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Research Article

Cost Efficiency Measurement with Adjustments for Variation in Capacity Utilization and Other Forms of Temporary Equilibrium: Evidence of Small-Scale Fish Farming in Niger State, Nigeria

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Abstract

This research empirical investigate cost efficiency of small scale fish farming in Niger State of Nigeria, using farm survey level information elicited from 109 fish farmers in the study area. The results revealed relative presence of economies of scale among the farmers meaning that an average fish farm in the study area produce at a minimum cost considering their scale of operation which is an indication that they operates within stage II of production surface (efficient utilization of resource stage). This result was further justified by the mean cost efficiency of 1.10 obtained which indicates that an average fish farm in the study area is 10% above the frontier cost, indicating that average fish farmers in the study area incurred extra 10 percent cost due to inefficiency in scarce resource allocation. The result indicate presence of cost inefficiency effects in fish farming as depicted by the significant estimated gamma coefficient of 0.999 and the generalized likelihood ratio test result obtained. Although results of the study have shown that fish farmers were inefficient in the application of productive resources, the low output prices and the imperfect condition of input markets in the study area may have constrained efficient use of production resources. To improve allocative efficiency in small scale fish production, the fish farmers should be availed of current technical and price information, because the best option and the most effective way to improve productivity and sustainability is through efficient utilization of the scarce resources keeping in view cost content at the disposal of these producers, most especially the small-scale producers who account for the bulk of total fish output in the country. Therefore, government participation in fish farming should be encouraged in the study area to boost the quantity of fish available for consumption. Furthermore, the study opined that improvement in efficiency should be an inclusive responsibility, viz. individual farmers, relevant stakeholders, non-governmental organizations, research institutions and government both at local, state and federal level respectively.

Keywords: *Cost; Efficiency; Fish; Small-scale; Niger State; Nigeria*

Introduction

The fundamental postulate of modern welfare state is to help the people in the fulfillment of their needs for a decent and comfortable livelihood. In this context it is widely recognized that in the hierarchy of human needs, food ranks first since the survival of Homo-Sapiens hinges on it. As such, it is a matter of paramount importance for the state to accord overriding priority to the concerns for food security, more so, in a world where aid and trade in food have to be important tools of international diplomacy. There is a growing concerns in different quarters on the issues, "will there be enough food for our children"? This question is causing alarm, particularly in the less developed countries. The developed countries have successfully tackled this problem through sustained growth over time. However, the major part of the globe especially the poorly developing countries of sub-Saharan, Africa and Latin America are still finding the way out to avoid crisis on the food front, not only for the present but important for their future as well. It has been predicted that world is going to face acute food shortage in the next century. The FAO has estimated that around 75 percent more food is required over the next three decades to feed future population. Furthermore, FAO's estimates for the nineties suggest that out of 117 developing countries, 64 countries would be facing problem in feeding adequately their population and even worse is that around 38 among these would be unable to feed at least half of their population. Recently, it was estimated that around 800 million populations go hungry every day, despite the fact that commensurate with technological improvements food production has increased over the years. In developing countries of Africa, Latin America and parts of Asia, a substantial chunk of population, an estimated 450 million, live in abysmal poverty and suffer from hunger, poor health and malnutrition and go without a square meal-a-day. 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. Furthermore, the efficiency or inefficiency of utilization of available resources for fish production has remained an unanswered question in the study area. An efficient method of production is that which utilizes the least quantity of resources in order to produce a given quantity of output. For fishery industry to continue to support the balanced diet of ever-growing population in the face of climate change, increasing global population and limited resources, cost efficiency need continue rising. The current level of food insecurity calls for proper assessment of fishery sub-sector of the economy because the greatest problem associated with food insecurity is that of inadequate animal protein in the diet of most people especially in the developing countries like Nigeria.

Research Methodology

The study area is Niger State, Nigeria. The State is located in North-central Nigeria between Latitudes 8°20′N and 11°30′ N and Longitudes 3°30′ E and 7°20′E with a total land area of 76,363 square kilometers and an estimated population of about 4,082,558 people. Annual rainfall ranges between 1100mm and 1600mm with average monthly temperature hovering around 23°C to 37°C [1]. The range of local climatic and soil conditions, resource availability, and markets allows favourable fish farming practices. Multi stage sampling techniques was used for the study. Primary data were elicited during 2014 production season vis-à-vis administration of pre-tested questionnaire coupled with interview schedule to active small-scale/homestead fish farmers from three Local Government Areas (LGAs) purposively selected due to preponderance of small-scale fish culture activities, viz Bida (Zone I), Chanchaga (Zone II) and Borgu (Zone III) one each from the three Agricultural zones in the state. Sampling frame of 182 active fish farmers was obtained from Niger State Ministry of Livestock and Fisheries Development out of which 109 (60%) respondents were selected as representative sampling size for the study. Information were collected on input and output keeping in view the cost involved in carrying out each operation. Major analytical technique used for data analysis was stochastic profit frontier model.

Agricultural Zones	Selected LGAs'	Population	Sample Size
Bida (Zone I)	Bida	55	33
Kuta (Zone II)	Chanchaga	70	42
Kontagora (Zone III)	New-bussa	57	34
Total	3	182	109

Table 1: *Sampling frame of catfish farmers in Niger state, Nigeria.*

Source: NSMLFD, 2014

Empirical model

Gini coefficient: It is a measure of statistical dispersion developed by the Italian statistician Corrado Gini and published in his paper "variability and Mutability" (Italian: Variabilita e mutabilita). The Gini index is defined as a ratio of the areas on the Lorenz curve. The formula is given as follows:

G = A/0.5 = 2A=1-2B ……………………….. (1)

Stochastic frontier cost function

Cost efficiency refers to the ratio of the minimum cost at which it is possible to attain a given level of production to the actual cost incurred. C_{EE} takes value of 1 or higher with 1 defining cost efficient farm. The costs of a farm depend on the output level (y), the price of inputs (w), the level of cost inefficiency (u) and a set of random factors (v) which incorporate the effect of errors in the measurement of variables. Thus, the cost function is expressed as:

C = C(y,w,u,v) ……………………………… (2)

Specification of cost function involves alteration of error term from (V_i – U_i) to (V_i + U_i). For example, this substitution would transform the production function into cost function:

$Y_i = X_i \beta (V_i + U_i)$, i = 1………… n ………………………………………… (3)

Where Y_i is the cost of production of the i^{th} farm;
X_i is a k x 1 vector input prices and output of the i^{th} farm; and,
β is a vector of unknown parameters

The V_i are random variables which are assumed to be iid $N(0, \delta_v^2)$ and independent of the Ui which are nonnegative random variables which account for the cost inefficiency in production, often assumed to be iid $N(0, \delta_u^2)$, in this cost function the U now defines how far the firm operates above the cost frontier.

The explicit Cobb-Douglas function for the maize farms in the study area was specified as follows:

$In\ C = \beta 0 + \beta_1 InP_{1i} + \beta_2 InP_{2i} + \beta_3 InP_{3i} + \beta_4 InP_{4i} + \beta_5 InP_{5i} + \beta_6 InP_{6i} + \beta_7 InP_{7i} + + \beta_8 InP_{8i} + \beta_9 InY_i + (V_i + U_i)$ .... ………. (4)

Where;
C_i = Total production cost (₦);
P_1 = Cost of labour (₦);
P_2 = Cost of fingerlings (₦);
P_3 = Cost of fertilizer (₦);
P_4 = Cost of feeds (₦)
P_5 = Cost of medication (₦)
P_6 = Cost of lime (₦)
P_7 = Annual depreciation cost of farm tools (₦); and,
Y_i = Output of fish (in kg).
β_0 = Constant co-efficient
β_{1-n} = Co-efficients of parameters to be estimated.

The choice of the Cobb-Douglas is based on the fact that the methodology requires that the function be self –dual as in the case of cost function in which this analysis will be based on.

The inefficiency model (U_i) is defined by:

$U_i = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5i} + \delta_6 Z_{6i} + \delta_7 Z_{7i}$ .... (5)

Where;

Z_1= Age (in years);

Z_2= Education (in years);

Z_3 = Farming experience (in years);

Z_4 = Household size (in numbers);

Z_5 = Extension services (Yes=1, otherwise= 0);

Z_6 = Access to credit (Yes=1, otherwise= 0); and,

Z_7 = Co-operative membership (Yes=1, otherwise=0).

δ_0 and δ_{1-n} are scalar parameters to be estimated.

These socioeconomic variables are included in the model to indicate their possible influence on the cost efficiency of the farmers. The δ_0 and δ_{1-n} are scalar parameters to be estimated. The variance of the random error, σ_{v2} and that of the cost inefficiency effects σ_{u2} and the overall variance of the model σ^2 are related as follows: $\gamma = \sigma_u^2/\sigma_v^2 + \sigma_u^2$. The gamma ($\gamma$) measures the total variation of total production cost from the frontier cost which can be attributed to cost inefficiency.

The test for the presence of cost inefficiency using generalized likelihood-ratio statistics λ defined by: λ =-2 In (H_0/H_a), where, H0 is the value of the likelihood function for the frontier model in which parameters restriction specified by the null hypothesis, H_0 are imposed; and H_a is the value of the likelihood function for general frontier model. If the null hypothesis is true then δ has approximately a mixed chi-square distribution with degree of freedom equal to the number of parameters excluded in the unrestricted model.

Economies of Scale (Es): Economies of scale may be defined in terms of elasticity of cost with respect to output. However, in a multi-product setting, economies of scale (Es) is defined as those reduction in average cost when all output are increased proportionally holding all other input prices constant. Es mathematically is equivalent to the inverse of sum of all the elasticities of total production cost with respect to all output. Economies of scale prevail, if Es is greater than 1 and, accordingly diseconomies of scale exist if Es is below 1. In the case of Es=1 no economies of scale or diseconomies of scale exist. Return to scale and economies of scale are equivalent measures if and only if the product is homothetic [2-4]. If Cobb- Douglas function was used, this assumption is imposed.

Results and Discussion

Summary Statistics of the Variables in Stochastic Cost Frontier (per farm per production cycle)

Table 2 shows the summary statistics of the variables included in the cost frontier. The mean yield of 753kg per farm in one production cycle was recorded over the sampled farm with a standard deviation of 214kg, and an average output price of ₦ 350 per kg in the sampled area. The result revealed a mean total production cost of ₦ 100, 083.30 per farm per production cycle with standard deviation of ₦62, 332.40. The average level of education of the farmers was 14 years with an approximately 5 years of fish farming experience, and an average household size of 5 persons. The distribution of total cost of production among the respondents was less equal as depicted by the Lorenz curve (Figure 1).

Variables	Mean	Standard Deviation
Total production cost (₦)	100083.30	62332.40
Fingerlings (₦)	15927.40	1345.22
Feeds (₦)	47330.60	6445.21
Fertilizer (₦)	1801.90	254.00
Labour (₦)	19220.50	3126.00
Medication (₦)	3483.70	532.00

Lime (₦)	1145.20	163.30
Depreciation on capital items (₦)	11174.00	2031.00
Fish output (kg)	753	214
Education (years)	14	3
Experience (years)	5	2
Household size (number)	5	2
Age (years)	41	5

Table 2: *Summary statistics of the variables in stochastic cost frontier model (per farm per production cycle).*

Source: Field survey, 2014

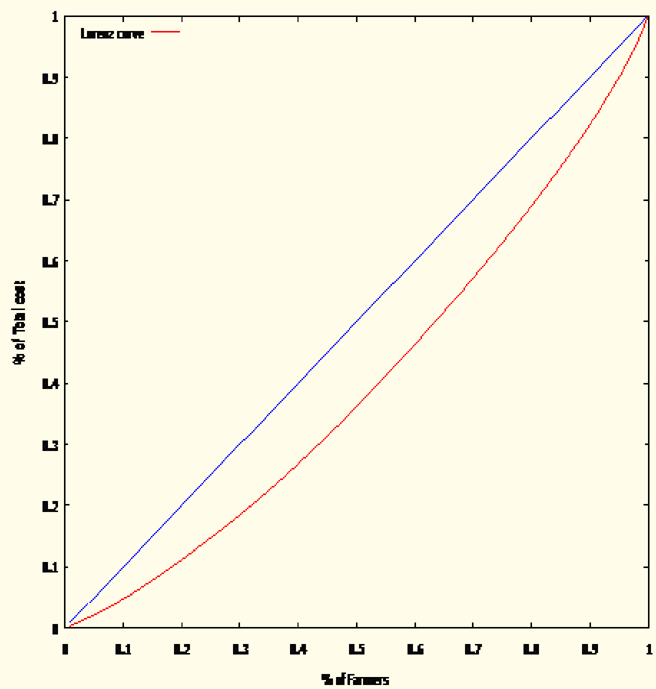

Figure 1: *Total production cost distribution among fish farmers in Niger State, Nigeria.*
Sample Gini coefficient = 0.19928

Estimate of population value = 0.200954

Maximum Likelihood Estimates of Stochastic Cost Frontier

The maximum likelihood estimate of the parameters of the stochastic cost frontier approach of fish farmers in the study area is given in Table (3a). The table contained parameters estimates of stochastic cost frontier approach, inefficiency model and the diagnostic statistics in the model. Diagnostic statistics of the frontier model are sigma squared (σ^2) and gamma (γ) parameters, respectively. The estimated sigma square (σ^2) was 0.0081 and significant at 1 percent probability level, indicating goodness of fit and the correctness of the specified distributional assumption of the composite error term. The estimated value of gamma (γ) was close to 1 and was significantly different from zero thereby indicating that high level of inefficiencies exists in fish production. The estimated gamma parameter (γ) was 0.999 and significant at 10 percent probability level implying that 99.9 percent of the variations in total cost of fish production resulted from cost inefficiency. Moreover, variation in actual total cost of fish production from maximum total cost of fish production between fish farms was attributed to differences in farmer practices rather than white noise or random walk. All the estimated coefficients of expenditures exhibit the expected sign; costs incurred on labour, fertilizer, feed, medication and capital item depreciation were highly significant at 1 percent probability level, respectively, while expenditure incurred on fingerlings was significant at 10 percent probability level. However, expenditure on lime was non-significant, and this may be attributed to low utilization of this input in the production process. The cost elasticities with respect to all input variables use in the production analysis were positive and imply that an increase in the significant variable items will trigger total cost incurred in fish production; ₦1 increase on labour expenditure will trigger total cost incurred by approximately 46kobo; ₦1 increase on fingerlings expenditure will trigger total cost incurred by 4kobo; ₦1 increase on fertilizer expenditure will trigger total cost incurred by 22kobo; ₦1 increase on feed expenditure will trigger total cost incurred by 7kobo; ₦1 increase on medication expenditure will trigger total cost incurred by 11kobo; ₦1 increase on capital item expenditure will trigger total cost incurred by approximately 12kobo, while 1kg increase in fish output will decrease total cost incurred by approximately 63kobo, and this reveals presence of economies of scale. However, all costs parameters are positive, implying that the cost function monotonically increases in input prices, monotonically, in the sense that no-negative marginal returns was observed for all cost inputs included in the model.

The presence of economies of scale among the fish farms computed as inverse coefficient of cost elasticities with respect to the fish output in kg as the only output in the analysis shows that economies of scale prevail among the sampled farms, judging by computed Es which exceed unity (Es = 1.66). The economic implication of this value is that the sampled farms despite being small scale in nature expand their production capacities in order to reduce expenditure incurred to the lowest minimum in course of production irrespective of their scale of operation which indicates that the farms were experiencing decreasing but positive return to scale (stage II of production surface), since return to scale and economies of scale are equivalent measures. Based on the economies of scale and monotonicity observed, validly it can be concluded that all the respondents in the study area operated at the rational production surface. This result further validate Schultz's poor-but-efficient hypothesis that resource poor producers in agricultural setting are efficient in their resource allocation behavior giving their operating circumstances [5]. Homestead/small-scale fish farming is not necessarily a backward, labour intensive, using little of modern machinery and other inputs, and recording very low productivity. Homestead/small-scale, or backyard fish farming as often called can be capital intensive as well as highly productive, and yet may be conventional in nature.

The presence of cost inefficiency model gives appropriate insight in investigating sources of inefficiencies among fish producers. Variation in cost efficiency of fish farmers are likely to arise from their attributes and prevailing technology in the study area. Socio-economic variables included in the model are age, education, experience, household size, extension service, co-operative membership and credit facilities. The signs of the estimated coefficients in the inefficiency model have important implications on cost efficiency of the respondents in the study area. All the estimated coefficients are significant at 1 percent probability level; those with negative signs and significant exhibit influence on fish farmers cost efficiency positively, and vice versa. When investigated at 1 percent probability level the function reveals that the coefficient of age education, experience, household size, extension service, co-operative membership and credit facilities were significant in influencing cost efficiency of fish farming in the surveyed area. Age coefficient was significant but carried positive sign, indicating that cost efficiency decreases with advances in age. It is expected that as farmer becomes older, his or her productivity will decline which in turn leads to cast waste. Education coefficient was negative and significant, implying that formal education leads to improvements in cost efficiency of fish farmers. This is linked to the fact that farmers with education are in better position to read and understand instructions on fish innovation, easily adopt these new technologies and use them effectively to enhance productivity, hence more proceed that will accrue to the enterprise. Experience coefficient was negative and significant, implying that increase in experience improves cost efficiency in fish farming. Farmers with more years of farming experience tend to be more efficient in farm management. Household coefficient was positive and significant, indicating that large household sizes decreases cost efficiency in fish farming. This hold true for household size composed of children less than 14 years and aged people (inactive labour force) because chunk of farm proceeds will be directly consumed by these households leaving farm enterprise with staggering amount of money which in the long run will result to enterprise insolvency. The bid to provide numerous household needs engenders reduction in the magnitude of resources allocated to fish farming activities. Extension service coefficient was negative and significant; indicating that increase extension service delivery improves cost efficiency of fish farming. Agricu1tural extension through advisory services and programmes forges to strengthen the farmers' capacity to develop by providing access to agricultural information, thus, contribute to improvement in agricultural development and enhance good living condition of fish farmers in the study areas. The coefficient of co-operative membership was negative and significant, implying that co-operative membership decreases cost inefficiency in fish farming. Therefore, the need to strength co-operative organization was recognized form marketing their produce and making inputs available to them at reasonable fair prices and at the right time. Credit facilities coefficient was negative and significant; indicating that access to production credit improves cost efficiency of fish production. Access to agricultural credit has particular importance for improving and sustaining production efficiency of fish farms. The need for agricultural loan among the small scale farmers cannot be over emphasized as it enables them to establish and expand their farms. Farm credit long ago had been identified as a major input in the development of the agricultural sector in Nigeria because it determines access to all of the resources on which farmers depend upon.

However, Table (3b) revealed presence of cost inefficiency among the respondents in the study area as justified by hypothesis test of inefficiency effects using the generalized likelihood ratio test which is defined by chi-square distribution, therefore, indicating that the traditional response function (OLS) is not an adequate representation for these data and the inefficiency parameters are stochastic. As such, the null hypothesis of no inefficiency effects in fish farming was rejected, and the alternative was accepted.

Variable	Parameters	Coefficients	SE	t-ratios
General model				
Constant	β_0	1.813***	0.22016	8.23
Cost of labour (₦)	β_1	0.461***	0.01841	25.1
Cost of fingerlings (₦)	β_2	0.0422*	0.02178	1.94
Cost of feeds (₦)	β_3	0.0723***	0.0234	3.09
Cost of fertilizer (₦)	β_4	0.2219***	0.0319	6.96
Cost of medication (₦)	β_5	0.1118***	0.01857	6.02
Cost of lime (₦)	β_6	0.013^{ns}	0.011	1.18
Capital Depreciation cost (₦)	β_7	0.1155***	0.01568	7.36
Fish output (kg)	β_8	-0.6258***	0.2222	2.82
Economies of scale (ES)		1.66		
Inefficiency model				
Constant	δ_0	-0.10723^{ns}	0.1170	0.917
Age (years)	δ_1	0.2346***	0.0322	7.29
Education (years)	δ_2	-0.3536***	0.0395	8.96
Experience (years)	δ_3	-0.6745***	0.07965	8.47
Household size (number)	δ_4	0.8068***	0.11033	7.31
Extension services	δ_5	-0.3520***	0.03893	9.04
Co-operative membership	δ_6	-0.3559***	0.03824	9.30
Access to credit	δ_7	-0.5967***	0.05432	3.82
Diagnostic statistic				

Sigma-square $\sigma^2 = \sigma^2 v + \sigma^2 u$		0.0081***	0.0212	3.79
Gamma $\gamma = \sigma^2 u/\sigma^2 v + \sigma^2 u$		0.999*	0.5995	1.666
Log-likelihood function (llf)		170.794		
LR test		37.48		

Table 3a: *Maximum-likelihood estimates of parameters of the Cobb-Douglas stochastic cost frontier function and cost inefficiency in small-scale fish farming in Niger State, Nigeria.*

Source: Computer print-out of FRONTIER 4.1

*Note: ***, ** Implies significance at 0.01 and 0.05 probability levels respectively.*

Null Hypothesis	Log Likelihood	No. of Restriction	χ^2- Statistics	Critical Value	Decision
H_0: $\gamma = 0$	170.794	9	37.48	23.5893	Rejected

Table 3b: *Generalized likelihood ratio test of hypothesis for parameters of the stochastic cost function for small scale fish farmers in Niger State, Nigeria.*

Source: Computer print-out of FRONTIER 4.1

Estimates of Cost Efficiency

The result of frequency distribution of cost efficiency scores in Table (4) shows individual cost efficiency score which ranged from1.00 to 1.53, with the distribution seemed to be skewed towards the frontier. This means that virtually most cost efficiency index were more than 1.00 or 100 percent. The hypothesis that fish farmers in the study area are allocative inefficient in resource use was, therefore, accepted This suggests that potentials still exist for increasing farm proceeds through better resource allocation The minimum cost efficiency was 1.00, which indicated high level efficiency in resource allocation, maximum cost efficiency score of 1.52. The mean efficiency score was 1.10 with standard deviation of 0.082, implying that most efficient fish farmer operated closer to the frontier. This mean that average fish farmers in the study area recorded cost waste of 10 percent due to poor mix of inputs cost. The estimated score index of the average fish farmer entails that an average fish farm in the surveyed area has costs that are 10 percent above the minimum defined by the frontier. In other words, 10 percent of their costs are wasted relative to the best practiced farms producing the same output and at the same prevailing technology. The cost waste recorded may partly be attributed to poor inputs cost mix. The higher the value of C_{EE}, the more inefficient the fish farm is. However, the frequencies of occurrence of the predicted cost efficiency between 1.0 and 1.05 represent approximately 31.7 percent of the sampled farmers, implying that majority of the farmers are fairly efficient in producing at a given output level using cost minimizing input ratios which reflects the farmers' tendency to minimize resource wastage associated with production process from cost perspective.

Even with the mean score index of 1.10, approximately 64.4 percent of the respondents are frontier farmers since their efficiency scores index are below the mean. The best inefficient fish farmer requires cost reduction of 1 percent [(1.01/1.00)*100] to become economically efficient fish farmer (frontier). The average fish farmer in the study require a cost reduction of 10 percent [(1 - 1.10/1.00)*100] to become economically efficient fish farmer (frontier); require cost reduction of 8.9 percent [(1-1.10/1.01)*100] to attain the status of the best inefficient fish farmer in the study area. The worst fish farmer in the study area require cost reduction of 53 percent [(1 – 1.53/1.00)*100] to become economically efficient farmer (frontier farmer) in the study area; cost reduction of approximately 39.1 percent [(1-1.53/1.10)*100] to attain the status of the average fish farmer, while a cost reduction of approximately 51.5 percent [(1-1.53/1.01)*100] to attain the status of the best inefficient fish farmer in the study area. Graphical distribution of the efficiency scores is shown in Figure 2a. The distribution of the efficiency scores among the respondents are depicted by the Lorenz curve indicate almost equal distribution, given that the Lorenz curve is very close to the line of equality (2b).

Efficiency Level	Frequency	Relative Efficiency (%)
1.00	5	1
1.01-1.05	30	2.5
1.06-1.10	35	22.5
1.11-1.15	14	15.8
1.16-1.20	14	21.7
1.21-1.25	6	9.2
1.26-1.30	4	8.3
≥ 1.31	1	9.2
Total	109	100
Minimum	1.00	
Maximum	1.53	
Mean	1.10	
Mode	1.08	
Standard deviation	0.082	

Table 4: *Deciles frequency distribution of cost efficiencies of fish farmers.*

Source: Computed from MLE Results

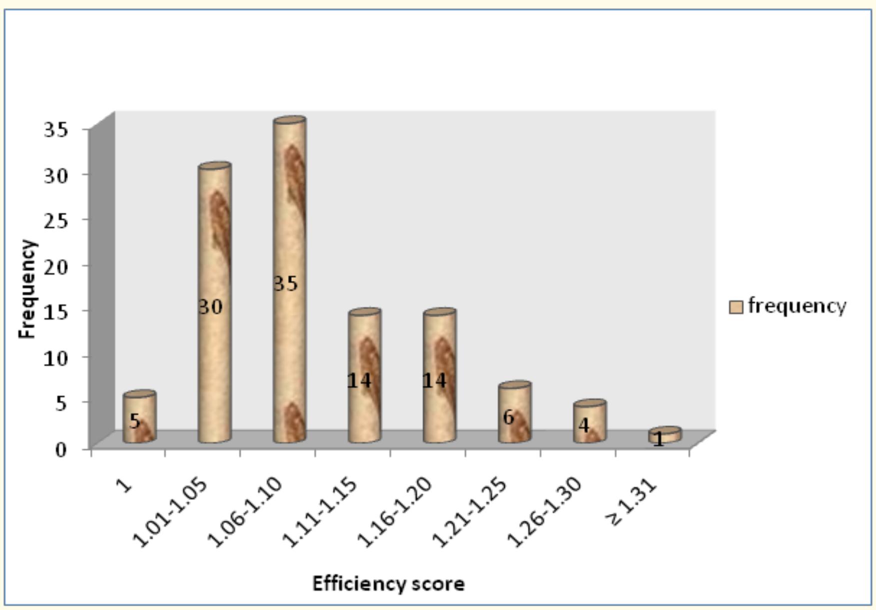

Figure 2a: *Efficiency score distribution of fish farmers in Niger State, Nigeria.*

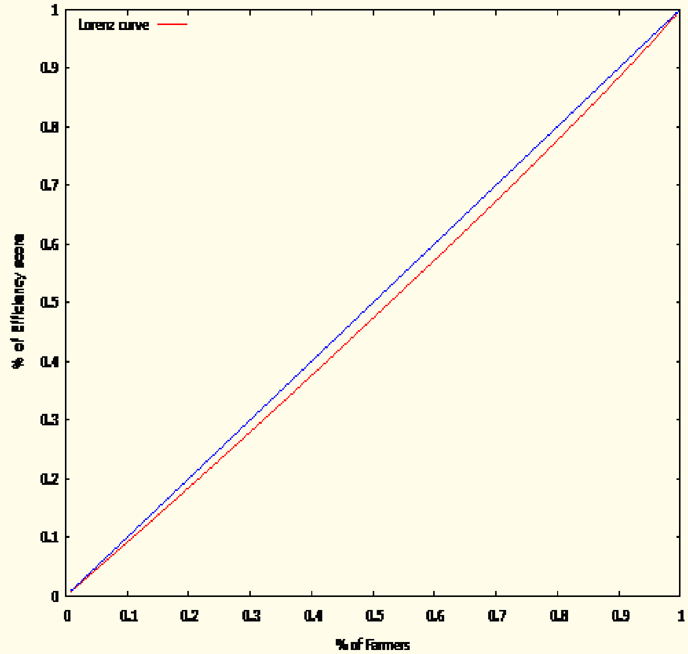

Figure 2b: *Efficiency score distribution among fish farmers in Niger State, Nigeria.*

Sample Gini coefficient = 0.0384578

Estimate of population value = 0.0387809

Skewness of the OLS residuals and problem fitting stochastic frontier model

In maximum likelihood estimation (MLE), the skewness of the OLS residuals in the regression of dependent variable on independent variable need to be checked. The rule is that, when the OLS residuals are skewed in the wrong direction, a solution for the maximum likelihood estimator for the stochastic frontier model is simply OLS for the slopes and for σ_v^2 and 0.0 for σ_u^2. Therefore, pictorial view in Figure (3) revealed a normal skewed distribution for the residuals, thus justifying the appropriateness of MLE application.

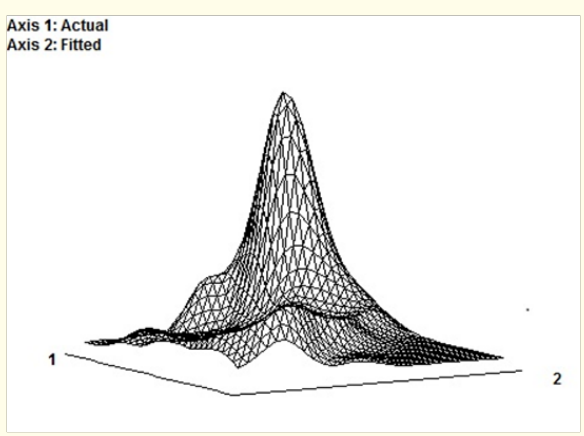

Figure 3: *Kernel Density for Least squares Residual.*

Summary and Conclusion

This empirical study pertain to cost efficiency in homestead/small-scale fish farming in Niger State, Nigeria using stochastic cost frontier approach. A Cobb-Douglas functional form was used to impose the assumption that economies of scale and returns to scale are equivalent measures if the production function is homothetic. The empirical result reveals existence of relative economies of scale in spite that the farms scale of operation is small. Relative economies of scale in the sense that the computed overall economies of scale was above one, which is an indication that homestead fish farmers are currently expanding their present level of production, which in the long run will enable them to experience reduction per out cost of production. The results further revealed that approximately 64.4 percent of the sampled farms operate close to the frontier level, recording scores index of 10 percent or below in terms of cost difference in relation to best-practiced technology. However, findings of the study revealed that fish farmers in the study area are not operating at full allocative efficiency level, but opportunities exist for allocative efficiency improvement by the respondents. Age and large household sizes lead to misallocation of the resources employed by fish farmers. In conclusion, the relative closeness of the computed overall economies of scale (Es) of 1.66 and an average cost efficiency (C_{EE}) of 1.10 from unity, is an indication that despite farmers are small scale resource poor, they are fairly efficient in the use of their resources and that any expansion in their present level of production will cut per output cost of production, given the prevailing economies of scale obtained.

Recommendation

The following recommendations were made based on the basis of the findings obtained:

1. To improve cost efficiency in resource allocation fish production, farmers need to have access to proper current technical and price information at all time and relevant policies to steer the farmers in this direction should introduced by public and private stakeholders in fish production in the state.
2. Fish farmers should adopt cost effective measures in fish production to generate efficient proceed.
3. Fish production enterprise is also recommended as a good strategy to managing surging youth unemployment and a critical weapon to poverty alleviation in the study area.
4. There is need for households to embrace family planning in other to reduce their household sizes.
5. Timely credit facilities should be extended to fish farmers to enable them purchase farm inputs and increase their farm holding.
6. Extension attention to the farmers should be intensified so as to extend improved practices and technical advice to fish farmers.

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