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An Estimation of Profit Efficiency among Aquaculture Catfish Producers in Maiduguri Metropolis, Borno State, Nigeria

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Abstract

This study estimated profit efficiency among aquaculture catfish producers in Maiduguri Metropolis, Borno State, Nigeria. Five (5) wards were purposively selected out of the existing fifteen (15) wards in the area. These were areas where fish farmers are predominantly found. The wards are Gamboru I, Gwange, Gamboru II, Bolori and Bulabulin. One hundred and fifty (150) catfish farmers would be randomly and proportionately selected from the five wards for the study. Data for the study were collected from both primary and secondary information sources. The analytical tools used for this study includes descriptive statistic and Stochastic Frontier Profit Function Analysis. The finding indicates that the coefficient of total kilogram of catfish raised, catfish farm size, cost of fingerlings, cost of hired labour and cost of family labour were all positive and significant at 1%, 5% and 10% respectively while cost of feed was negative and not significant. The result also shows that all the aquaculture catfish producers considered in this study were profit inefficient. The result also reveals that age *farmer squared, educational level, catfish farm income and extension contact were negative and significant at 1% and 10% levels respectively, while household size, access to credit facilities and membership catfish producers association were positive and significant at 5% and 10% levels respectively. The study recommended that aquaculture catfish producers should fully participate in the various activities of their association in order to enhance their productivity as well as profit efficiency.*

Introduction

Aquaculture is the practice of producing fish under controlled environment is a major source of protein for many poor people in most part of the world (United Nations Environment Programme (UNEP), 2006). It was mainly undertaken by a large number of small farmers in Nigeria. The agricultural production of fish species in which production cycles that include breeding, feeding, cultivation and protection are virtually controlled by humans in contrast to capture fishery where the wild stocks of fish are harvested is referred to as underwater aquaculture. The exercise is viewed as being distinctively placed to reverse declining supplies from capture fisheries. Several fish farms in Nigeria focus on catfish, as they can have a market value of two to three times that of tilapia (Olagunju, 2007). From a biological perspective, the African catfish is said to be one of the most ideal aquaculture species in the world because it thrives in diverse environments. It can also survive on natural food or artificial food, which it accepts readily in captivity. It can be cultured in different culture systems such as ponds, cages, tanks, water re-circulatory system and whether through intensive or extensive fish culture system. Besides, catfish grows fairly fast and can be cross-bred to enhance certain favorable traits such as better body conformation (smaller head, more flesh), more hardiness, higher fecundity, improved survival of fry, and adaptation to supplementary feed. For instance, catfish which is naturally a bottom feeder, now readily accepts floating feed, which makes it easy to observe the fish for behavioral patterns, growth rate and disease outbreak (Oguntola, 2008).

Fish production in Nigeria, is not only significant as a source of rich protein, but it also can be used to bring about institutional changes. These changes can offer access to production assets and resources which can help to empower the poor and directly promote their livelihoods. Fish is as good as a stable food consumed by a larger population of Nigeria. This has given rise to high demand for fish both for the purpose of local consumption and export (Daferighe, Offiong & Emah, 2017). Regrettably, the production level of fish has not matched the consumption level in the country. There is therefor need to meet this shortfall in supply. Increase in the population of Nigeria has led to huge increase in the demand for animal protein; which is higher in quality than plant protein. The average protein intake in Nigeria is about 19.38g/output/day which is below the Food and Agriculture Organization (FAO) benchmark of 65g/output/day (Daferighe *et al.*, 2017).). The requirement for nutrition is thus crucial in Nigeria, where malnutrition and starvation are key problems encountered by most rural dwellers (Ibrahim, Shamai, Sanda, Lawal, Saidu, Majama, Gambo, Badau & Kushi, 2014).

Fish has been acknowledged to provide about 55% to the protein intake in Nigeria. Though, local fish production has been below consumption with import accounting for about 1.4 billion US dollars in 2014 (FAO, 2017). An emphasis on this fish production sub-sector would not only result in reduction in the amount of money spent on imports, but also lead to the growth of Small and Medium scale Enterprises (SMEs) in the country; which is capable of generating employment, improve income generation and improve the standard of living of the populace. Estimating profit efficiency constitutes a more significant source of information for policy makers than the partial vision offered by analyzing cost efficiency. The stochastic frontier profit function estimation captures firm level production specialization, therefore allowing the higher revenues reserved by the firm that produced differentiated or higher quality output to compensate for a higher cost incurred (Kolawole, 2006). This study thus estimated profit efficiency among aquaculture catfish producers in Maiduguri Metropolis, Borno State, Nigeria.

Objectives of the Study

The main objective of the study was to estimate profit efficiency among aquaculture catfish producers in Maiduguri Metropolis, Borno State, Nigeria using the Stochastic Frontier Analysis. The specific objectives were to: estimate the profit function of the aquaculture catfish producers; estimate profit efficiency among the aquaculture catfish producers; and estimate the determinants of profit inefficiency among the aquaculture catfish producers.

Hypothesis of the Study

The following hypotheses were postulated for testing:

H_0: The restricted Cobb-Douglas profit frontier model is not the same as the unrestricted Cobb-Douglas Stochastic profit model; and Ha: The restricted Cobb-Douglas profit frontier model is the same as the unrestricted Cobb-Douglas Stochastic profit model.

THEORETICAL FRAME WORK

Stochastic Profit Frontier Function

Based on the theoretical framework for production efficiency, it is typically estimated by its two constituents, that is, technical and allocative. Current improvements combine both measures into one system, which enables more efficient estimates to be obtained by simultaneous estimation of the system (Wang, 1996). The common method to measure efficiency- technical efficiency component –is the use of frontier production function (Trouvelekas, 2001). Though, it has been argued that a production function approach to measure efficiency may not be suitable when farmers face different prices and have different factor endowment (Ali and Flinn, 1989). This results in the use of stochastic frontier profit function technique to estimate farm specific efficiency directly.

The method of profit function combines the notions of technical and allocative efficiencies in the profit relationship, and any errors in the production decision are assumed to be translated into lower profit or revenue for the producer (Ojo, 2003). Profit efficiency is, thus, regarded as the capability of a farm to attain the highest possible profit given the prices and levels of fixed factors of that farm, and profit inefficiency in this context is loss of profit for not operating on the frontier (Ali and Flinn, 1989). The inefficiency effects is stated as a linear function of explanatory variable, reflecting farm-specific characteristics (Battese and Coelli, 1995). The advantage of this model is that, it allows the estimation of farm specific efficiency scores and the factors explaining the efficiency differentials among farmers in a single stage estimation procedure. This study applied the Battese and Coelli (1995) model by postulating a profit function, which is assumed to behave in a manner consistent with the stochastic frontier concept (Kolawole, 2006; Rahman, 2002; Adeleke, 2008; Ogundari, Ojo and Brummer, 2006). The stochastic frontier profit function can therefore be stated following Tsue *et. al.* (2012) as:

$$\pi_i = f\left(P_{ij}, Z_{kj}\right) Exp, e_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots i$$

Where:

$\pi_i =$ normalized profit of the jth catfish farm estimated as gross revenue less variable cost divided by the farm specific output price;

$P_{ij} =$ the price of jth variable input cope with by the ith catfish farm divided by output price;

$Z_{ik} =$ the level of the kth fixed factor on the ith catfish farm;

$e_i =$ error term.

$i =, \ldots\ldots\ldots\ldots\ldots, n,$ number of catfish farms in the sample

The error term e_i is assumed to behave in a manner consistent with the frontier concept (Rahman, 2002), which is stated as:

$$e_i = V_i - U_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots ii$$

V_i is the symmetric error term and it is assumed that it is an independently and identically distributed two-sided error term representing the random effects, measurement errors, omitted explanatory variables and statistical noise, U_i is the one-sided error term, representing the inefficiency of the catfish farm. The model of profit inefficiency effects U_i in equation (ii) is stated following Tsue *et. al.* (2012) as:

$$U_i = \vartheta_0 + \sum \vartheta_i Z_{di}, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots iii$$

Where:

$Z_i = (1$ x m$)$ vector of catfish farm specific variables, which varies across respondents and not over time. $\vartheta = (m$ x 1$)$ vector of unknown coefficients of the farm specific inefficiency variables.

The U_i is a non-negative one-sided error term representing the inefficiency of the farm. Thus, it represents the profit shortfall from its maximum possible value that will be given by the stochastic frontier. The estimated frontier function provides an estimate of industry's 'best practice' profit for any given level of price and fixed factors (Tsue *et. al.*, 2012; Adeleke, 2008).

The method of maximum likelihood was used to estimate the unknown parameters, with the stochastic frontier and the inefficiency models estimated simultaneously. The likelihood function is expressed in terms of the variance parameters,

$$\sigma^2 = \sigma_v^2 + \sigma_u^2, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots iv$$

and $$\gamma = \sigma_u^2 / \sigma_u^2 + \sigma_v^2, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots v$$

METHODOLOGY

Study Area

The study area was Maiduguri Metropolis of Borno State, Nigeria. It lies between latitude $11^0$15' and 45 'N and longitude $11^0$35'E, with a total mass of about 50,778 square kilometers (Ministry of Land Survey Maiduguri, 2017). It shares boundaries with Konduga to South and Jere local government area to the Northeast. Maiduguri Metropolis has a population of 521, 492 people (National Population Commission (NPC), 2006), which was projected to be 706, 597 for 2017 based on an annual growth rate of 2.8 per cent (Umar, Adamu and Baba, 2017). The study area is characterized by dry and rainy seasons. It has a short rainfall period of about three months that lasts from July to September with an average of 647 mm per annum. The temperature ranges between 35 0C and 44 0C for the greater part of the year (Nigeria Metrological Agency, 2018). The vegetation of the study area comprises of trees, shrubs and grasses. The major food crop cultivated are maize, millet, sorghum, rice, wheat, cowpea and groundnut as well as vegetables such as onion, tomato, cabbage, lettuce, spinach and watermelon. Livestock commonly produced are cattle, sheep, goat, poultry and fish farming. Aquaculture is becoming a major farming activity in Maiduguri Metropolis of Borno State.

Sampling Technique

A total of five (5) wards were purposively selected out of the existing fifteen (15) wards in the area. These were areas where fish farmers are predominantly found. The wards are Gamboru I, Gwange, Gamboru II, Bolori and Bulabulin.

A total of one hundred and fifty (150) catfish farmers would be randomly and proportionately selected from the five wards for the study, through a simple random sampling procedure from the list of catfish farmers that was obtained from their association.

Method of Data Collection

Data for the study were collected from both primary and secondary information sources. The secondary sources of information included journal, textbooks, internet, conference papers, past projects, dissertation etc. The primary data were collected using structured questionnaire that would be administered to 150 catfish farmers in the study area. Data were collected on total kilograms of the catfish sold and corresponding prices, total area of ponds under catfish production in meter square, cost of feed in naira, cost of fingerlings cultured per culturist per crop, cost of hired labour, opportunity cost of family labour and other costs incurred on other inputs in naira. Data were also collected age of farmer in years, years spent in formal education, number of persons in the household, experience in catfish farming in years, catfish production income in naira, access to credit facilities: 1 if the farmer has access to credit and 0 otherwise, extension contacts: 1 if frequent contact with extension agents and 0 otherwise, and membership of catfish producers association: 1 member, 0 otherwise.

Analytical Techniques

The analytical tools used for this study includes descriptive statistic and Stochastic Frontier Profit Function Analysis using Frontier version 4.1

Descriptive Statistics

The descriptive statistics used for this study includes frequency, percentage, mean etc. These were used to organize and summarize the results of the study.

Stochastic Profit Frontier Function

The Cobb-Douglas stochastic profit frontier function was used to achieve specific objective (i) and (ii). The model was expressed following Tsue *et. al.* (2012) as follows:

$$\ln Y = \beta_0 + \beta_{1i} \ln X_{1i} + \beta_{2i} \ln X_{2i} + \beta_{3i} \ln X_{3i} + \beta_{4i} \ln X_{4i} + \beta_{5i} \ln X_{5i} + \beta_{6i} \ln X_{6i} + U_i \text{........} vi$$

Where:
lnY= profit (gross margin) in naira (normalized by dividing the profit by output price);
$\ln X_1$ = total kilograms of the catfish raised;
$\ln X_2$ = catfish farm size (total area of ponds under catfish production in meter square);
$\ln X_3$ = cost of feed in Naira (normalized by dividing the cost of feed by output price);
$\ln X_4$= cost of fingerlings cultured per culturist per crop normalized by dividing the cost of fingerlings by output price;
$\ln X_5$ = cost of hired labour (normalized by dividing the cost of hired labour by output price);
$\ln X_6$= opportunity cost of family labour (normalized by dividing the opportunity cost of family by output price.
$\beta_0 - \beta_6$ = parameters to be estimated
V_i = Random error which are assumed to be independently and identically distributed as $N(0, \sigma_v^2)$
U_i = non-negative profit inefficiency effects which are assumed to be half normal (because catfish farmers are assumed rational in their production behavior and hence negative profit is not expected) and independently distributed of V_i. The presence of technical inefficiency effects were tested using the generalized likelihood ratio test (λ), which is defined by

$$\lambda = 2(L_R - L_U), \text{..} vii$$

Where:
$L_R =$ log likelihood of the restricted model (model 1); $L_U =$ log likelihood of the unrestricted model (model 2); λ has a chi-square distribution with degree of freedom equal to the number of parameters excluded in the unrestricted model. The null hypothesis was that the restricted Cobb-Douglas profit frontier model is the same as the unrestricted Cobb-Douglas Stochastic profit model.

Profit Frontier Inefficiency Model

The U_i are the catfish farm's profit frontier inefficiency effects model, this was used to achieve specific objective (iii) and the model is expressed following Tsue *et. al.* (2012) as follows:

$$U_i = \partial_0 + \partial_1 Z_{1i} + \partial_2 Z_{2i} + \partial_3 Z_{3i} + \partial_4 Z_{4i} + \partial_5 Z_{5i} + \partial_6 Z_{6i} + \partial_7 Z_{7i} + \partial_8 Z_{8i} + \partial_9 Z_{9i} + \partial_{10} Z_{10i} \ldots\ldots\ldots\ldots viii$$

Where:

U_i = the ith aquaculture catfish farm's profit inefficiency effects

∂_0 = Intercept coefficient

$\partial_1 - \partial_{10}$ = Parameters to be estimated

Z_1 = Age of farmer (years)

Z_2 = Age of farmer squared (years)

Z_3 = Educational level (years spent in formal education)

Z_4 = Household size (number of persons in the household)

Z_5 = Experience in catfish farming (years)

Z_6 = Catfish production income (Naira)

Z_7 = Access to credit facilities (1 if the farmer has access to credit and 0 otherwise)

Z_8 = Extension contacts (1 if frequent contact with extension agents and 0 otherwise)

Z_9 = Membership of catfish producers association (1 member, 0 otherwise)

i = 1, 2, 3… N.

The maximum likelihood estimates of the parameters in the Cobb-Douglas stochastic frontier profit model indicated in equation (vi), given the specification for profit inefficiency effects shown by equation (viii), was obtained using a computer program, Frontier 4.1 (Coelli, 1994).

The parameters of the models β's and ∂'s and the variance parameter, $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \frac{\sigma_u^2}{(\sigma_u^2 + \sigma_v^2)}$ would be estimated simultaneously.

The value of γ above indicates the relative magnitude of the variance, associated with the distribution of the inefficiency effects, U_i. If U_i in the stochastic frontiers are not present or alternatively, if the variance parameter, γ, associated with the distribution of U_i has value of zero, then σ_u^2 in the frontier model explain by equation (vi) is zero (Tsue *et. al*., 2012).

RESULTS AND DISCUSSION

The results and discussion of the study were presented under profit function of aquaculture catfish producers, profit efficiency and determinants of profit inefficiency.

Profit function of Aquaculture Catfish Producers

The Cobb-Douglas profit frontier function was estimated by regressing gross margin of the aquaculture catfish producers against total kilogram of catfish raised, catfish farm size, cost of feed, cost of fingerlings, cost of hired labour and cost of family labour. The result of maximum likelihood estimation in table 1 indicates that the estimated value of 0.9716 for the variance parameter gamma (γ) was highly significant at 1%. This implies that 97.16% variation in profit was due inefficiency and it confirms the existence of one sided error component in the profit function model specified in the study. Thus, rendering the application of ordinary least square (OLS) estimation technique insufficient in representing the data used in the study (Wadud and White, 2000). The value of sigma-squared (σ^2) of 0.3240 was also highly significant at 1%, meaning the profit function model specified in the study was fit for the analysis.

Table 1: Maximum Likelihood Estimates of Cobb-Douglas Stochastic Frontier Profit function of Aquaculture Catfish Producers

VARIABLES	ESTIMATED PARAMETERS	COEFFICIENTS	STANDARD ERROR	T-VALUE

CONSTANT	X_0	7.2049	0.2928	24.6055***
TOTAL KILOGRAM OF	X_1	1.3009	0.0291	43.3922***
CATFISH RAISED	X_2	0.0266	0.0133	2.0058**
CATFISH FARM SIZE	X_3	-0.3139	0.0307	-0.0010^{NS}
COST OF FEED	X_4	0.0449	0.0273	1.6442*
COST OF FINGERLINGS	X_5	0.0182	0.0137	1.3320*
COST OF HIRED LABOUR	X_6	0.0568	0.0138	4.1032***
COST OF FAMILY LABOUR				
SIGMA-SQUARED	σ^2	0.3240	0.0555	5.8338***
GAMMA	γ	0.9716	0.0096	101.1022***
LOG LIKELIHOOD FUNCTION		47.2154		
LOG LIKELIHOOD RATIO		133.3234		

Source: Maximum Likelihood Estimates from field survey data, 2018, using Frontier version 4.1, NS= Not significant at specified level, *= Significant at 10%, **= Significant at 5%, *** = Significant at 1%

The finding in table 1 further indicates that the coefficient of total kilogram of catfish raised, catfish farm size, cost of fingerlings, cost of hired labour and cost of family labour were all positive and significant at 1%, 5% and 10%, respectively while cost of feed was negative and not significant. The negative coefficient of the cost of feed (Alawode & Jinad, 2014), could be due to the purchase of wrong feed for the catfish. The positive elasticities of total kilogram of catfish raised (1.3009), catfish farm size (0.0266), cost of fingerlings (0.0449), cost of hired labour (0.0182) and cost of family labour (0.0568), implies that profit increase by 130.09%, 2.66%, 4.49%, 1.82% and 5.68% with increase in one kilogram of catfish raised, one meter squared of catfish farm size and one naira increase in the cost of fingerlings, cost of hired labour and cost of family labour respectively.

Profit Efficiency among Aquaculture Catfish Producers

The result in table 2 indicates that all the aquaculture catfish producers considered in this study were profit inefficient. The maximum and minimum profit efficiency estimates were 0.9956 and 0.0243 respectively, with a mean of 0.2052.On the average, the aquaculture catfish producers were operating at 20.52% profit efficiency level. This reveals about 79.48% profit inefficiency exist among the aquaculture catfish producers in the study area. This suggests wide prospect of reducing inputs to enhance the catfish producer's profit efficiency.

Table 2: Estimated Result of Profit Efficiency among Aquaculture Catfish Producers

EFFICIENCY CLASS	FREQUENCY OF THE AQUACULTURE CATFISH PRODUCERS	PERCENTAGE OF AQUACULTURE CATFISH PRODUCERS
0.0000-0.2500	116	77.33
0.2501-0.5000	21	14
0.5001-0.7500	6	4
0.7501-0.9999	7	4.67
FULLY EFFICIENT (EXACTLY 1.0000)	0.00	0.00
TOTAL	**150**	**100**
SUMMARY:		
MINIMUM	0.0243	
MAXIMUM	0.9956	
MEAN	0.2052	

Source: Computed from Field Survey data, 2018, using Frontier version 4.1

Determinants of Profit Inefficiency among Aquaculture Catfish Producers

Analysis of the finding in table 3 indicates that age farmer squared, educational level, catfish farm income and extension contact were negative and significant at 1% and 10% levels respectively, while household size, access to credit facilities and membership catfish producers association were positive and significant at 5% and 10% levels respectively. The negative coefficient of age of farmers squared contradicts the *a priori* expectation, and this implies that older aquaculture catfish producers were likely to profit efficient than the young ones. This finding indicates certain backing for the life cycle hypothesis (Henderson and Kingwell, 2002), where the profit inefficiency of the aquaculture catfish producer's likely increases at the initial stage with age and later decreases as the catfish producer grows beyond the middle age. This could be due to experience they have acquired over the years.

The negative coefficient of educational level also agrees with the *a priori* expectation, which implies that highly educated catfish producers were more likely to be profit efficient. This is probably due to the fact that catfish producers with more years of formal education have better understanding and adopt improved farming techniques which would likely take them closer to the production frontier and subsequently increase their profit. The negative coefficient of catfish farm income conforms to the *a priori* expectation, which means profit inefficiency reduces with increase in the catfish production income of farmers. This could be due to the fact that catfish producers who earn higher income from catfish production can purchase improved inputs such feed and other necessary equipment due to their large capital base than low income earners. The negative coefficient of extension contact also agrees with the *a priori* expectation and this suggests that catfish producers who frequently meet with extension agents were more profit efficient. This is probably due to the fact that catfish producers who frequently meet extension agents obtain information on recommended farming techniques and useful information that could improve their productivity and subsequently increase their profit.

Table 3: Maximum Likelihood Estimates of the Determinants of Profit Inefficiency among Aquaculture Catfish Producers

ITEMS	ESTIMATED PARAMETERS	COEFFICIENTS	STANDARD ERROR	T-VALUE
CONSTANT	Z_0	-1.3231	1.2334	-1.0727^{NS}
AGE OF FARMERS	Z_1	0.0391	0.0654	0.5976^{NS}
AGE OF FARMERS SQUARED	Z_2	-0.0016	0.0001	-1.6456*
EDUCATIONAL LEVEL	Z_3	-0.0701	0.0189	-3.7122***
HOUSEHOLD SIZE	Z_4	0.0501	0.0213	2.3466**
EXPERIENCE IN CATFISH FARMING	Z_5	-0.0009	0.0021	-0.0041^{NS}
CATFISH FARM INCOME	Z_6	-0.7321	0.5282	-1.3862*
ACCESS TO CREDIT	Z_7	0.5698	0.3968	1.4361*

FACILITIES				
EXTENSION CONTACT	Z_8	-0.4059	0.2236	-1.8153*
MEMBERSHIP OF CATFISH PRODUCERS ASSOCIATION	Z_9	1.5072	0.4043	3.7279***

Source: Maximum Likelihood Estimates from field survey data, 2018, using Frontier version 4.1

*= Significant at 10%, **= Significant at 5%, *** = Significant at 1%.

Table 3 shows that the positive coefficient of household size conforms to the *a priori* expectation, and this suggests that catfish producers with large number of persons in their households tend to be profit inefficient. The reason might be due to the fact that an increase in number of persons in the household results in an increase in household consumption expenditure, which takes away some proportion of the household income meant for the procurement of modern farm inputs and other operations. This may lead to profit inefficiency among the catfish producers who have large household size. The positive coefficient of access to credit facilities contradicts the *a priori* expectation, which implies that catfish producers who have more access to credit facilities were likely to be profit inefficient. The reason might be due to inappropriate utilization of credit by the catfish producers. The positive coefficient of membership catfish producers association contradicts the *a priori* expectation, which implies that profit inefficiency likely increases with catfish producer being member of association. This might be due to non-participation of the member catfish producer from association activities that could have enhance profit efficiency.

CONCLUSION AND RECOMMENDATIONS

The finding of the study concludes that variation in profit among the aquaculture catfish producers was due inefficiency and it confirms the existence of one sided error component in the profit function model. The result also revealed that the aquaculture catfish producers were operating at low profit efficiency level, implying wide prospect of reducing inputs to enhance the catfish producer’s profit efficiency. The study affirmed that age farmer squared, educational level, catfish farm income and extension contact were the determinants of profit inefficiency among the aquaculture catfish producers in the study area. Based on findings of the study, the following recommendations were made:

i. The aquaculture catfish producers should fully participate in the various activities of their association in order to enhance their production as well as profit efficiency;
ii. There is need to improve the quality of adult education extension program so as to educate catfish producers on how to use the various farm inputs that would increase their profit margin;
iii. There is also need to make the aquaculture catfish producers to ensure appropriate use of the credit facilities in order to enhance their profit efficiency.

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