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RESEARCH ARTICLE **ARAŞTIRMA MAKALESİ**

Technical efficiency and artisanal fishing households: Any hope in oil extracting locations? Evidence from Nigeria

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Abstract: Artisanal fishing household's production is investigated using stochastic frontier analysis through Cobb-Douglas production function, which incorporates an inefficiency effects model. Descriptive statistics and profitability index were also used to analyzed the data collected. One hundred and twenty eight households were randomly picked through multistage techniques in the Niger Delta Region of Nigeria. Primary data were chosen using structured questionnaire and interview schedule. Results indicates that greater part of respondents were males with an average age of 42 years who were married with household size of 6 persons. Very many of them did not belong to cooperative society with high educational level. The result indicates that labour, baits and capital inputs were significantly related to output. The average technical efficiency was 73%. This means that the households can still improve their efficiency level by 27%. The structure of production suggests that the returns to scale was 0.9584. The estimated gamma parameter was 0.9423 and was significant at 5% level. Access to credit, membership of cooperative society and fishing experience had an inverse relationship with technical inefficiency while age, fishing distance, gender, number of trips and oil spill had a direct relationship with inefficiency**.** Artisanal fishing was found to be profitable with a net farm income of ₦135261.21 and a benefit cost ratio (BCR) of ₦1.20k. The major constraint to artisanal fishing was pollution. Therefore, the study calls for policies that increases the security of oil pipelines in order to stem the tide of oil spillage and invariably water pollution.

Keywords: *Oil exploitation, technical efficiency, artisanal households, stochastic frontier*

INTRODUCTION

The Nigeria fisheries sub-sector is one of the most significant sector in terms of GDP output and employment of labour. According to Mathew (2001) he stressed that the fishery sector is mostly dominated by small scale farmers that produce total marine catch of 95% in Nigeria.

Fishing has financial and societal benefits. The fishery sector, however, has failed to keep pace with the domestic demand for fish in Nigeria which experts say is fast depleting (Nwosu et al., 2007; Ojo and Fagbenro, 2004). This are however not unrelated with the illegal oil operation activities of multinational companies. This present study tries to find ways to improve on the resource use efficiency of artisanal household. This would amount to proper adjustment in resource utilization in artisanal fishing which would in turn lead to increase in farmers income and standard of living. Measuring efficiency of artisanal households and identifying factors affecting efficient production systems would serve as a panacea to assessing potentials for development of sustainable artisanal fish production (Kareem et al., 2008). In the Niger Delta region, challenges linked to oil spillage had caused harsh financial depression and catastrophe for economic development. It is noteworthy that several studies of fish farming have been carried out by (Adewuyi et al., 2010., Akinrotimi et al., 2009; Nwiro, 2012) but there exists deficiency of pragmatic information on consequence of illegal oil operations on the technical efficiency of fisher folks and therefore, this study was undertaken to fill the knowledge gap. There has been a downward trend in fish output in the Niger Delta region. This down trend is prompted by illegal oil exploitation activities which led to oil spillages in several locations. The water bodies became heavily polluted on each of the occasions, thereby leading to loss of most of the aquatic lives . The downward trend of fishing output has drawn momentous attention from stakeholders globally. Firming the management of artisanal fishing capability, embarking on responsible fishing and stimulating the economic development of artisanal fishing sub-sector are inevitable necessities for the viable improvement for artisanal fisheries as well as for the significant task for management of fisheries in the present or in the future (Zheng et al., 2009). The artisanal fishing industry is an essential component in Nigeria which has developed and made remarkable achievements for the economy.

Therefore, illegal oil exploitation activities has made oil spillage intensity to far outstrip the capacity to regenerate fisheries resources which led to a severe fisheries resources scarcity (Chaoqing, 2007; Yuke, 2009; Handuo, 2013). Consequently, all of these would seriously threaten fish catch vis a viz low income. Efficiency denotes to the superlative interests of the fishing folks profiting from scarce resources (ManKiw, 2013). In other words, the efficiency means the maximum degree of utilization of resources under the condition of certain technical levels or investments (Zhaogun et al, 2018). Technical efficiency of artisanal households is a pointer to evaluate the quality of the fisheries economy progress, which talk about the aptitude to obtain the utmost output from a certain combination of inputs or the knack to use minimum inputs under certain combinations of outputs. Hence, how to improve the technical efficiency of fishing of households and realize the rational distribution of resources in oil extracting location will occupy an important position in national debates. Especially for a country like Nigeria which has witness severe decline in fish output for the past decay leading to huge importation of frozen fish to meet local demand and the resultant effect was low degree of resource use, low efficiency and low benefit, hence study of this nature become fundamental (Yuan, 2014). According to Hannesson (1983) that the level of technical efficiency can significantly affect the financial gain and economic growth of fisheries (Fabio et al, 2009). Chunlei et al. (2007) used the Cobb Douglas functions to calculate the capacity of marine fishing in Zhejiang Province from 1994- 2004 by regarding the annual fishing harvest as the output and putting the quantity of vessels and the professional workforce as inputs. Tingley et al. (2005) utilized the econometric stochastic production frontier (SPF) and the non-stochastic, linear-programming data envelopment analysis (DEA) methodologies to calculate technical efficiency of the English Channel fisheries, and analyzed the factors influencing technical efficiency by using an SPF inefficiency model and Tobit regression of DEA derived scores. Techniques to measure efficiency can be categorized into two groups: non-parametric models, epitomized by Data Envelopment Analysis (DEA); and parametric models, fit in Deterministic Frontier Analysis (DFA) and Stochastic Frontier Analysis (SFA).

Fishing folks may decrease technical efficiency by limiting the use of certain inputs (Pascoe et al., 2001), or on the other hand, they may increase it by intensifying these inputs or by taking processes that correctly explain the property privileges of the fisher folks. However, reduced utilization would result in even lower levels of profitability. Pascoe et al. (2002) stated that measurement of efficiency in fishery sub-sector is vital for numerous ins and outs, particularly when input controls are in place.

Gbigbi (2013) reported that artisanal fishing in oil exploratory communities is not profitable. The possible reasons or explanation for the above finding is lacking. It is possible that oil spillage and its adverse consequence on the artisanal fishing environment could be responsible for the losses incurred/experienced in artisanal fishing business in such communities. The present study was designed to factor oil spillage in the technical efficiency function for artisanal fishing in the study area. There is an on going search for strategic policy that can address the effect of oil spillage on artisanal fishing activities in Nigeria. Yet issue of lack of data is a challenge. Artisanal fishing value chain involves stakeholders such as producers, processors, marketers and fish consumers. The effect of oil spillage on artisanal fishing activities will directly or indirectly create a spill over effect on all the stakeholders. The objective of the study was to present some empirical evidence of oil spillage on technical efficiency of artisanal fishing households in Delta State Nigeria. There is weak knowledge of about technical efficiency especially in relation to oil spillage. This study has successfully factored oil spillage in the technical inefficiency model for artisanal fishing. The individuals that will benefit include all stakeholders in artisanal fishing sub-sector of the economy. This study has provided missing data for policy making which was lacking before now. The specific objectives were to: describe the socioeconomic characteristics of the household head, determine the factors influencing technical efficiency and inefficiency of artisanal fishing households, estimate the elasticity of production inputs and returns to scale among artisanal fishing households, assess cost and return of artisanal fishing and constraints affecting artisanal fishing in the study area.

MATERIALS AND METHODS

The study was conducted in four states within the Niger Delta Area., Nigeria. The states are Delta, Bayelsa, Akwa-Ibom and Rivers. The region has three distinctive ecological zones. The mangrove forest to the south, the rain forest in the middle and the savannah to the north. The area lies between latitudes 5^0N and 7^0N of the equator and approximately between 3^0E and 6^0E longitude. Most of the people are known for artisanal fishing and arable crop production.

The multistage sampling technique was used to choose two local government areas from each state in the firstly based on predominance of fishing and oil exploitation activities. Secondly, four Communities were selected from the eight oil mining local government areas giving sixteen Communities for the study. Finally, eight artisanal households each were picked randomly from the communities and this gave a sample size of one hundred and twenty eight artisanal households. Questionnaire and interview schedule was designed in line with the objectives of the study for the collection of data.

Data were analyzed using frequency count, percentages and means. The stochastic frontier production function model is a modified version of the Cobb-Douglas model used to analyze the technical efficiency and inefficiency of fisher folks in the study area

Model specification

Cobb-Douglas functional form

The Cobb-Douglas functional form of the stochastic frontier production function specified by Seyoum, Battese and Flemming (1998) was adopted in this study. It is defined by an implicit function, y=f(x), which is explicitly stated as ;

$Ln\ Y = b_o + b_1 LnX_1 + b_2 LnX_2 + b_3 LnX_3 + b_4 LnX_4 + Vi-Ui$……………………….(1)

$TE_i = (\exp(-Ui)$

Where $0 \leq TE \leq 1$

Y = Quantity of fish caught (kg)

X_1 = labour used per household head/week (hrs)

X_2 = quantity of fuel and lubricant used per household head/week (litres) for fishing

X_3 = quantity of baits used for fishing per week (kg)

X_4 = depreciation of capital inputs such as boats, engines, gears and accessories (₦)

b_o = intercept

Vi = random error term which are assumed to be independently and identically distributed (having a normal distribution with mean zero and constant variance, envisioned to apprehend events beyond the control of fisher folks. Ui = non-negative random variable called technical inefficiency effects related with the technical efficiency of production of fjsher folks involved. The inefficiency model is stated explicitly as:

$U_i = \delta o + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + \delta_8 Z_8 + \delta_9 Z_9 + d_{10} Z_{10} + d_{11} Z_{11} + d_{12} Z_{12} + e_i$………..........................(2)

Where:

dis are the parameter estimates.

Z_1= age of household head (years)

Z_2 = household size

Z_3 = fishing distance (km)

Z_4 = level of formal education of household head (years)

Z_5 = access to credit (dummy, access =1 otherwise = 0)

Z_6 = gender (dummy, male=1, otherwise=0)

Z_7 = membership of co-operative of household head (membership = 1, otherwise = 0)

Z_8= fishing experience of household head (years)

Z_9= extension contact (number of visit in a year)

Z_{10} = number of fishing trips per week

Z_{11} = type of fishing craft (motorized canoe/boat=1, non-motorized canoe/boat = 0)

Z_{12} = oil spill (oil spillage = 1, no oil spillage = 0)

Cost and return analysis

Net Farm Income (NFI) by and large gives the profitability level of the fishing enterprise by adding together fixed and variable costs and subtracting the total cost from the total revenue in naira.

Hence; NFI = TR – TC (i.e. TFC+TVC)

Where

NFI = Net farm income

TR = Total Revenue

{P = Unit price of output (Naira) multiply by Q = Total quantity of output (Kg)}

TVC = Total variable cost

TC = Total cost.

GM = Gross margin

Hence; GM = TR – TVC

RESULTS AND DISCUSSION

Socioeconomic attributes of respondents

The result indicates that majority (81.25%) of the households were males while 18.75% of them were female. This infers that there were more males into artisanal fishing than females. The male domination in artisanal fishing may be attributed to the fact that women cannot cope with the tedious activities of fishing. The result supports Iyiola (2015) findings that male dominated fishing activities on Ogunpa River at Ibadan. The result indicates that 55.47% of them were within the age range of 40-50 years. This was closely followed by 16.41% that fell between 31-40 years and 14.84% of them were less than 30 years. Only about 13.28% of the respondents were above 50 years. The mean age of the respondents was 42 years. The respondents were within their active age and probably could contribute to artisanal fishing. The finding was congruent with those of Olaoye

(2010). The result further indicated that 76.56% of the respondents were married, 12.50% were singles while very few (about 10.94%) were either widow or divorced. This is an indication that married people are more saddle with economic responsibilities of taking care of their dependents which push them to involve in artisanal fishing. This result support (Adewumi et al., 2012) findings in Kwara State Nigeria. The result also showed that majority (79.69%) of them had between 4-8 persons while 14.06% and 6.25% had less than 3 persons and more than 8 persons respectively. The mean household size was 6 persons. The large household size could denote the availability of labour for artisanal fishing because labour is a major limitation in agricultural production. The finding is in consonance with (Kumolu-Johnson and Ndimele, 2010) about the preponderance of large family sizes among the rura poor in the study area. The result indicated that 64.84% of the respondents did not belong to cooperative society while the remaining 35.16% were members of cooperative society. The result disclosed that majority (88.28%) of households had formal education. This findings supports Lawal and Idega (2004). This could help them in the utilization of innovations in artisanal fishing.

Estimation of the frontier model

The Maximum Likelihood (ML) estimated

Table 1. Socioeconomic attributes of respondents

Variable	Frequency	Percentage	Mean/mode
Gender			
Male	104	81.25	Male
Female	24	18.75	
Age in years			
Less than 30	19	14.84	
31-40	21	16.41	42 years
41-50	71	55.47	
Above 50	17	13.28	
Marital status			
Single	16	12.50	
Married	98	76.56	Married
Widowed/er	6	4.69	
Divorced	8	6.25	
Household size			
Less than 3	18	14.06	
4-8	102	79.69	6 persons
9-13	8	6.25	
Cooperative member			
Yes	45	35.16	
No	83	64.84	Non-member
Educational status			
No formal education	15	11.72	
Primary education	34	26.56	
Secondary education	76	59.38	Secondary edu
Tertiary education	3	2.34	
Total	128	100.0	

parameters of artisanal households are summarized in Table 2. The coefficients of labour, quantity of baits used and capital inputs have the a priori expected positive signs and are statistically significant at 1% showing direct relationship with output. This implies that a 1% increase in labour, quantity of baits used and capital inputs will increase the quantity of artisanal fish by 0.3059%, 0.4633% and 0.1845% respectively.

The estimated variance (s^2 = 0.62) is statistically significant at 5% indicating goodness of fit and the correctness of the specified distribution assumptions of the composite error term. Gamma (g) is estimated at 0.9423 and is statistically significant at 1% indicating that 94% of the total variation in fish output is due to technical inefficiency.

Sources of technical inefficiency

The estimated determinants of technical inefficiency in artisanal fishing by households as obtainable in Table 2 which shows that age had a positive and significant effect on inefficiency, which agrees with a priori expectation at 5% level of probability. This implies that increasing age would lead to increase in technical inefficiency. This shows that the older the fishing household head, the more inefficient he or she becomes. This support the findings of Mbanasor and Kalu (2008) who reported that the older the household head becomes, the more he or she is unable to combine the available technology. The coefficient of fishing distance was positively signed and highly significant at 1% level of probability. This implies that any increase in fishing distance will lead to a corresponding increase in technical inefficiency of the households probably because the households could not employ all means possible to make a good catch to augment for the long distance traveled.

The coefficient of access to credit was negatively signed and significant at 5% level of probability. This implies that households who have access to credit were more technically efficient than their counterpart who does not have access to credit. Because artisanal fishing is highly labour-intensive, substantial part of available credit is used to hire labour, especially for fishing operations. Also, the availability of credit helps to finance the procurement of fishing inputs which have a positive effect on artisanal fishing by household.

The coefficient for gender was positively signed and highly significant at 1% level of probability. This implies that the male-headed households were more technically inefficient than the female-headed household in the study area. So an additional male-headed household will increase technical inefficiency in artisanal fish production by 0.1869% probably because they are physically stronger, they tend to over utilize resources than women.

The coefficient for membership of cooperative societies was negatively signed and significant at 10% level of probability. This implies that households who belong to any form of social organization were technically more efficient than their counterparts who were not members probably because members of farmers' associations or cooperative societies who had access to agricultural information and other production inputs as well as more enhanced ability to adopt innovations than non-members paid adequate attention to such information.

The coefficients of fishing experience was negatively signed and highly significant at 1% level of probability. This implies that increase in the years of experience will lead to increase in technical efficiency. The reason may be that those with experience are likely to seek out for new technology, unlike those with no experience. More experienced households were expected to have had higher levels of technical efficiency than households with low fishing experience. This result disagrees with the findings of Onyenweaku and Nwaru (2005). The coefficients of number of trips was positive and significant. This implies that increase in the number of fishing trips will lead to increase in technical inefficiency.

The coefficient of oil spill was positively signed and highly significant at 1% level of probability. This implies that any increase in oil spill will lead to a corresponding increase in technical inefficiency of the households. The result is not surprising because the adverse effects of oil exploitation on the socio-economic activities of households in the area are high, this helps explain this. Thus with dwindling harvest, fish productivity is bound to fall. This is in line with the findings of Worgu (2000).

Technical efficiency estimates

A significant characteristic of the stochastic frontier production model is its ability to provide farm specific measures of technical efficiencies. The distribution of sample household technical efficiency indices, derived from the analysis of the stochastic production function, is provided in Table 3. The technical efficiency of the sample households is less than 1 (or 100%), indicating that all the households are producing below the maximum efficiency frontier. A range of technical efficiency is observed across the sample household, where the spread is large. The best fishing household had a technical efficiency of 94.98%, while the worst household has a technical efficiency of 10.11%. The mean technical efficiency was 72.66%. This implies that on the average, the respondents were able to obtain just over 73% of optimal output from a given set of inputs. This shows that artisanal fishing households' technical efficiency can be improved by 27% in order to raise the level of fish output in the study area. The distribution of technical efficiency of the artisanal fishing households reveals that only 28 household heads representing 17.50% had a technical efficiency of less than 50%, while 83 fishing household heads representing 51.88% had a technical efficiency of above 80%.

Elasticity of production inputs and return to scale

Elasticity of production inputs and return to scale among artisanal fishing households in the Niger Delta area, Nigeria. The elasticity of production is shown in Table 4. The summation of the coefficients of the inputs 0.9584 obtained indicated decreasing return to scale, and that, in general the artisanal fishing households in the study area used their production inputs relatively efficiently and however, the relative unit prices of individual technical inputs would determine the most efficient use of the variable inputs.

Test of null hypotheses

The outcome of null hypothesis in Table 5 shows that inefficiency effects are present and the variables included in the inefficiency effect model, have effect on the level of technical inefficiency. The chi-square test score of 58.72 was greater than the critical value of 15.13. This null hypothesis is therefore rejected, meaning that the joint effect of these variables on technical inefficiency is statistically significant. This suggest that technical inefficiency effects are significant components of total variability of fishing

Table 2. ML estimates from SFP parameters of artisanal fishing households

Variables	Parameters	Coefficients	Standard Error	t-value
Production factors				
Constant term	β_o	3.0646	0.4668	6.5652***
Labour	β_1	0.3059	0.0929	3.2947***
Fuel and lubricants	β_2	0.0047	0.0762	0.0618
Baits	β_3	0.4633	0.0801	5.7821***
Capital Inputs	β_4	0.1845	0.0596	3.0973***
inefficiency factors				
Constant term	z_0	4.3229	1.1019	3.9228***
Age	z_1	0.0214	0.0194	2.0003**
Household Size	z_2	-0.0208	0.0604	-0.3449
Fishing Distance	z_3	0.0011	0.0002	5.3220***
Education	z_4	0.0928	0.1605	0.5781
Access to Credit	z_5	-0.7426	0.3586	-2.0704**
Gender	z_6	0.1869	0.0320	5.8380***
Membership of Cooperative Society	z_7	-0.7153	0.3962	1.8054*
Fishing Experience	z_8	-0.0215	0.0025	8.5905***
Extension Contact	z_9	0.2263	0.2462	0.9193
Number of Trips	z_{10}	1.1483	0.4006	2.8663***
Type of Fishing Craft	z_{11}	-2.2995	1.9722	-1.1659
Oil spill	z_{12}	4.2018	0.6140	6.8436***
Diagnostic statistics				
Total Variance (Sigma squared)	σ^2	0.6285	0.2366	2.6559**
Variance Ratio (Gamma)	g	0.9423	0.0258	36.4948***
LR Test		88.1930		
Log-Likelihood Function		-63.8258		

*** , ** and * are significant levels at 1%, 5% and 10% respectively output of the respondents (Battese and Coelli, 1995). The null hypothesis, which specifies that the explanatory variables in the technical inefficiency model are not stochastic was also rejected. The chi-square test score of 64.31 was greater than the critical value of 21.59. Therefore, artisanal fishing households are not technically efficient, implying that inefficiency effects are present. therefore, it can be inferred that the explanatory variables in the technical efficiency model significantly contributed to the reason of the technical inefficiency effects for respondents in the study area.

Cost and return analysis

The result in Table 6 indicates that the total cost of artisanal fishing was ₦672138.79 and total revenue of ₦807400 was realized from the sales of fish, making a net income of ₦135261.21. the benefit cost ratio (BCR) value of 1.20 shows that artisanal fishing is profitable and worth venturing into. The BCR of 1.20 simply means that every 1.00 naira invested in artisanal fishing enterprise will yield ₦1.20k. As a rule of thumb, project with benefit cost ratio greater than one implies profit. Since the ratio is greater than one, it indicates that the enterprise is profitable. From this study, the return on investment (ROI) which is net profit (NP) divided by total cost (TC) was estimated and the result showed an index of 0.20. this means that for every one naira invested in fishing business, there is a return of two kobo in the study area. This is a very important parameter for investment decision as artisanal fishers like any other investors may wish to know the profit that can possibly be generated from their limited financial resource.This result indicates that the artisanal fishery business is highly profitable (Abowei and Hart, 2008).

Constraints of artisanal fishing

The result in Table 7 shows that high cost of fishing materials and lack of credit facilities were the most serious problems affecting artisanal fishing which constituted 73.44% and 67.19% respectively. This credit facities which are needed could assist them to get more fishing nets, canoe and other inputs. This will improve fishing activities and enable them adopt new technologies. The respondents further highlighted that those problems were associatezd with high cost of labour (53.13%), pollution (52.34%), water hyacinth (50.78%), lack of government support (50.00%) while the latter constraint was associated with lack of storage facilities (42.97%). This would increase fish spoilage which will reduce their income. The increase cost of labour will invariably result to increased cost of production thereby reducing their profit. Other problems identified were lack of cooperative society (32.81%) and high cost of fuel (31.25%) which affect the smooth operations of artisanal fishing in the study area.

Table 3. Frequency distribution of technical efficiency among artisanal households

Technical Efficiency Range (%)	Frequency	Relative Frequency
≤50	28	17.50
51-60	06	3.75
61-70	18	11.25
71-80	25	15.63
81-90	65	40.63
90-100	18	11.25
Total	160	100
Mean technical efficiency	72.66%	
Minimum technical efficiency	10.11%	
Maximum technical efficiency	94.98%	

Table 4. Elasticity of production inputs and returns to scale among artisanal fishing households

Variables	Coefficient(elasticity of production)
Labour	0.3059
Fuel and lubricant	0.0047
Baits	0.4633
Capital inputs	0.1845
Return to Scale (RTS)	0.9584

Table 5. Generalized log likelihood-ratio test of null hypotheses

Null hypothesis		X^2 statistics	Critical value	Decision
(1)	Ho :g = d_1 = --- = d_{12} = 0	58.72	15.13	Reject Ho
	Artisanal households are technically efficient (no inefficient effects)			
(2)	Ho :g = 0	64.31	21.59	Reject Ho
	(Coefficients of the explanatory variables in inefficiency model are simultaneous equal to zero)			

Table 6. Cost and return of fishing households

Items	Amount (₦)	Percentage
Revenue		
Volume of sales/trip (kg)	1468	
Average selling price/kg	550	
Total Revenue	807400	
Variable costs		
Hiring of gears	46367.80	6.90
Repairs of crafts	102291.00	15.22
Repairs of gears	84909.50	12.63
Fuel	35030.42	5.21
Transportation	8606.08	1.28
Labour	75212.17	11.20
Feeding	195673.45	29.11
Running cost	45000.00	6.70
Total variable costs	593090.42	88.24
Fixed costs		
Cost of gears	35386.70	5.26
Cost of craft	28175.67	4.19
Accessories	15486.00	2.30
Total fixed cost	79048.37	11.76
Total cost	672138.79	
Gross margin	214309.58	
Net profit	135261.21	
Benefit Cost Ratio (BCR)	1.20	
Return on investment (ROI)	0.20	

Table 7. Constraints of artisanal fishing

Constraints	Frequency	Percentage
High cost of spare parts	35	27.34
High cost of labour	68	53.13
Lack of credit facilities	86	67.19
Lack of government support	64	50.00
Lack of storage facilities	55	42.97
Pollution	67	52.34
High cost of fuel	40	31.25
Inadequate extension contact	25	19.53
High cost of fishing materials	94	73.44
Water hyacinth	65	50.78
Lack of cooperative society	42	32.81
Fluctuating Market prices	30	23.44

Multiple responses recorded

CONCLUSION

The study investigated technical efficiency of artisanal fishing households in oil extracting locations in the Niger Delta Area, Nigeria. The results of the study showed that the artisanal fishing households in the oil extracting communities were technically inefficient as a result of illegal oil extracting activities which led to oil spillage which got water bodies polluted and most of the aquatic flora and fauna destroyed and consequently leading to low output and income. The study observed that technical efficiency of artisanal households varied due to the presence of technical inefficiency effects. The variable of access to credit, membershipof cooperative society and fishing experience decreased the artisanal households technical inefficiency and invariably increased their technical efficiencies, while age, fishing distance, gender, number of trips and oil spill increased their technical inefficiencies. The result further showed that there is a substantial potential for enhancing profitability by reducing technical inefficiency through improved efficiency. Artisanal fishing enterprise is profitable. The major constraints identified to impede artisanal fishing were high cost of fishing materials, lack of credit facilities, high labour cost and pollution, but the most serious of the problems is that of oil spillage which pollutes the bodies of water, from where fisher folks earn their livelihood. Conclusively, their technical efficiency is poor.

RECOMMENDATIONS

Arising from the afore said, it is recommended that the government should help the situation of the water bodies by remediating the polluted waters; access to input subsidies should be given to the fisher folks by governmental and non-governmental organizations; microcredit should be made available to the fisher folks; extension programmes should be organized to train the fishermen and women on how to improve their outputs; as a result of the long distance they have to cover while fishing, motorized fishing gears should be given to fishers on long term payment arrangement.

REFERENCES

Abowei J.F.N & Hart A.(2008). Economic Efficiency in Fish Farming: Hope for Agro-Allied Industriesin Nigeria. *Chinese Journal of Oceanology and Limnology*,26(1), 104-115. DOI: 10.1007/s00343-008-0104-6

Adewumi M.O.,. Ayinde O.E.,. Adenuga A.H & Zacchaeus S.T (2012). The profitability analysis of artisanal fishing in Asa River of Kwara state, Nigeria. *International Journal of Development and Sustainability.* 1 (3), 932-938.

Adewuyi S.A., Philip B.B., Ayinde I.A & Akerele D.(2010). Analysis of profitability of fish farming in Ogun State, Nigeria. *Journal of Human Ecology*,31(3), 179-184. DOI: 10.1080/09709274.2010.11906313

Akinrotimi O.A., Abu. O.M.G., Ibemere I.F & Opara C.A. (2009). Economic viability and marketing strategies of periwinkle Tympanotonusfuscatus in Rivers State, Nigeria. International *Journal of Tropical Agriculture and Food Systems*, 3(3), 238-244.

Battese G.E & Coelli T. J (1995). A model for technical inefficiency effects in a stochastic frontiers production function for panel data. *Empirical Economics*, 20, 325-332. DOI: 10.1007/BF01205442

Chaoqing, C.A.O. (2007). The causes of fishery resources decline and countermeasures for sustainable development. *Hebei Fisheries*, 2, 4-5, 49.

Chunlei, F., Hongliang, H & Xuezhong, C. (2007). The theory of SPF and its application to fishing capacity. *Journal of Shanghai Fisheries University*, 1, 48-53.

Fabio, A., Madau, Idda, L & Pulina, P.(2009). Capacity and economic efficiency in small-scale fisheries: Evidence from the Mediterranean Sea. *Marine Policy*, 33, 860–867. DOI: 10.1016/j.marpol.2009.03.006

Federal Republic of Nigeria Official Gazette. (2007) .N0.24, vol (94) Government notice N0.21, Lagos.

Gbigbi, T.M. (2013). Fishing in oil spillage zone: A case study of Burutu Local Government of Area of Delta State, Nigeria. African Journal of Agricultural Research, 8 (16):1563-1569.

Handuo, X (2013). Flowdown of China's marine fishing industry under the recession of resources: An empirical analysis based on the fishery data from 1956 to 2011. Journal of ShanDong University (Philosophy and Social Sciences) 5, 93 (in Chinese).

Hannesson, R. (1983). Bioeconomic production function in fisheries: theoretical and empirical analysis. *Canadian Journal of Fisheries and Aquatic Sciences*, 40, 968-982. DOI: 10.1139/f83-123

Iyiola A.O. (2015). Human Impact on the Water Quality and Benthic Macro-Invertebrate Compositions in Ogunpa River, Nigeria. *Journal of Agriculture and Ecology Research International*, 2 (2), 120-28. DOI: 10.9734/JAERI/2015/14323

Kareem R.O., Dipeolu, A.O., Aromolaran, A.B & Samson A.(2008). Analysis of technical, allocative and economic efficiency of different pond systems in Ogun State, Nigeria. African *Journal of Agricultural Research*, 3(4), 246-254.

Kumolu-Johnson C.A & Ndimele P.E (2010). Length-weight relationships and condition factors of Twenty-one fish species in Ologe lagoon, Lagos, Nigeria, *Asian Journal of Agricultural Sciences* 2(4), 174-179.

Lawal W.L & Idega E.O. (2004). Analysis of fish marketing in Benue State. Proceeding of Paper Presented at Annual Conference of the Association in Agricultural Economist (NAAE) Held at A.B.U. Zaria, November 3-5.

ManKiw, (2013). Principles of economics. Beijing: Peking University Press. 138-139

Mathew S. (2001). Small- scale fisheries perspectives on an ecosystem-based approach to fisheries management. paper presented at the Reykjavik conference on responsible fisheries in the marine ecosystem, Reykjavik, Iceland. food and agriculture organization, Rome.

Mbanasor J.A & Kalu K.C. (2008). Economic efficiency of commercial vegetable production system in Akwa Ibom State, Nigeria: a translog stochastic frontier cost function approach. *Tropical and Subtropical Agroecosystems*. 8(3), 313-318.

Nwiro E.(2012). Fish farming a lucrative business. Accessed online from http://www.thisdaylive.com/articles/fish-farming-a-lucrative-business/119253/

Nwosu F.O., Oguoma N.N.O.; Ohajianya D.O & Ibekwe U.C. (2007). Factors influencing output of fish in Imo State, Nigeria *International Journal of Agriculture and Rural Development*, 10, 37-40.

Ojo S.O & Fagbenro O.A .(2004). Poverty reduction strategy in Nigeria: Improving productivity and technical efficiency in artisanal fisheries in Niger Delta region. paper presented at the 12th Bi-annual conference of the international institute of fisheries economics and trade (IIFET), Tokyo, Japan.

Olaoye O. J., Idowu A. A., Omoyinmi G. A. K., Akintayo I. A., Odebiyi O. C & Fasina A.O. (2012). Socio-Economic Analysis of Artisanal Fisher Folks in Ogun Water-Side Local Government Areas of Ogun State, Nigeria. *Global Journal of Science Frontier Research Agriculture and Biology*,12 (4), 123.

Onyenweaku C.E & Nwaru J.C.(2005). Application of stochastic frontier production function to the measurement of technical efficiency in food production in Imo State, Nigeria: Nigeria. *Agricultural Journal*, 36, 1-12. DOI: 10.4314/naj.v36i1.3202

Pascoe, S & Coglan, C. (2002). The contribution of unmeasurable inputs to fisheries production: an analysis of technical efficiency in fishing vessels in the English Channel. *American Journal of Agricultural Economics*, 84, 585-597. DOI: 10.1111/1467-8276.00321

Pascoe, S., Andersen, J. L & de Wilde, J. W. (2001). The impact of management regulation on the technical efficiency of vessels in the Dutch beam trawl fishery. *European Review of Agricultural Economics*, 49, 16-33.

Seyoum E. T., Battese, G.E & Flemming E.M .(1998). Technical efficiency and productivity of maize producers in Eastern Ethiopia: A study of farmers within and outside the Sasakawa-Global 2000 project. *Agricultural Economics*, 19, 341-348. DOI: 10.1016/S0169-5150(98)00037-1

Tingley, D., Pascoe, S & Coglan, L.(2005). Factors affecting technical efficiency in fisheries: stochastic production frontier versus data envelopment analysis approaches. *Fisheries Research*, 73, 363–376. DOI: 10.1016/j.fishres.2005.01.008

Worgu S.O. (2000). Hydrocarbon exploitation, environmental degradation and poverty in the Niger Delta region of Nigeria, Lund University Lumes programme, Lund, Sweden. Pp 2-11.

Yuan, Y (2014). Low utilization efficiency of China's marine fisheries resources. Guangming Daily.

Yuke, Y (2009). Study on sustainable utilization of marine fishery resources in China: an economic analysis based on the declining phenomenon of marine fishery resources. *Journal of Agricultural Economics,* 8, 100-104.

Zhaoqun, S., Rong, W & Yugui ,Z (2018). Analysis on technical efficiency and influencing factors of fishing vessels: a case study of Haizhou Bay, China. *Iranian Journal of Fisheries Sciences*. 17(3) 516-532.