One of the earliest empirical studies in stochastic frontier production function was an analysis of the sources of technical inefficiency in the Indonesian Wheat Industry by Pit and Lee, (1983). The study estimated a stochastic frontier production function by the method of maximum likelihood and the prediction of technical inefficiencies were then regressed upon size of firm, age and ownership structure of each firm. These variables were found to have significant effect on the degree of technical inefficiency of the firms.

Battese and Coelli, (1992) also investigated factors which influenced the technical inefficiency of Indian Farmers using a stochastic frontier production function which incorporated a model for the technical inefficiency effects, the results found out that some farmers were able to achieve maximum efficiency while others were technically inefficient. Onu et al. (2000) similarly investigated the determinants of cotton production and economic efficiency using a stochastic frontier production function, which incorporated a model of inefficiency effects. The results indicated that labour and material inputs were the major factors associated with changes in the output of cotton. Farmer-specific variables which comprise, status of farmers, education, farming experience and access to credit facilities were found to be significant factors that accounted for the observed variation in inefficiency among the cotton producers.

Conceptual framework

The frontier production model analysis for cross sectional data can be defined by considering a stochastic production function with a multiplicative disturbance terms of the forms:

$$Y = f(X_a;\beta)\, e^{\varepsilon} \qquad \ldots\ldots\ldots(1)$$

Y = the quantity of original output
X_a = a vector of input quantities;
β = a vector of parameters and
ε = error term.

Where 'ε' is a stochastic disturbance term consisting of two independent elements 'μ' and 'v'

Where; $\varepsilon = \mu + v$ …… (2)

The symmetric component 'v' accounts for random variation in output due to factors outside the farmer's control, such as weather and diseases. It is assumed to be independently and normally distributed with zero mean and constant variance as N ~ (0, σ^2_v). A one-sided component $\mu < 0$ reflects technical inefficiency relative to the stochastic frontier, f (X_a ;β)e^{ϵ}. Thus, $\mu = 0$ for a farm output which lies on the frontier and $\mu < 0$ for one whose output is below the frontier as $|N \sim (0,\sigma^2_u|$, that is, the distribution of 'μ' is half normal.

The frontier of the farm is given by combining (1) and (2).

$$Y = f(Xa : \beta)e^{(u + v)} \qquad \ldots\ldots (3)$$

Measures of efficiency for each farm can be calculated as:

$$TE = \exp.[E\{\mu/\in\}] \qquad \ldots\ldots.(4)$$

And 'μ" in equation 4 is defined as μ= f (Z_b :δ) …..(5)

Where,;

Z_b= a vector of farmer specific factors
δ = a vector of parameters

The parameters for the stochastic production frontier model in equation (3) and those for the technical inefficiency model in equation (5) were estimated simultaneously using the maximum –likelihood estimation (MLE) programme, FRONTIER 4.1 (Coelli, 1994), which gives the variance parameters of the likelihood function in terms of $\sigma^2=\sigma^2_\mu + \sigma^2_v$, + $\gamma = \sigma^2_\mu / \sigma^2$. In terms of its value and significance γ is an important parameter in determining the existence of a stochastic frontier: rejection of the null hypothesis, H0: $\gamma = 0$, implies the existence of a stochastic production frontier. Similarly, $\gamma = 1$ implies that all the deviations from the frontier are due entirely to technical inefficiency (Coelli *et al*., 1998). However, in recent years, the Battese and Coelli (1995) model for the technical inefficiency effects has become more popular because of its computational simplicity as well as its ability to examine the effects on various firm-specific variables on technical efficiency in an econometrically consistent manner, as opposed to traditional two-step procedure. According to Battese and Coelli (1995), technical inefficiency effects, U_is in equation 1 are assumed to be independently distributed and truncations (at zero) of the normal distribution with mean $Z_i\ \delta$ and variance,σ^2_u [(|N($Z_i\delta$,s^2_u)|], where Z_i is a (1 x m) vector of observable firm specific variables hypothesized to be associated with technical inefficiency, and δ is an (m x 1) vector of unknown parameters to be estimated. Under these assumptions, the technical inefficiency effects, U_is can be expressed as follows:

$$U_i = Z_i\delta + W_i$$

Where; W_is are random variables, defined by the truncations of the normal distribution with mean zero and variance,σ_{2u}, such that the point of truncation is $-Z_i\delta$ i.e $W_i \geq Z_i\delta$. if Z-variables also include interactions between firm -specific factors and input variables, then the Huang and Liu (1994) non-neutral stochastic frontier is obtained. The technical efficiency of the i-th sample fish farms is denoted by:

$$TE=\exp(-U)=\exp(-Z_i\delta-W).$$

Research methodology

The study area is Ogun State; which has twenty Local Government Area divided into four Administrative zones (Abeokuta, Ijebu-Ode, Yewa, Ikenne) by the Ogun State Agricultural Development Programme (OGADEP). A total of 100 fish farmers were selected using a Multi Stage Sampling technique. The first stage involved broken of a sample frame of 220 into sub- group or strata in order to get adequate representation of the four Agric Zones. Secondly, the simple random Sampling was then used from each stratum or sub group among the list of fish farmers in each stratum. Only 85 were used for meaningful analysis. However, data collected in-

Table 1. Average total cost structure of fish farmers using concrete and earthen pond systems.

Concrete Pond	Values	Percent of ATC
Total Fixed Cost	2,271.1	1.3
Total Variable Cost	184,976.2	98.7
Total	**187,247.3**	**100**
Earthen pond		
Total Fixed Cost	2,333.2	2.0
Total Variable Cost	118,965.3	98.0
Total	**121,298.5**	**100**

Source: Field Survey, 2001

cluded Production acreages; input Prices (fingerlings, liming, labour used (hired and family labour), fertilizers, fixed inputs among others.

Sources of data: Primary data was obtained through the use of well-structured questionnaire given to fish farmers to collect information on socio- economic (costs and return), production (that is, production inputs like fingerling quantity, quantity of liming, hired and family labour etc), marketing characteristics (determination of pricing and marketing channel) as well the prices of input and output. This was complemented with

Secondary data: Which was sourced publications from past and recent journal articles, literature and other valuable texts.

Analytical procedure

Descriptive statistics was used to describe the costs and returns of the fish farmers using both concrete and earthen pond system.

Stochastic frontier production model. Was used to determine the level of inefficiency among the fish farmers in the study area.

The empirical stochastic frontier production model

Following the standard assumption that farmers maximize expected profits (Zellner et al., 1966), a single equation Cobb-Douglas stochastic production frontier was applied to the analysis of fish farmers in Ogun State is specified as follows:

$Q_i = f(X_I; \beta_I) \exp^{(v_i - ui)}$
- (implicit) …(5)

$\ln Q_i = \beta o + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \ldots\ldots \beta_n \ln X_n + vi - \mu i$ -(explicit) …(6)

For technical efficiency specification:

Where; Q_i = output of the i-th farm in kilogram (kg).
Pond (X_1) = area of pond (ha)
Feed (X_2) = quantity of feed (kg)
Lime (X_3) = quantity of lime (kg)
Labor (X_4) = total labour used (family and hired labour) in man days.
Omat. (X_5)= other materials (quantity / month)
Fing (X_6) = quantity of fingerlings (kg)
Ln= natural logarithm

βo = constant

β_i = coefficient to be estimated.

I=1-6

For allocative efficiency specification:
Where;

Q_i = revenue from sales (output price x output of the i-th farm in kilogram kg).
cPond (X_1) = cost of pond (ha)
cFeed (X_2) = cost of feed (kg)
cLime (X_3) = cost of lime (kg)
cLabor (X_4) = monetary value of total labour used (family and hired labour) coMat (X_5) = cost of other materials (quantity / month)
cFing (X_6) = cost of fingerlings (kg)

RESULTS AND DISCUSSION

Costs and return analysis of fish farmers in Ogun State

Table 1 explains the objective of determining the costs and return analysis of fish farmers using concrete and earthen pond systems. The results showed that under concrete pond system, the total variable cost constituted 98.7% while the fixed cost constituted only 1.3% while in earthen pond, the total variable cost constituted 98% while fixed cost incurred was 2.0%. These results compare the composition of the total fixed cost of the two systems.

The monthly returns for concrete pond system were N204, 079.6 per month. Meanwhile, the return to investment for fish farmers using concrete ponds system is N6.5. This indicates that a N1.00 investment yields N6.5 naira (Table 2). The results for the fish farmers using earthen pond system show that a return of N161.798.42 per month was accrued. Similarly, a return to naira invested is N8.0. This means that a N1.00 naira invested yields N8.0 naira (Table 3). This therefore implies that earthen yielded more returns to investment.

Relative efficiency indices

The estimation of economic efficiency (Table 4) shows the relative efficiency indices by age category for fish farmers using both the concrete and earthen pond systems. The results revealed that earthen pond system have higher economic efficiency level compared to concrete pond system. Though, analysis indicated that both methods operate at a high economic efficiency level, but age group 44 - 49 [years] operated at 0.84% for earthen pond system while for concrete pond system, age groups 44 - 49 years and 50 - 59 years operated at 0.76 percent efficiency level respectively. The range of economic efficiencies of earthen pond system shows the economic efficiency ranging between 0.69-0.84% (that is, between the lowest and the highest) while concrete pond system has a range of 0.55 - 0.76%. Thus, higher economic efficiency rate of earthen pond system might be as a result of fish species habitat which have the tendency to thrive better in their natural environment.

Table 2. Costs and return analysis of an average fish farmer using concrete pond system.

Item	Value [₦] / Season	Value [₦] / Season
A. Revenue (Output x Price)		
* Clarias	787,059	
* Tilapia	136,416	
* Others	488,250	
	1,411,725	
B. Variable Cost		
Water pump Services	400.0	
Hired Labour	10,800.0	
Family Labour	15,792.6	
Feeds	6,352.4	
Lime	1,493.4	
Fertilizer	251.5	
Fingerlings	57,493	
Other Costs	92,393.3	
	184976.2	
C. Total Variable Cost (A-B)		**1,226,748.8**
D. Depreciated Fixed Cost items/Season		
Pond	948.5	
Fence	154.6	
Pumping Machine	850.00	
Harvesting	161.8	
Weighing Scale	19.9	
Wheel Barrow	105.7	
Shovel	16.0	
Water Basin	14.5	
E. Total Fixed Cost	**2,271.100**	
F. Returns to Investment (A-(B+C)		**1,224,477.7**
Returns to Naira Invested (A-(B+C)		**1,224477.7**
Returns to Naira invested **(F/(C+E)**		**₦ 6.5**

Source: Field Survey 2001

Note: * Monthly Returns = Returns on Investment /Season (6 months)
= ₦ 1,224,477.7 /6
= ₦ 204,079.6 / month

Return to Naira Invested =Return to Investment/ Total Cost
= ₦ 1,224,477.7/-₦ 187,247.3
= ₦ 6.5

cooled edaphic condition). The results supported the assertion of Kalirajan and Shand (1989), Shapiro and Muller (1977) that given a technology to transform physiccal inputs into output, some farmers are able to achieve maximum efficiency up to 100% while others are technically inefficient.

Stochastic frontier models

The results of the stochastic frontier model estimated further showed that there are significant differences in the technical, allocative and economic efficiency of both concrete and earthen pond systems in the study area. Pond area, quantity of lime used, and number of labour were found to be the significant factors that were associated with technical efficiency of concrete pond system while pond, quantity of feed and labour were the signifycant factors in earthen pond type (Table 5).

Allocative efficiency results also revealed that expenses on other costs and labour were found to be signifycant variables in concrete pond type while in earthen pond only cost of lime was found to be the significant factor. This results indicated that these variables contributed greatly to the allocative efficiency of fish farmers in the study area (Table 6). The inefficiency sources model for concrete pond showed that only years of experience is the significant factor. Thus, a year of experience contributed significantly to the explanation of efficiency Tables

Table 3. Costs and return analysis of an average fish farmer using earthen pond system.

Item	Value [₦] / Season	Value [₦] / Season
A. Revenue (Output x Price)		
* Clarias	544, 887	
* Tilapia	125, 048	
* Others	422, 100	
	1, 092, 035	
B. Variable Cost		
Water pump Services	400	
Hired Labour	14060	
Family Labour	15200	
Feeds	5659.7	
Lime	1450.2	
Fertilizer	219.8	
Fingerlings	43058	
Other Costs	38917.60	
	118,965.3	
C. Total Variable Cost (A-B)		**973,069.7**
D. Depreciated Fixed Cost Items/6 months		
Pond	807.9	
Fence	256.7	
Pumping Machine	923.3	
Harvesting	197.4	
Weighing Scale	96.8	
Wheel Barrow	19.9	
Shovel	16.5	
Water Basin	14.5	
E. Total Fixed Cost	**2,333.2**	
F. Returns to Investment (A-(B+C)		**970,736.5**
Returns to Naira Invested (F/(C+E)		**₦8.0**

Source: Field Survey 2001

* The Pumping Machine is only used by few of the respondents.

Note: * Monthly Returns = Returns on Investment/Season (6 months)

= ₦970, 736.5/6

= ₦161, 789.4/month

Return to Naira Invested = Return to Instatement/Total Cost

= ₦970, 736.5 / ₦121, 298.5

= ₦8.0

in concrete pond (Table 7).

Hypothesis

5, 6, 7 and 8 showed that the null hypothesis which specifies that inefficiency sources model do not have effects in the use of resources is accepted. Moreso, $\delta = 1$, $= \delta = 2$, $=\ldots\ldots \delta=5\neq0$. This implies that the entire delta (δ) estimates are not zero. It further revealed that the delta variables estimated contributed significantly to the inefficiency of the fish farmers in the study area. Also, that the χ^2 -calculated is less than the χ^2-tabulated (Table 8) indicating the relevance of the variables in both concrete and earthen pond systems respectively.

Conclusion

This study focused on the analysis of economic efficiency of fish farming in Ogun State, Nigeria. The findings showed that earthen pond system is more technically, and allocatively efficient, though not at 100% level. The results agreed with findings of Sanni et al. (1998) who found out that an average fish farmer in Gombe State of Nigeria utilized resources below economic optimum level. The research therefore concluded that it is more advisable for fish farmers and to who would be investor in fish farming business in the study area to adopt this technolo-

Table 4. Relative efficiency indices by age category for fish farmers using concrete and earthen pond in Ogun state. Estimation of Economic Efficiency.

Age Category A	No of Farmers B	Sum of Tech.Ef. C	Sum of Allo. Effi. D	Av. Tech.Eff. E(C/B)	Av Allo. E ff. (%) F(D/B)	Av. Economic Efficiency (%) E*F
Concrete Pond						
26-31	-	-	-	-	-	-
32-37	8	6.56	5.32	0.82	0.67	0.55
38-43	7	6.08	4.72	0.87	0.67	0.58
44-49	1	0.87	0.88	0.87	0.88	0.76
50-55	13	11.72	10.86	0.90	0.84	0.76
>56	5	4.46	4.09	0.89	0.82	0.73
Total	**34**					
Earthen Pond						
26-31	4	3.2	3.64	0.82	0.19	0.75
32-37	14	11.92	11.4	0.85	0.81	0.69
38-42	16	14.56	13.89	0.91	0.87	0.79
44-49	3	2.69	2.79	0.90	0.93	0.84
50-55	10	8.21	9.07	0.82	0.91	0.75
>56	4	3.62	2.46			
Total	**51**					

Source: Field Survey

Table 5. Results of maximum likelihood estimate of the Cobb-Douglas frontier production functions for technical efficiency (Concrete and earthen pond systems).

Variable (Kg)/Parameter estimates	**Concrete pond type**			**Earthen pond type**		
	coefficient	**Std. error**	**t-value**	**Coefficient**	**Std. error**	**t-value**
Constant (ßo)	0.752*	0.219	3.41	0.265**	0.131	2.02
Ln pond (ß1)	0.292**	0.137	2.12	0.852	0.621	1.37
Ln feed (ß2)	0.461	0.237	1.95	0.751*	0.181	4.14
Ln lime (ß3)	0.154***	0.239	0.64	0.138	0.146	0.95
Ln labour (ß4)	0.329*	0.118	2.79	0.314**	0.123	2.54
Ln Other materials (ß5)	0.159	0.682	0.23	0.634***	0.328	1.93
Ln fingerlings (ß6)	0.637***	0.328	1.94	0.770**	0.350	2.20
Sigma – Square: ($\sigma_s^2 = \delta u^2 + \delta v^2$)	0.239		2.39	0.132		
Gamma ($\gamma = \delta u^2 / \delta v^2$)	0.726	0.210	3.45	0.759		
Log (likelihood)(θ_o)	-0.3463	0.110	3.14	0.489		
Mean Technical efficiency	0.880			0.890		

Source: Field Survey
*Significant at (P<0.01), ** Significant at (P<0.05), *** Significant at (P<0.10).
Other materials (e.g number of other miscellaneous items on the farm instrumental to fish farming).

gy (earthen pond system) with a view to make more profit and to be more economically efficient in their investment decision.

The results further concluded that year of experience were found to be statistically significant at 1 percent. The results of the hypotheses which showed that the Beta (β) values are different from zero also revealed the production variables (pond, feed, lime labour, other materials, fingerlings) are relevant to the technical and allocative efficiency in both systems. Moreso, the delta (δ) values representing the farmers specific variables (years of experience, age of farmers, household size and level of education of fish farmers) are also relevant in both concrete and earthen pond systems respectively.

Table 6. Results of maximum likelihood estimate of the Cobb-Douglas frontier production function for allocative efficiency (Concrete and Earthen Pond Systems)

Variable (₦)/Parameter	Concrete Pond Type			Earthen Pond Type		
	Coefficient	Std. error	t-value	coefficient	Std. error	t-value
Constant (ßo)	0.187 ***	0.100	1.98	0.239**	0.100	2.39
Ln cost of pond (ß1)	-0.544	0.119	-0.46	-0.483	0.431	1.12
Ln cost of feed (ß2)	0.111	0.883	0.13	0.456	0.506	0.90
Ln cost of lime (ß3)	-0.163	0.330	-0.49	-0.588*	0.134	-4.4
Ln labour (ß4)	-0.945**	0.424	-2.23	-0.664	0.532	-1.25
Ln other costs(ß5)	0.837*	0.207	4.04	-0.282	0.473	0.59
Ln cost of fingerlings (ß6)	0.104	0.430	0.242	0.204	0.276	0.74
Sigma – Square: ($\sigma s^2 = \delta u^2 + \delta u^2$)	0.886	0.382	2.32	0.125		
Gamma ($\gamma = \delta u^2 / \delta u^2$)	0.388	.223	1.74	0.24		
Log (likelihood) (θ_o)	-0.51536			-0.723		
Mean Allocative Efficiency	0.794			0.848		

Source: Field Survey.
*Significant at (P<0.01), ** Significant at (P<0.05), *** Significant at (P<0.10).
Other materials (e.g number of other miscellaneous items on the farm instrumental to fish farming).

Table 7. Results of maximum likelihood estimate for inefficiency sources model (Concrete and earthen pond).

	Concrete pond type			Earthen pond type		
	Coefficient	Std error	t-value	Coefficient	Std. error	t-value
Constant (δo)	0.108	0.431	0.25	0.161	0.453	0.35
Experience (Yrs)(δ1)	-0.897*	0.275	-3.26	-0.268	0.743	-0.36
Average age (yrs) (δ2)	0.145	0.449	0.32	0.102	0.283	-0.36
House hold size (No.)(δ3)	-0.194	0.5824	-0.33	-0.137	0.380	-0.36
Level of education (yrs)(δ 4)	-0.182	0.557	-0.33	-0.321	0.890	-0.36
Sigma-Square: ($\sigma s^2 = \delta u^2 + \delta v^2$)	0.239	0.102	2.39	0.132		
Gamma ($\gamma = \delta u^2 / \delta u^2$)	0.726	0.210	3.45	0.759		
Log (likelihood)	-0.3463			-0.489		
Mean Technical Efficiency	0.880			0.890		

Source: Field Survey.
*Significant at (P<0.01), **Significant at (P<0.05), ***Significant at (P<0.10).

Table 8. The generalized likelihood ratio test for the parameter of the inefficiency sources model

S/N	Pond Systems	Log(Likelihood).	χ^2 Statistics	$\chi^2_{V,095}$	Decision
1	Concrete	-346.39	2.19	12.59	Accept Ho
2	Earthen	-489.0	2.0	12.59	Accept Ho

Source: Field Survey

The inefficiency sources model for concrete pond showed that only years of experience is the significant factor. Thus, it can therefore be concluded that years of experience contributed significantly to the explanation of inefficiency measures in concrete pond system in Ogun State, Nigeria. On the basis of the findings, the study hereby suggested that government of Nigeria should provide a conducive environment for the establishment of more earthen pond system, encourages more citizenry, mostly youth to set up earthen pond system in a bid to alleviate poverty status and un-employment in the State and the the country at large.

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