Catch Levels and Capital Investment of Artisanal Fishermen in Lagos State, Nigeria

K.A. Akanni[1,]*
[1] Olabisi Onabanjo University, College of Agricultural Sciences, Department of Agricultural Economics, Ago-iwoye, Ogun State, Nigeria.

* Corresponding Author: Tel.: +234.805 604 6858; Fax:-;
E-mail: akannikunle2003@yahoo.co.uk

Received 16 November 2006
Accepted 09 October 2008

Abstract

Within the past three decades, the supply of fish in the Nigerian markets is steadily on the decline. This is largely due to the low catch levels of the traditional fishing techniques and other related factors. This study investigates factors that are responsible for the low catch in artisanal fisheries. A total of 222 sets of questionnaire from 120 operators of the manual propulsion fisheries (MPF) and 102 fishermen operating the motorized fisheries (MF) were analyzed. Data were analyzed using descriptive statistics, probit model, stochastic catch frontier measures. The weekly average catch for the MPF operators was 26.1kg, which represents only 41.0% of the 64.1kg the MF operators caught. The fishermen's level of education, fishing distance, fish catch level, available credit facilities, number of contact with extension agents and gender determined the use or otherwise of the motorized fisheries technology. The mean economic (EE), technical (TE) and allocative efficiency (AE) indexes for the artisanal fisherfolks (MPF) are 0.5425, 0.6450 and 0.6317, respectively and 0.6000, 0.7971 and 0.7049, respectively for the MF. However; the technical efficiency of the MF operators can be improved through a better fishing education and timely provision of credit facilities to acquire the needed fishing equipment and materials.

Key words: Artisanal fishermen, Catch level, Efficiency, Capital investment.

Introduction

In Nigeria, there is an on-going quest for improved fishing techniques and gears to replace the low yielding traditional fishing methods. Fishermen are interested in new and improved fishing gears such as canoes, buoys, floats, nets, fish chemicals and mechanization with the use of an outboard engine (Watson *et al.*, 2006). The use of poor quality fishing materials limits the catch levels (Tietze *et al.*, 2005). Some of the synthetic nettings are, for instance, very expensive and poor in quality. Low tensile strength netting and slippage - prone single knots result in distorted or irregular mesh sizes especially in the gillnets. Another example is that the fuel mixture dissolves some floats, reducing their buoyancy. Similarly, hooks are eaten up by rust; thus, lose their efficiency in less than six months. The dearth and high cost of fishing gear accessories are the another problems and many fishermen often need to seek cheaper local options (Davidse *et al.*, 1993 and AER, 2003). The buoyancy of the multi-various floats and the gravitational force of the cement sinkers are not quantified and the attitude of suspending the gear was more of the guess work than science, compromising on gear efficiency.

The fishing gear used by the investigated fishermen is, in general, not well designed nor fabricated. Net meshes are small and therefore generating a lot of drag and the high hanging ratio, thus effective mesh opening and gear efficiency are reduced. Another problem is the loss of fishing gear especially of set gillnets when trawlers plunder grounds reserved for small scale fishermen (Pauly, 2006). This jeopardizes the full financial benefits of gears and by implication, the total investment in artisanal fisheries. Then, there are economic restraints. The Federal Bureau of Statistics FBS (1992) and Clark *et al*. (2005) reported that non-availability of a credit scheme for small-scale capture fisheries militated against its capital-intensive expansion. Only a few financial institutions provide some credit without collateral for "small" loans. Small-scale fisheries are often considered too risky hence most banks do not include them in their credit loan scheme (Clark *et al.*, 2005). In any case, banks have always opted to pay the penalty - fines for under lending rather than chase defaulters. The cost of outboard engines is prohibitive and this is another major problem confronting the artisanal fishermen of Lagos State. An average out-board engine with 55 - 65 horse power costs between ₦250,000 to ₦400,000 depending on the make and state of engine (Hint: The Nigerian currency, Naira (₦) is exchanged at ₦120.00 for US$1.00). Also, timber resources such as Mahogany, *Iroko* and other hard texture wood are getting scarce. As a result, the cost of producing a dug-out boat/canoe is between ₦45,000 and ₦120,000 depending on the type of wood used and the size of the boat/canoe (FBS,1992).

The broad objective of this study was to examine the factors that are responsible for the low fish catch rate in artisanal fisheries of Lagos State. The socio-economic characteristics of the artisanal fisher folks

© Central Fisheries Research Institute (CFRI) Trabzon, Turkey and Japan International Cooperation Agency (JICA)

and the determinants of the use of motorized fishing technology were identified. The efficiency levels of the fisherfolks were also estimated.

Materials and Methods

Sampling Techniques

For the purpose of this study a two-stage sampling technique was used in selecting the respondent fishermen. Lagos State was selected out of the eight (8) maritime states in Nigeria because of the high fishing population. There are three (3) distinct fishing zones in the State: the Western, the Eastern and the Far – Eastern zones. The fishing zones and communities were identified with the assistance of the Lagos State Agricultural Development Authority (LASADA) and agricultural extension agents (AEAs). There are a total of 16 blocks comprising 6 blocks in the Western zone and 5 blocks in each of the Eastern and Far-eastern zones. The first stage involved a random selection of three (3) fishing blocks from each of the three (3) identified fishing zones, thus giving a total of 9 blocks for the study. Then a total of forty – five (45) fishermen (or 45% of total) using Manual Propulsion Fishing (MPF) technology and forty (40) fishermen (or 40 % of total) using Motorized Fishing (MF) technology were randomly sampled from each of the three zones. This gave a total of 255 samples for the study. However, fifteen (15) of the samples from the MPF operators were not returned at all and eighteen (18) samples from the MF operators were rejected due to incomplete and inconsistent responses. Thus, only 222 samples, comprising 120 samples from MPF operators and 102 samples from MF operators were left for proper analysis.

Data Analyses

A combination of various analytical tools was used in the study. These tools include descriptive statistics such as means, frequency and percentages. Specifically, the first objective was achieved using descriptive statistics. The probit model was used to identify the determinants of the use of motorized fisheries (MF) against the less resourceful and traditional, manually -paddled boats (MPF). The probit model which is a quantitative response model, made it possible to predict the likelihood of adoption and use decisions expected on their personal attributes (Falusi, 1976; Ameniya, 1981; Akinola, 1987; Daramola, 1987). In probit analytical technique, the probability of a fisherfolk adopting the use of a fishing technology /innovation is defined in terms of an index or stimulus, which is unobservable. The cumulative normal distributions with zero mean and unit variance are used in transforming the index to the probability range as given by Ayedun and Atobatele (1995) However, Pindyck and Rubinfeld (1998) stated that the general form of the univariate dichotomous choice model could be expressed as;

$$P_i = P_i(y_i=1) = F(\omega_i, \varepsilon_i) \quad (1)$$

$$P_i = P_i(y_i=1) = \int_{-\alpha}^{\omega_I} 1/2\pi \, e^{-t_2/2dt} \quad (I = 1,2\ m) \quad (2)$$

Where, $P_i = P_i\ (y_i=1)$ is the probability of a fisherfolk adopting the use of motorized fisheries (MF). This expression is again a function of the vector of explanatory variables, ω_I, and the unknown parameter vector, ε_I, P_i is the probability that the i[th] fisherfolk chooses to use motorized fisheries (MF): y=1 and y=0 if otherwise. This is because these fisherfolks vary in the critical or threshold levels over a range for which they use a particular practice. It was further stated that probit analysis was a procedure that takes account of heteroscedasticity of the disturbance as well as restricting predictions to values between 0 and 1 by monotonically transforming the original model. The expression is stated in model (3);

$$\omega_i = \eta_0 + \eta_1\gamma_1 + . . + \eta_8\gamma_8 + \eta_9 D_1 + \eta_{10} D_2 + \eta_{11} D_3 + \varepsilon_i \quad (3)$$

Where, ω_i = probability of a fisherfolk using a technology (users of motorized engine = 1; otherwise = 0). γ_1 is the age of fisherfolk (years), γ_2 is the fishing experience (years) and γ_3 is the educational status (years). Similarly, γ_4 is the fishing distance (nautical miles), γ_5 is the household size, γ_6 is the weekly fish catch quantity (₦), γ_7 is the available credit facilities (₦) and γ_{8t} is the number of contacts with extension agents/week. In addition, D_1 is the pollution level of fishing medium (Dummy: low=1; otherwise=0), D_2 is the level of risk (Dummy: low=1; otherwise=0) and D_3 is the Gender of fisherfolk (Dummy: male=1; otherwise=0). ε_I is the error term and η_0 is the constant term. η_1 ....η_{11} are the regression co-efficients (parameters). The reported co-efficient estimates are the asymptotically unbiased and efficient point estimates to be used here. The corresponding standard error to these co-efficient usually measures the likely variation in the estimated co-efficient that may arise from sample to sample. The sign on the constant term can also give some hints on the interpretation of the result. A positive value means that there is a bias towards the dependent variable i.e. probability of the use of a particular fishing technology by a fisherfolk while a negative value is a bias away from it.

The stochastic frontier catch model was used to determine the level of technical, allocative and economic efficiency in both the Manual Propulsion Fisheries (MPF) and Motorized Fisheries (MF) across technologies. Following Bravo-Ureta and Evenson (1994), the fisher folk's frontier catch function written below was basically assumed;

$$Q = g (x_a;\beta) \quad (4)$$

Where Q is the quantity of fish catch, x_a is the vector of input quantities, and β is a vector of parameters. Equation (4) was solved simultaneously to derive the technical efficiency x_t, for a given level of catch (Q), using the following input ratios; $x_1/x_i = k_i$ (i > 1), where k_i is the ratio of observed inputs x_1 and x_i at output Q. If the functional form of the catch frontier is self-dual, (e.g. Cobb-Douglas), then the corresponding cost frontier can be derived analytically and written in general form as:

$$C = h (k, Q, \alpha) \quad (5)$$

Where C is the minimum cost associated with the catch level of Q, h is the translog function, k is the vector of input prices, α is the vector of parameters. By using Shephard's Lemma, equation (5) above becomes

$$\frac{\delta c}{\delta k} = x_i (k, Q) \quad (6)$$

which is a system of minimum cost input demand equation. Substituting a fisherfolk's input prices and quantity of fish catch into the demand system in equation (6) yields the economically efficient input vector x_e. Given a fisherfolk's observed level of fish catch, the corresponding technically and economically efficient costs of fish catch are equal to $x'_t.k$ and to $x'_e.k$ respectively, while the cost of the fisherfolk's actual operating input combination is $X_a.k$. These three cost measures are the bases for computing the following technical (TE) and economic efficiency (EE) indexes:

$$TE = (x'_t.k)/(X'_a.k) \quad (7) \text{ and}$$
$$EE = (x'_e.k)/(X'_a.k) \quad (8)$$

Finally, allocative efficiency (AE), derived from equations (7) and (8) above is given by

$$AE = EE/TE = (x'_e.k)/(x'_t.k) \quad (9)$$

The fishing enterprise, technical efficiency (TE_j) of the j^{th} fisherfolk was estimated by using the expectation of U_j conditions on the random variable $\in_j$ as shown by Battesse and Coelli (1988) i.e.

$$TE_j = \exp. (-U_j) \quad (10)$$

So that $0 \leq TE_j \leq 1$. Similarly, allocative efficiency of the jth fisherfolk (AE) is given by:

$$AE_j = \exp. (-V_j) \quad (11)$$

So that $0 \leq AE_j \leq 1$

To empirically measure efficiency, a stochastic catch frontier model is firstly estimated, and then followed by the approach introduced by Jondrow *et al.*, (1982) to separate the deviations from the frontier into a random and an efficiency component. To show how this separation is accomplished, the stochastic catch frontier was used thus;

$$Q = f (x_a; \beta)\in_j \quad (12)$$

$$\text{Where } \in_j = v_j - u_j \quad (13)$$

is the composed error term (Aigner *et al.*, 1977; Meeusen and Van den Broeck, 1977).

The two components v_j and u_j are assumed to be independent of each other, where v_j is the two-sided, normally distributed random error ($v \sim N(0, \sigma^2)$, and u_j is the one-sided efficiency component with a half-normal distribution ($u \sim /N(0, \sigma^2_u)$).

The maximum likelihood estimation of equation (13) yields estimation for β and λ, where β was defined earlier, $\lambda = \sigma u/\sigma v$ and $\sigma^2 = \sigma u^2 + \sigma v^2$. But assuming a half-normal distribution of u_j, Jondrow *et al*. (1982) suggested the estimation of the conditional mean of u_j given $\in_j$ as;

$$E(u_j / \in_j) = \sigma \left(\frac{f^*(\in_j \lambda/\sigma)}{1 - f^*(\in_j \lambda/\sigma)} - \frac{\in_j \lambda}{\sigma} \right) \quad (14)$$

where, F* and f* are respectively the standard normal density and distribution functions, evaluated as $\in_j\lambda/\sigma$ and $\sigma^{*2} = \sigma_u^2 \text{ x } \sigma_v^2/\sigma^2$. Equations (9) and (11) thus provide the estimates for u and v after replacing∈, σ* and λ by their estimates. Subtracting v from both sides of (14) gives

$$Q^* = f(x_a) - u = Q - v \quad (15)$$

where Q* is the fisherfolk's observed catch level adjusted for the statistical disturbance captured by vj. Equation (15) is the basis for computing the vector x_t and for algebraically deriving the cost frontier. Lastly, the application of Shepherd's Lemma to the cost frontier yields the minimum cost factor demand equations which, in turn, are used to obtain the vector x_e. The use of the single – equation model depicted in equation (13) and (14) is justified by assuming that the fisherfolks maximize expected profit. This has been done in similar studies (Kopp and Smith, 1980; Caves and Barton, 1990; Bravo-Ureta and Evenson, 1994; Rahji, 2003).

For the purpose of this study, the specific estimated Cobb-Douglas model, written explicitly, is as follows:

(i) $In\ Q_{1ij} = \beta_0 + \beta_1 l_n X_1 + \beta_2 l_n X_2 + \beta_3 l_n X_3 + \beta_4 l_n X_4 + \beta_5 l_n X_5 + V_{ij} - Uij$ (16)

where, Q_{1ij} is the quantity of fish catch per fisherfolk per week (kg), X_1 is the labour used per fisherfolk/week (hrs), X_2 is the quantity of fuel used per fisherfolk/week (litres) for fishing, X_3 is the credit used per fisherfolk/week (₦), X_4 is the quantity of Baits used for fishing per week (kg) and X_5 is the quantity of cold storage facilities used per fisherfolk per week (kg). β_i and V_{ij}, Uij are as earlier defined. *ln* is the natural logarithm. The functional form stated in equation (16) above did not reflect seeding/stocking" in the specification of the relevant variable inputs since the fisherfolks only harvest the aquatic media in which they operate. These media are open access resources with unlimited chances of use to members of the public. The *a priori* expectation is that all the independent variables (x_1 ... x_5) above should have a positive relationship with the quantity of fish catch per fisherfolk per week.

Results and Discussion

The socio-economic characteristics that were discussed included the fishermen's age, catch level, fishing experience, credit sources and educational level. The average age of the fishermen practising manual propulsion fisheries (MPF) was 29.42 years while it was 25.5 years for the operators of outboard engine fisheries (MF). About 74.2 percent of those operating MPF and 73.5 percent of the MF operators was 60 years or younger (Table 1). Age may, however, have both positive and negative relationship with efficiency level of the fisherman. It is assumed that younger people with a lot of energy have the capacity to catch more fish than older men with feeble hands. As the fishermen grow older, their performance drops and so does the general fish catch levels (Olomola, 1991; Mabawonku *et al.*, 1984). Youths should therefore be encouraged by the government, through various empowerment schemes such as the National Directorate of Employment, (NDE) and Federal Ministry of Labour and Productivity, to take up jobs in artisanal fisheries sub-sector for a better output level in Lagos state.

For the MPF, the majority (87.5%) of the fisherfolks had a weekly catch level of 60kg or less with an average of 26.1 kg while only 47% of the MF operators had a weekly maximum catch level of 60kg with an average of 64.1kg (Table 2). These catch levels are rather low compared to catch capacity of the motorized engines with high horse power which are capable of covering long distances on water (Zeller and Pauly, 2005; Pauly and Palomares, 2005).

The average fishing experience of the operators of MPF was 18 years and 10 years for the MF operators (Table 3). This may be due to the fact that the use of MF was a relatively new fishing technology among the investigated fishing households compared to the traditional dug out boats/canoes. Normally, the more the fishing experience, the higher the fish catch level since experience aids fishermen's the performance and fortune (Olomola, 1991).

Personal savings were the most important sources of funds for the fisherfolk. About 57% and 52% of the MPF and MF operators respectively got their funds this way. Other sources, arranged in descending order of importance were co-operative loans, loans from friends and relatives, banks and other minor sources (Table 4). Available funds to artisanal fishermen in Lagos state were inadequate. The FBS (1992) and Clark *et al.* (2005), for instance, reported that the non-availability of a credit scheme taking into full consideration the peculiar circumstances of small-scale fisheries militate against capital –intensive expansion. Generally, lack of liquidity and the poverty of the practitioners have retarded the growth of artisanal fisheries. Forde (1994) also supported this position when he wrote that

Table 1. Distribution of artisanal fisherfolks according to their ages

Variables	MPF (n = 120)		MF (n = 102)	
	Freq.	%	Freq.	%
< 20	22	18.3	20	19.6
21 – 40	33	27.6	30	29.4
41 – 60	34	28.3	25	24.5
> 60	31	25.8	27	26.5
Mean	29.42	100.0	25.5	100.0

Table 2. Distribution of artisanal fisherfolks according to their fish catch level per week

Interval	MPF (n = 120)		MF (n = 102)	
	Freq.	%	Freq.	%
< 20	30	25.0	9	8.8
21 – 40	43	35.8	13	12.7
41 – 60	32	26.7	26	25.5
61 – 80	12	10.0	22	21.6
81 – 100	3	2.5	15	14.7
> 100	0	0.0	17	16.7
Mean	26.1 kg	100.0	64.1 kg	100.0

Table 3. Distribution of artisanal fisherfolks according to their fishing experience

Interval	MPF (n = 120)		MF (n = 102)	
	Freq.	%	Freq.	%
< 5	9	7.5	23	22.5
6 – 10	11	9.2	38	37.3
11 – 15	21	15.5	32	31.4
16 – 20	27	22.5	4	3.9
21 – 25	34	28.3	5	4.9
26 – 30	18	15.2	0	0
Mean	18.0	100.0	9.6	100.0

Table 4. Distribution of artisanal fisherfolks according to their sources of credit facilities

Variable	MPF (n = 120)		MF (n = 102)	
	Freq.	%	Freq.	%
i. Personal funds	63	56.8	58	52.2
ii. Co-operative loans	41	46.0	57	51.4
iii. Friends & Relatives	53	43.2	52	46.8
iv. Banks	9	8.1	21	18.9
v. Others	5	4.5	10	9.0

the shortage of credit facilities was one of the major constraints to artisanal fishermen.

The majority (49.2%) of the MPF operators and (34.3%) of the MF operators had less than secondary school education (Table 5). Forde (1994) again stated that the low level of fishing education and social status of the artisanal fishermen were some of the constraints to their fish catching levels and indeed their development. Enlightenment and training/ workshops on fisheries may further enhance the operations and fortune of the fishermen.

The probit model was used to identify the determinants of the use of motorized (modern) fishing technology among artisanal fisherfolks in Lagos state. In the probit analysis, 6 complete iterations were done for the convergence of the model. The restricted parameter estimates are presented in Table 6. The likelihood ratio test indicated that the model, as specified, explained significant non-zero variations in factors affecting the use of motorized fisheries (MF). Parameter estimates for the model were evaluated at the 1%, 5% and 10% levels of significance and six of the eleven variables, (and the dummies) included in the specification of the probit model were significant. These variables are respondents' education, fishing distance, fish catch level, available credit facilities, number of contact with extension agents and gender. However, there are some observable differences in t-values of the significant parameter estimates for the model. Educated fisherfolks have greater likelihood of understanding the working mechanism of the motorized engines and therefore should be able to use it more than illiterate class of fisherfolks. Fishing distance is another important variable that could determine the use or (otherwise) of motorized fisheries technology among the artisanal fisherfolks of Lagos state. Fisherfolks generally want to reach out far into the water/sea to be able to make good catches. This is important, because the nearby coastal waters are usually over-exploited and therefore depleted. Again, the target of increasing fish catch level by the fisherfolks could also make them abandon the manually paddled canoes and adopt the use of modern outboard engines that reach out far into the water to make good catches. The availability of credit facilities for the use of the artisanal fisherfolks could also increase the likelihood of their adopting the use of outboard engines as against the use of traditional, manual-propelled boats/canoes. The credit facilities will enable the fisherfolks to acquire the fishing machines that are capable of reaching far into distant waters and thus increase the fish catch levels of the artisanal fisherfolks.

The higher the number of contacts with the extension agents, the higher the tendency of the fisherfolks to be informed/educated on the importance of the outboard engines. Finally, the gender of the artisanal fisherfolks, often determines the likelihood of use of the outboard engines. Male fisherfolks are more likely to use the modern (motorized) fishing machines than the risk- adverse female counterparts (Adeokun, 2000). This is because female fishers feel more comfortable fishing in the coastal water, for security reasons, as against fishing in the far turbulent deep sea waters. The effect of the variables such as experience, household size, pollution of the aquatic media, and fishing technology risk level was not significant in the probability of fisherfolks's use of modern (motorized) engines. Household size, pollution of aquatic media and fishing technology risk level recorded a negative relationship with the probability of the use of outboard (modern) engines by the artisanal fisherfolks. All other variables, however, had positive relationship with the probability of the use of motorized engines. The negative sign on the household size could be ascribed

Table 5. Distribution of artisanal fisher folks according to their level of fishing education

Variable	MPF (n = 120)		MF (n = 102)	
	Freq.	%	Freq.	%
i. No formal education	18	15.0	8	7.8
ii. Primary	41	34.2	27	26.5
iii. Secondary	53	36.1	39	38.2
iv. Tertiary	8	6.7	28	27.5
Total	120	100.0	102	100.0

Table 6. Restricted probit parameter estimates of the use of motorized (modern) fishing technology (n = 222)

Variable	Parameter Estimate	Std. Error	t-value
Education (γ_3)	1.4468	0.8618*	(1.6788)
Fishing Distance (γ_4)	0.8365	0.4115**	(2.033)
Catch level (γ_6)	0.7934	0.3001***	(2.6438)
Credit facilities (γ_7)	1.1134	0.6374*	(1.7468)
Extension (γ_8)	2.4628	1.4919*	(1.6508)
Gender (Dummy: male = 1; otherwise = 0)	0.1712	0.1031*	(1.6605)
Intercept	-3.7161	2.6054	
Log of likelihood function	-68.521		
Likelihood ratio test	67.120		

***Significant at 1% level.
**Significant at 5% level.
*Significant at 10% level.

to the low level of assistance received by the fisherfolks from the other household members, as well as the high domestic consumption pressure. This also, probably explained the negative relationship observed between the pollution of aquatic media and the risk level of the fishing technology and the probability of the use of motorized (outboard) engines by the artisanal.

The mean economic (EE), technical (TE) and allocative efficiency (AE) indexes for the artisanal fisherfolks (MPF) are 0.5425, 0.6450 and 0.6317, respectively (Table 7) and 0.6000, 0.7971 and 0.7049, respectively for the MF. The mean TE value of 0.7971 is somewhat higher than 0.6450, which was obtained for MPF. In a similar manner, Squires *et al.* (2002) found out in a study on technical efficiency in the Malaysian gillnet artisanal fishery that most fisherfolks exhibited a high degree of technical efficiency. Again, under MPF, the allocative efficiency recorded the highest maximum value of 0.8971 as against 0.8871 and 0.8624 recorded respectively for the technical (TE) and economic efficiency (EE). Technical efficiency (TE) also had the highest range of 0.5450 as against 0.5354 and 0.5284 recorded respectively for TE and EE. The long history of artisanal fisheries in Lagos State should be an asset to the fisherfolks towards increasing their technical efficiency. On the other hand, the technical efficiency (TE) of the fisherfolks under MF recorded the highest maximum value of 0.9514 as against 0.9462 and 0.8773 recorded, respectively for AE and EE. Again, the highest efficiency range of 0.4947 was recorded for EE as observed under MF (Table 7). The standard deviation is, however, higher for EE under both fishing technologies (MPF and MF) than their respective TE and AE values. This infers that the fisherfolks had better ability of maximizing profit (EE) than they were able to increase their fish catch level from the same quantities of measurable inputs (TE).

Conclusion

In this study the researcher investigated the factors that affect the fish catch rate and efficiency levels of the artisanal fishermen in Lagos State, Nigeria. Findings revealed that the average weekly fish catch levels for the MPF and MF operators are 26.1 kg and 60.0 kg, respectively. These quantities are rather too low compared to what obtains for the big fishing vessels with high horse power, which are capable of covering long distance on water. Such vessels often catch up to two tonnes of fish per week (Cheung *et al*., 2007; Zeller *et al*., 2007; Tesfamichael and Pitcher, 2007). There is therefore the need to further empower the local small-scale fishermen to acquire bigger fishing vessels to enable them increase the catch levels and the market supply of fish. Credit facilities could be made available to these fishermen at moderate and affordable interest rates. More microfinance banks should be established in the rural fishing communities where the facilities will be easily accessed by the prospective lender-fishermen. Similarly, as the fishermen gather more experience over time, their efficiency and therefore fish catch levels increase (Cheung *et al*., 2007; Pauly 2006; Mabawonku *et al.*, 1980; 1984). It is thus believed that an improved fish catch will lead to an improved market supply of the commodity and a cut in unit price. With this the catch levels and market supply of fish and the level of consumption of fish in the diets of Nigerians will improve.

Table 7. Distribution of artisanal fisheries according to levels of efficiency

Efficiency level	MPF (N = 120)			MF (N = 102)		
	TE	AE	EE	TE	AE	EE
0.31 – 0.40	5 (4.2)	3 (2.5)	35 (29.2)	0 (0)	0 (0)	2 (2.0)
0.41 – 0.50	16 (13.3)	15. (12.5)	20 (16.7)	0 (0)	0 (0)	21 (20.6)
0.51 – 0.60	31 (25.8)	37 (30.5)	26 (21.7)	3 (2.9)	18 (17.6)	35 (34.3)
0.61 – 0.70	19 (15.8)	29 (24.3)	9 (7.5)	8 (7.8)	36 (35.3)	22 (21.6)
0.71 – 0.80	26 (21.7)	18 (15.0)	18 (15.0)	32 (31.4)	24 (23.5)	12 (11.8)
0.81 – 0.90	23 (19.2)	18 (15.0)	12 (10.0)	56 (54.9)	22 (21.6)	10 (9.8)
> 0.90	0 (0)	0 (0)	0 (0)	3 (2.9)	2 (2.0)	0 (0)
Mean	0.6450	0.6317	0.5425	0.7971	0.7049	0.600
Minimum	0.3421	0.3617	0.3340	0.5361	0.5165	0.3826
Maximum	0.8871	0.8971	0.8624	0.9514	0.9462	0.8773
Range	0.5450	0.5354	0.5284	0.4153	0.4297	0.4947
Std Deviation	0.1181	0.1368	0.1461	0.0577	0.1215	0.1293

Figures in parentheses are percentage distributions.

References

Adeokun, O.A. 2000. Women's Involvement in fish Industry in Lagos State, Nigeria. Unpublished PhD Thesis, Ibadan: University of Ibadan, Department of Agricultural Extension.

Akinola, A.A. 1987. An application of the probit analysis to the adoption of the tractor hiring service scheme in Nigeria, Oxford Agrarian Studies, 16: 70-82.

AER, 2003. Concerted Action: Co-ordination of Research in Fishery Economics and Promotion of Common Methods for Economic Assessment in EU Fisheries. Economic performance of selected European fishing fleets. Annual Report. 289 pp.

Ameniya, T. 1981. Qualitative Response Model. A Survey Journal of Economic Literature, 19: 1483-1536.

Aigner, D.J., Lovell, C.A.K. and Schmidt, P.J. 1977. Formulation and estimation of stochastic frontier production function models. Journal of Econometrics, 6: 21-37.

Aiyedun, E.A. and Atobatele, J.T. 1995. "Multi-variate Probit Analysis of Selected Factors Influencing Technology Adoption Among Farmers in Kogi and Kwara States of Nigeria, Agricultural Systems in Africa, 5(1): 51-53.

Bravo-Ureta, B.E and Evenson, R.E. 1994. Efficiency in agricultural production: the case of peasant farmers in eastern Paraguay. American Journal of Agricultural Economics. 27-37.

Battesse, G.E. and Coelli, T.J. 1988. Prediction of the firm level technical efficiencies with a generalized frontier production function and panel dada. Econometrics. 38: 387-399.

Caves, R.E. and Barton, D.R. 1990. Technical Efficiency in U. S. Manufacturing Industries. MIT Press, Cambridge, M. A.

Cheung, W.W.L., Watson, R., Morato, T., Pitcher, T. and Pauly, D. 2007. Intrinsic vulnerability factors in the global fish catch. Marine Ecology Progress Series, 333: 2-5.

Clark, C.W., Munro, G. and Sumaila, U.R. 2005. Subsidies, buybacks, and sustainable fisheries. Journal of Environmental Economics and Management, 50: 47-53.

Daramola, A.G. 1987. The Study of Socio-Economic Factors Influencing Fertilizer Adoption Decision in Nigeria - A Survey of Oyo State Farmers Fertilizer Research 20: 143 - 151

Davidse, W.P., Cormack, E., Oakeshott, E., Frost, H., Jensen, C., Rey, H.S., Foucault, F. and Taal, C. 1993. Cost and earnings of fishing fleets in four EC countries. Agricultural Economics Research Institute, Department of Fishery, The Hague, 202 pp.

Falusi, A.O. 1976. Application of Multivariate Probit to Fertilizer use Decision" Sample Survey of Farmers in Three States in Nigeria, Journal of Rural Economics and Development, 1: 49 - 66.

FBS, 1992. Fishery Baseline Survey. Lagos State Agricultural Development Project, LSADP 34 – 79.

Forde, A.C. 1994. Update on Sierra Leone fisheries. IDAF Technical Report No: 69. FAO, Rome, 9 pp.

Jondrow, J.C., Lovell, A.K., Materov, I.S. and Schmidt, P. 1982. On the estimation of the technical inefficiency in the stochastic frontier production function model. Journal of Econometrics, 19: 233 – 38.

Mabawonku, A.F; Bolaji, J.O. and Igun, T. 1980. *Economic* Survey of Artisanal Fisheries in Nigeria – Phase 1. An Interim Report on Bendel, Cross – River, Lagos, Ogun, Ondo and Rivers States. Federal Department of fisheries, Lagos: 3-11.

Mabawonku, A.F., Olayemi, J.K., Ogunfowora, O. and Akinyemi, O. 1984. Evaluation of the Artisanal and Inshore Fisheries Development Project. A study commissioned by the Federal department of fisheries, Lagos: 34 – 41.

Meeusen, W. and Van den Broeck, J. 1977. Efficiency estimation from Cobb-Douglas production functions with composed error. International Economic Review, 18: 435 – 444.

Kopp, R.J. and Smith, V.K. 1980. Frontier Production Function Estimates for steam electric generation: a comparative analysis. Southern Economic Journal, 47: 1049-1059.

Olomola, A.S. 1991. Capture Fisheries and Aquaculture in Nigeria: A Comparative Economic Analysis. In: C. Doss and C. Olson (Eds). African Rural Social Sciences Research Networks: Issues in African Rural Development. Winrock International Institute for Agricultural Development. Arkansas: 343-361.

Pauly, D. 2006. Major trends in small-scale fisheries, with emphasis on developing countries and some implications for the social sciences. Maritime Studies (MAST), 4: 7-18

Pauly, D. and Palomares, M.L. 2005. Fishing down marine food webs: it is far more pervasive than we thought. Bulletin of Marine Science 76: 197-200.

Pindyck, R.S. and Rubinfeld, D.L. 1998. Econometric Models and Economic Forecasts. McGraw-Hill

International Editions. 4th Ed., New York: 298-329.
Rahji, M.A.Y. 2003. Determinants of fish catch level in capture fisheries: A case of Ogun Waterside Local Government Area of Ogun State. Personal note.
Squires, D., Grafton, R.Q., Alam, M.F. and Omar, I.H. 2002. Technical efficiency in the Malaysian gill net artisanal fishery. Economics and environment network. Australian National University.
Tesfamichael, D. and Pitcher, T.J. 2007. Estimating the unreported catch of Eritrean Red Sea Fisheries. African Journal of Marine Science, 29: 55-63.
Tietze, U., Lash, R., Thomsen, B. and Rihan, D. 2005. Economic Performance and Fishing Efficiency of Marine Capture Fisheries. FAO Fisheries Technical Paper. No 482. Rome, 68 pp.
Watson, R., Revenga, C. and Kura, Y. 2006. Fishing gear associated with global marine catches: Database Development. Fisheries Research 79: 97-100.
Zeller, D., Booth, S. and Pauly, D. 2006. Fisheries contributions to GDP:Underestimating small-scale fisheries in the Pacific. Marine Resources Economics, 21: 355-370.
Zeller, D. and Pauly, D. 2005. Good news, bad news: Global fisheries discards are declining, but so are total catches. Fish and Fisheries, 6: 156-159.
Zeller, D., Booth, S., Davis, G. and Pauly, D. 2007. Re-estimation of small-scale fisheries catches for U. S. flag Island areas in the Western Pacific: The last 50 years. Fishery Bulletin, 266-270.