

Small-scale Fisheries In Lagos State, Nigeria: Economic Sustainable Yield Determination

Olujimi O. Jinadu

Federal College of Fisheries and Marine Technology,
Wilmot Point, Victoria Island, Lagos, Nigeria.

Abstract: The objective of this study was to determine the sustainable yield of the small - scale fisheries operations in Lagos State. Between January and December 1991, 113 mechanized and 43 non-mechanized fishing units in 21 coastal villages were purposively chosen and surveyed on a bi-monthly basis through questionnaire administration. Costs components of fishing operations and landings of five highly targeted fish families namely: Sciaenidae, Ariidae, Polynemidae, Clupeidae and Carangidae were collected. Multiple linear regression and Cobb-Douglas technique were employed to determine the sustainable yield of the fisheries through the economies of scale in the wet and dry seasons. The multiple linear regression output of the non-mechanized category in monetary terms showed a range of adjusted R^2 values of 0.91 and 0.98 in the two seasons. The F-ratio values were significant at the 0.05 level and highly significant also at the 0.01 level in the two seasons. The respondent categories were unable to combine their cost of operation efficiently from the result of the elasticity. The economies of scale showed that the small-scale fisheries in Lagos State were largely undercapitalized. It was proposed that the Lagos State Government should rejuvenate the defunct subsidy scheme, which on the long run will optimize the catches. Measures recommended to achieve sustainability were those that could stimulate investments into the fisheries so that coastal fishing operations will on the long run be optimal in Lagos State, Nigeria.

Keywords: small-scale, sustainable, yield, multispecies, mechanization, undercapitalization

1.00 INTRODUCTION

Over the years different governments in Nigeria have recognized the relevance of the fisheries sub-sectors, which are composed of the marine, brackish and freshwater. Several attempts were made over the years to boost their productivity through institutional reforms and the various fiscal and economic measures. Some of these measures involved tax exemption and input subsidy schemes for distribution to fishermen to stimulate increased production. Despite all these forms of external intervention in the development plans, the fisheries sector still showed a deficit in the supply and demand of fish to the populace. It was also thought that the sub-sector was a temporary phase of transition to the industrial sector, but today the small-scale fisheries have come to stay as a permanent feature in the fisheries of developing nations worldwide, Nigeria inclusive. For Nigeria to have a meaningful fisheries development policy, information is required on the allocation and utilization of all the input resources or the resource use efficiency in addition to other economic data. The availability of such knowledge will assist the policy makers in pointing the right direction of future development or management.

1.01 Objectives Of Fisheries Management and Development.

A lot of literary studies exist on the objectives of fisheries management and development. These objectives have been classified into three major types, which are biological, economic and social. Their maximum levels

in active fisheries have been determined using the Maximum Sustainable Yield (MSY) by the biologists, Maximum Economic Yield (MEY) by the economists, and the Maximum Social Yield (MSoY) by the sociologists. These three determining levels were developed against the background of the law of diminishing returns applying to fish stock and the inputs - influenciabile and uninfluenciabile- and output relationships pertaining to the scale of fishing operations generally in the fresh, brackish and marine waters. There were pros and cons of the biological and economic objectives like difficulties in setting detailed objectives, inappropriateness of objectives due to changed priorities, technical difficulties in complying with details, the complex and unmechanistic natures of fish stocks. Panayotou (1983) defined MEY, while MacSween (1983) outlined and enumerated its limitations. As a result of the limitations associated with the individual objectives and their working prediction models, Roedel (1976) proposed the use of an amalgam of these three objectives called Optimum Sustainable Yield (OSY).

Fisheries workers in different parts of the globe have worked extensively on the problems facing the development and management of - the industrial and small-scale - fisheries and their failures are indicators of the limitations imposed on research by its complexity. There are problems of the resource base (common property nature, easy entry, finite and renewable nature and open access), heterogeneity and variations in technology of extraction, characterizations, operations (lack of alternative form of employment, profit

maximizing behavior, inter and intra competition, and dualism) and definitions from one location to the other. Studies by Firth (1946, 1966); Norbeck (1954); and Gulland (1974,1979) are some of those who highlighted these constraining factors.

1.02 Characteristics Of Artisanal, Small-scale And Peasant Fisheries.

Tredten and Hersoug, (1992) attempted a traditional definition of artisanal, small-scale, peasant and subsistence fisheries and used Smith's, (1979) classical definition for the purpose of generalization. Haakonsen, (1992) noted the ambiguity of the terms used to define artisanal fisheries in West Africa which he asserted are simpler to categorize as they are assumed to be the equivalent of canoe or pirogue fisheries. These include planked versions such as the "Ghana boat" in Sierra Leone, and to a very minor extent, fiberglass duplicates of traditional vessels such as the Nigerian "banana boat" (Haakonsen, 1992). A potential source of problem according to Haakonsen (1992) is the question of distinguishing professional from part-time fishermen because a large number of the half a million canoe fishermen in West Africa for example are actually occasional fishermen. They fish either for subsistence or to supplement incomes derivable from other economic activities. These part-timers are characterized by the utilization of low cost craft, usually one to three - man canoes, and the employment of gear requiring relatively moderate capital investments. It is also necessary to look primarily at the contribution of fishing to the fisherman's household income, secondly, how much time and effort is put into fishing; and thirdly how he and others perceive him or whether his status in the community is that of a fisherman. Haakonsen, (1992) further affirmed that this should be regardless of whether this may be "high" or "low" in his particular society and the above assertions are of course difficult to determine statistically but they are normally easily observable.

Thompson, (1983), successfully compared the attributes of the fisheries of the industrialized and developing countries and elaborated that most developing countries fisheries have very large artisanal sections and these constitute both social and economic problems. The FAO (1979) enumerated the attributes of the artisanal fisheries of developing nations like Nigeria. Thompson, (1983) asserted that all the drastic resource failures of more than 30 years ago may have been due to the pressure of commercial fleets on artisanal fishing grounds, and then over-exploitation may well occur.

1.03 Need, Importance And Limitations Of Prediction Models.

Prediction models are necessary for fisheries administrators to foresee in advance the evolution of the resource abundance. This is necessary for development and management measures to be taken in time (Garcia

and Le Reste, 1981) and Le Reste, (1982). The production function model is widely used in fisheries economics and can be injected with the universal economic model, The standard model assumes that there is an equilibrium point at which the development of the fishery will stop and where the economic profit will be nil. The existence, therefore, of natural variations in abundance involves the theoretical existence of a family of bio-economic models. The consequences will be fluctuations in profits and likely increases in overexploited fisheries (Garcia, 1984).

Caddy, (1983) noted differences between the multispecies tropical and steady state fisheries. The limitations of the use of stock assessment models that are geared towards the steady state fisheries for multispecies were observed by Pauly, (1979) using the Schaefer Growth model, for instance, takes care of virgin fishery expansion and the relationships or interactions are easy for single species fishery. Multispecies fishery on the other hand is a complex composition of fish species and technical interactions aside, when non-discriminatory gear is applied to such a fishery, total mortality that occurs is a function of stock abundance. One can get more than a hundred to two hundred species in a haul and changes in fishing intensity alter these ecological relationships of age, species, and overall biomass. This could lead to biological extinction of some species and expansion of some as exemplified in the Gulf of Thailand where flat fishes (*Heterosomata* sp) were kept in check by small prey fishes (*Leiognathus equulus*).

Padilla and Charles (1994) defined bio-economic models as quantitative models characterized by the integration of the natural and human sides of the fisheries equation, linking the biological and economic elements. They identified the behavioral and optimization models and noted the challenges of bio-economic models in tropical capture fisheries, which are multiple gears and technological inter-relationships in the harvesting process with limited selectivity. From the failures of the past biological models it was affirmed that bio-economic models can address three complexities that characterize tropical fisheries where pervasive overexploitation is rife: the multispecies nature of the fisheries resource, the multi-objective nature of the exploitation and management, and the multifaceted independent nature of the fishery system as a whole.

1.04 Definition, Causes And Consequences Of Overfishing.

Characterization, causes, symptoms and bio-socio-economic consequences of overfishing in multi-species fisheries have been defined by Pauly, (1984 and 1990). Pauly, (1987) characterized overfishing while Hardin, (1968), coined it the "tragedy of the commons" and this is when the lower bound of economic fishing is reached and fishermen will leave the fishery. McGoodwin, (1983) added that it is a happier state of

affairs to maintain a fishery above the lower bounds of economic and biological overfishing. Aguero, (1987), asserted that in quantitative terms, overfishing or excessive effort is not new and is the "turning point" in the yield levels of an exploitable fishery resource. In management terms, it is the last signal calling for regulations or controlling measures. He believed that the theoretical foundations, manifestations, causes and effects are not yet fully or consistently defined for management purposes.

Clark, (1976) and Waugh, (1984), have distinguished between biological and economic overfishing. Biological "overfishing" is any level of effort which prevents the stock from generating the maximum sustainable yield. Waugh, (1984), Bailey, (1987) and Pauly, (1987) believed that overfishing is essentially an economic problem with strong social and biological implications. Chumpol, (1987), McGoodwin, (1984) and Aguero, (1987), Bailey, (1983,1987), and Firth, (1966), are some of the workers who elucidated on some of the consequences of social overfishing

Since Gordon's first formalization of the economic theory of a 'common property' in 1954, (Clark, 1976, 1985), "economic overfishing" has generally been loosely defined and handled in empirical works without clear recognition or account of several important elements. Aguero (1987) added the inherent nature of fisheries as the causes of overfishing McGoodwin (1983) mentioned a high population while Pauly, (1987) blamed fish biologists or politicians. This is because the fishery biologists are guilty for conservative advice of recommended and adopted levels of management techniques like total allowable catches (TAC), licenses, and quotas in fishery bulletins of steady state fisheries globally especially in the developed nations. Three examples were described where a number of models routinely used by fishery biologists to formulate management advice have the common feature of positing management goals that induce overfishing viz.:

- (1) Using erroneous techniques for fitting surplus yield models to time series of catch - and effort data e.g. production models by Schaefer, (1957) or Fox, (1970). These apply to single species fisheries but are applied to multispecies fisheries also. Gulland, (1969) also noticed that example. The use of Arithmetic mean (AM) or predictive regression for their catch per effort versus effort plots. This regression type assumes that the data on the abscissa scale i.e. effort is to be measured without error (Ricker, 1973) which is clearly unrealistic. Instead, Pauly (1987) suggested the use of Geometric mean (GM) or functional regression.
- (2) Estimating optimum mesh sizes from length - per recruit analysis based on the assumption of knife-edge selection. Here, Beverton and Holt, (1957) assumed that a gear like trawl is knife - edged. This is not realistic in the small fish typical of tropical demersal stocks.
- (3) Continuing the use of Gulland's equation for potential

yield estimates. Gulland, (1970) proposed that the fishing mortality generating MSY ($= F_{msy}$) should be approximately equal to M. M is the rate of natural mortality in a stock, and based on this assumption used the proceeding equation.

$$MSY = 0.5 \times M \times \text{unexploited biomass..} \quad (1)$$

Where

MSY = Maximum Sustainable Yield

M = the rate of natural mortality in a stock

The above equation (1) has been used to estimate (potential) MSY in a variety of tropical stocks. A mean value of M is extremely hard to define. Francis, (1974), Beddington and Cooke, (1983) have shown that it is grossly misleading, this model is still universally used. They showed that $F_{msy} = M$ applies only in fishes with low values of M. such as North plaice and F_{msy} is much smaller than M when the latter is high. This is because it occurs in the small short-lived species characteristic of tropical waters (Pauly, 1980).

Waters, (1991) reviewed the incentives of the open access to overfish using the earlier arguments of Hardin, (1968) and defined the different types of externalities based on studies by Gordon (1954); Scott, (1955); Cheung, (1970); Bell, (1978); Christy, (1978); and Anderson (1986). Complete and detailed studies on the economic inefficiencies of open access regulations were done by Crutchfield and Wellner, (1963); Crutchfield and Pontecorvo (1969); Bell, (1978); Christy, (1978); Anderson (1986) and Hanneson (1989). Different forms of restricting access to a fishery have been discussed in details by Rettig and Ginter, (1978); Rettig, (1984); Mollet (1986); Huppert (1987); Clark et al, (1988); Geen and Nayar, (1988); and Townsend (1990). Other less frequently mentioned alternatives include territorial use right (TURF) by Christy, (1982), Smith and Panayotou, (1984) and sole ownership (Scott, 1955 and Keen 1988).

Much has been written locally about the Nigerian fisheries by Longhurst, (1960a, 1960b, 1962, 1963 and 1964a); Bayagbona (1965); Fagade (1969); Troadec and Bayagbona (1973); Tobor (1973, 1978, 1990, and 1993); Kusemiju (1981, 1991 and 1993); Nsetip (1983); Ajayi and Talabi (1984); Akinyemi (1986); and Elliot (1993). These workers concentrated mainly on the inter-relationships between the biological characteristics of the various fish species and their abundance and hence catchability. Mabawonku (1979, 1981 and 1986) however placed attention on the economics of fishing as a business concern and, the public policies (interventions) that affect returns to the fishing operators. It is noteworthy to mention that studies by Tobor (1983), Kusemiju (1993), and Elliot (1993) reported instances of possible overfishing either in the inshore and inland waters in Nigeria. This study was an attempt to determine the economic sustainable yield of the coastal small-scale fisheries in Lagos State, Nigeria through the cost route

method, the impacts of seasonality and outboard engine mechanization, and the policy implications of the findings.

2.00 Area Of Study.

Lagos State lies to the southwestern part of Nigeria and has boundaries with Ogun State both in the north and east. It is bordered on the west by the Republic of Benin and in the south, stretches for 180 km. along the coast of the Atlantic Ocean. It therefore has 22.5% of Nigeria's coastline and occupies an area of 3,577 sq. km. landmass with about 786.94 sq. km. (22%) of it being lagoons and creeks in Lagos, Ikorodu, Badagry and Epe.

The State is endowed with marine, brackish and fresh water ecological zones with varying fish species that provide productive fishing opportunity for fishermen. FAO (1971) survey showed that at the inception of the State's creation, there were about 30,000 actively engaged fishermen with manual gears and craft types. Of the many policies inherited from the old Western Region, the canoe mechanization scheme was continued with at a period when catches were poor and morale and income very low.

2.01 Common Fishing Gears And Craft Types In Lagos State, Nigeria

A survey by the Lagos State's Ministry of Agriculture and Natural Resources (MANR) in 1985 showed that glass reinforced boats was yet to be adopted in the State but three craft types were in use. These were: (1) Ghanaian dugout canoes with planked free boards (2) smaller local dugout canoes, and (3) local planked canoes. The outboard engines used were of numerous brands with a range of horsepower from 5 to 55 HP. The gears in use were: (1) gill nets which could be surface or bottom, set, drifting and/or encircling, (2) beach seines could be of 200 to 800 meters length, (3) cast nets, (4) hooks and lines, (5) stream weirs and, (6) traps (Udolis and Solarin, (1979).

The Ghanaian dugout canoes ranged from 8 - 12 meters length over-all (LOA) with beach seine as fishing gears. The canoes were made from silk samba trees (*Triplochiton scleroxylon*) in the western zone. The local dugout canoes had LOA range of 6.1 - 8 meters from silk cotton trees of *Ceiba penitandra* and ironwood (*Lophira alata*) used by marine and inland gill net operators. Planked canoes of 5.5 - 8.5 meter LOA were also being used for gill netting, long lining and shark fisheries in the eastern zone. Woods used were *Terminalia sp* (white or black afara), Mahogany (*Khaya ivorensis*) or silk cotton tree of ceiba. The nettings were of mesh sizes with a range of 9 to 51 mm. in the codend, bunt and wings of beach seines; 24 to 52 mm. for encircling gill nets; 41 to 305 mm. for set gill nets and 300 mm. for shark nets. The crew of the marine encircling net was made up of seven to fifteen while for the beach seine net crew it was 20 to 50.

3.00 METHODOLOGY.

The traditional fisheries operations surveyed for this study were in the coastal and brackish water fisheries. The survey was carried out through questionnaire administration for a period of eleven months (covering the dry and wet seasons) in twenty-one (21) predominantly fishing villages in 1991. Since the fishing population is made up of indefinite strata with differing characteristics and each stratum has a proportionate ratio in terms of number of fishing units to every other stratum the villages were purposively chosen for being active fishing locations. The multispecies nature limited our choice and preference for certain economically viable and targeted fish families therefore the landings chosen for the survey were from the families of Sciaenidae (croakers), Polynemidae (threadfins), Carangidae (bumpers), Ariidae (sea catfishes) and the Clupeidae (sardines). The choice of these fish families was based on past studies by Nsetip (1983); Ajayi and Talabi (1984); FDF (1985, 1988 and 1990) and Akinyemi et al (1986) who observed the predominance of these fish families in artisanal landings.

Table 1: Distribution of the Respondent Fishing Units

| Villages | No. | % | Gear Types | Fishing Gears |
|----------------------------|-----|------|-------------|--------------------------|
| 1) Okunfolu | 22 | 14.1 | Gillnet | Plank canoe |
| 2) Okegelu | 3 | 1.92 | Gillnet | Plank canoe |
| 3) Okun Ise | 9 | 5.77 | Gillnet | Plank canoe |
| 4) Imedu | 1 | 0.64 | Gillnet | Plank canoe |
| 5) Akodo | 5 | 3.22 | Gillnet | Plank canoe |
| 6) Idasho | 10 | 6.44 | Gillnet | Plank canoe |
| 7) Lekki | 9 | 5.77 | Gillnet | Plank canoe |
| 8) Igbekodo | 5 | 3.22 | Gillnet | Plank canoe |
| 9) Apakin | 6 | 3.85 | Gillnet | Plank canoe |
| 10) Osoroko | 10 | 6.44 | Gillnet | Plank canoe |
| 11) Otolu | 10 | 6.44 | Gillnet | Plank canoe |
| 12) Oringanrigan | 5 | 3.22 | Gillnet | Plank canoe |
| 13) Olomowewe | 5 | 3.22 | Gillnet | Plank canoe |
| 14) Ikare | 1 | 0.64 | Beach seine | Local dugout |
| 15) Ibeshe | 1 | 0.64 | Beach seine | Local dugout |
| 16) Liverpool* | 4 | 2.6 | Setnet | Plank canoe |
| 17) Ashikpa | 12 | 7.69 | Beach Seine | Ghanain type |
| 18) Agbonrin | 7 | 4.49 | Beach Seine | Ghanain type |
| 19) Sakpo-Beach | 13 | 8.33 | Beach Seine | Ghanain type & Gillnet |
| 20) Sakpo-Falola | 1 | 0.64 | Beach Seine | Ghanain type |
| 21) Gbagi-Aivoji | 3 | 1.92 | Beach Seine | Local dugout Gillnet |
| 22) Ajido-Vivi | 14 | 9.0 | Beach Seine | (All above types) Setnet |
| Total: 160 | | | | |
| * Omitted from the study. | | | | |
| Source: Study data (1991). | | | | |

The primary data were collected using a purposive sample of one hundred and fifty six (156) respondent fishing units with considerations given to the common problem of seasonal redeployment of craft and gear types. Initial samples were collected on the stock of the fishing units

with the cooperation of the Lagos State Agricultural Development (LSADP) agents in the villages. Information gathered were fishing inputs' sizes, life span, (yrs.) and types viz: length of boat, (m.), area and types of net (m²), outboard engine, ownership, capacity and types. Based on the ownership of outboard engines, the respondent fishing units were categorized into two with 113 mechanized and 43 non-mechanized Table 1 shows the distribution of the respondent units during the survey period.

The data collection was done on a fortnightly basis by the field enumerators who made actual observations of the fish sales transactions at the landing jetties. This enabled them to record the prices, quantities and types of fish landed and the general marketing situation. They additionally extracted information from the fishermen about the conditions at the fishing grounds, weights of the different species/families of interest to the study frame. Thereafter at a time most appropriate and convenient to the sample unit owner(s), the enumerators visited the household(s) and canvassed for details relating to the costs and earnings of the fishing trip(s). The data collected were directly entered into the schedules. After the monthly data were collected, the enumerators added the figures and entered them as the monthly totals. All the input data collected during the survey were standardized and processed using two weeks (14 days) of good fishing period as the yardstick of a monthly operation. The extrapolated monthly data were averaged and thereafter multiplied using the above factor of fourteen (14). Data processing on the variable costs (gear repairs, craft repairs, fuel, losses incurred during fishing, hired labor), earnings and total fishing effort, actual fishing time, voyage time, number of non-owners fishing were analyzed. The findings to be presented later are the results of analysis of the data in their highest state of consolidation at the monthly and seasonal levels.

3.01 Theoretical Consideration

Ogunmoroti (1989) quoting Smith (1982) asserted that the choice of the explanatory variables to include and the appropriate functions depends largely on the assumption underlying the biological relationships in the production process. Frederick et al (1985), and Panayotou (1985) described the stock and fishing effort as the two major variables of relevance in the consideration of the production function. A production function can therefore be specified on the basis of these two variables as follows;

$$Q = f(s, e, Ei) \dots \dots \dots (2)$$

Where Q = catch
 s = fish stock
 e = fishing effort
 Ei = error term

Khaled (1985) and Panayotou (1985) added that

a fish stock could be assumed fixed for a given fishing season. The variation in catch will therefore be solely due to the variation in effort applied. This is implied in the above specification of equation (2). The fishing effort is however a composite input which could be broken into its component elements of capital, labor, time spent at sea, actual fishing time, length of craft, area of gear, depth of fishing, weather conditions at sea and on land. The capital item in particular can be broken down into costs of gear and craft, maintenance and repair of gear and craft types, depreciation, insurance, taxes, hired labor, fuel and other miscellaneous expenses. The present paper however concentrated on costs of labor, maintenance and repairs, fuel, losses (to craft and gears) during fishing; and the residual costs of craft and gears. In addition, variables without observable prices like length and area of craft and gears, actual fishing time, number of hired hands, actual fishing and total voyage times were considered in explaining the variations in output of the fishing units whether mechanized or not. This was stated implicitly as:

$$Q = f(X_1, X_2, \dots, X_n, Ei) \dots \dots \dots (3)$$

Where
 Q = an index of catch from summation of quantities of individual species caught in kg. and weighted by their prices (=N=, \$1.00US = N100.00).
 X₁ = cost of gear repairs
 X₂ = cost of craft repairs
 X₃ = fuel cost (where applicable)
 X₄ = cost of losses incurred during fishing trips
 X₅ = hired labor cost
 X₆ = residual cost of craft
 X₇ = residual cost of gear
 X₈ = actual time spent fishing (hrs.)
 X₉ = boat length
 X₁₀ = area of gear
 X₁₁ = total voyage time
 X₁₂ = number of non-owners fishing
 X₁₃ = outboard engine mechanization (where applicable)

This relationship could be quantified by making this equation 3 explicit. The ordinary least squares (OLS) technique was then employed to estimate the functions. The power function (Cobb-Douglas) had however been used in Asia (Thailand) for capture fisheries production by Panayotou (1987) and Rungrai et al (1987). In Nigeria, Okiya and Oguru, (1991) related catch to the components of fishing effort with specifications of the variables in monetary terms for their study of artisanal fisheries while Olomola (1992) used the production function for the mechanized and non-mechanized small-scale fisheries in Ondo State, Nigeria. They estimated the Cobb-Douglas function as

$$\ln Q = \ln a_1 + \ln X_1 + a_2 \ln X_2 + \dots + \ln X_n \dots (4)$$

The ease of estimation of the physical marginal product (MP) of the fishing inputs, production elasticities,

returns to scale/economies of scale, technical and economic efficiencies are some of its advantages (Panayotou et al, 1982). Ogunmoroti, (1989) however enumerated some of the disadvantages of the power function as constraining the elasticity of substitution between inputs to be always equal to one. This study will however make use of this power function in spite of this demerit alongside the linear function. Using the ordinary least squares techniques (OLS), equations (3 and 4) were estimated for the two fishing categories and seasonality. The results obtained from equations (3 and 4) and the summation of the individual chosen variables were used to achieve the objective of sustainable economic yield with respect to the variations in the categories of mechanized and non-mechanized in the seasons. The choice of the variables included in the above models was based on the exploitative technology of fish production among the small-scale fishermen in Lagos State, Nigeria. The resultant adjusted R² determined which model fitted the analysis closely, that is, the one that gave the best fit with the higher adjusted R².

The outputs of regression analyses for either the mechanized or non-mechanized fishing units in the seasons (wet and dry) were further tested for multicollinearity due to the number of the variables used. Kane (1969) asserted that multicollinearity arises whenever, either in the population or in the sample, several of the explanatory variables stand in an exact or almost exact relation to each other. When multicollinearity occurs, it is as if numbers of a subset of explanatory variables act always in unison. The greater the degree of multicollinearity that obtains, the more arbitrarily and unreliably does least squares allocate the sum of explained variation among the individual explanatory variables (Watson, 1951a; 1951b). Multicollinearity, according to Kane (1969) must be regarded as a black mark that reduces our confidence in conventional tests of the significance of the various coefficients. To solve this problem a Durbin Watson statistic was employed.

3.02 Estimation Of Annual Cost And Revenue Of Fishing.

Revenue was based on sales from catches and the cost of fishing was based on annual expenses on fishing gear(s) and boat(s). Based on the formula of Harcourt, (1972), rental value of the cost of fishing, k, was calculated as:

$$k = \frac{n}{1-(1+r)} + rk \dots\dots\dots (5)$$

where

- k = acquisition cost of fishing inputs (canoe, fishing gear).
- N = life span of boat and gear.
- r = interest rate (at 30% per annum).

Table 2: Result of the Linear Regression technique for the Non-mechanized Category in Lagos State, Nigeria.

(1991).

| Variables/ Seasons | Dry | Wet |
|--|------------------------------|-------------------|
| Constant | na. (14809.4) | na. (1239.27) |
| X ₁ – Gear repairs cost | 0.03 (2.00) | -0.44 (1.15) |
| X ₂ – Craft repairs cost | 0.03 (1.87) | 0.47 (1.41) |
| X ₃ – Fuel cost | - | - |
| X ₄ – Cost of fishing losses | 0.03 (0.99) | 0.36 (0.91) |
| X ₅ – Hired labor cost | 0.33 (0.65) | 0.08 (0.65) |
| X ₆ – Residual cost of craft | 0.04 (53.64) | -0.03 (31.01) |
| X ₇ – Residual cost of gear | 0.08 (130.75) | -0.37 (48.05) |
| X ₈ – Actual time spent fishing | 0.11 (91.49) | 0.25 (64.13) |
| X ₉ – Boat length | -1.84 (12401.54) | 0.61 (1018.81) |
| X ₁₀ – Area of gear | 0.04 (0.52) | 0.02 (0.28) |
| | R ² 0.98 | 0.91 |
| | Adjusted R ² 0.97 | 0.88 |
| Durbin Watson Statistic | - | - |
| F – Ratio Calculated | 109.22 | 35.37 |
| df | 9 | 9 |
| N | 43 | 43 |

() Figures for the standard errors of the b- coefficients
Source: Survey Data

4.0 RESULTS AND DISCUSSION.

4.01 Economies of Scale

The result of the regression techniques with their variable coefficients in the dry and wet seasons for the non-mechanized and the mechanized fishing categories are shown in Tables 2 and 3. The estimation of a production function yields further results such as the returns to scale (RTS). This indicates the proportionate increase in output resulting from a proportionate increase of all inputs. If doubling of all inputs brings about a doubling of outputs, constant returns to scale are said to prevail, or the production function is homogeneous of degree one; if output more (or less) than double as a result of doubling of all inputs, we have increasing (or decreasing) returns to scale or the production function is homogeneous of degree greater (or less than) one. In Cobb-Douglas production function, the returns to scale (RTS) are given by the sum of the explanatory input coefficients (Wattanatchariya et al, (1982) and Panayotou, (1987).

$$RTS = \sum E a_i \dots\dots\dots (6)$$

Table 4: Result of Cobb-Douglas Technique of the Mechanized category in Lagos State, Nigeria. (1991)

| Variables/ Seasons | Dry | Wet |
|---|-----------------|--------------------|
| Constant | 11.67 (4.3) | 6.52 (1.27) |
| X ₁ – Gear repairs cost | 0.06 (0.13) | -0.00284 (0.04) |
| X ₂ – Craft repairs cost | -0.31 (0.19) | 0.1 (0.13) |
| X ₃ – Fuel cost | -0.0057 | -0.16 |
| X ₄ – Cost of fishing losses | 0.09 (0.09) | 0.14 (0.07) |
| X ₅ – Hired labor cost | 0.55 (0.09) | 0.45 (0.06) |
| X ₆ – Residual cost of craft | -0.06 (0.26) | -0.1 (0.08) |
| X ₇ – Residual cost of gear | 0.05 (0.31) | 0.04 (0.17) |
| X ₈ – Actual time spent fishing | -0.21 (0.12) | - 0.1 (0.09) |
| X ₉ – Boat length | -1.1 (0.33) | 0.01 (0.02) |
| X ₁₀ – Area of gear | 0.38 (0.18) | - 0.04 (0.05) |
| X ₁₁ – Total voyage time | -0.37 (0.33) | -0.05 (0.09) |
| X ₁₂ – No. of non-owners fishing | -0.53 (0.34) | 0.09 (0.08) |
| R ² | 0.71 | 0.95 |
| Adjusted R ² | 0.62 | 0.94 |
| Durbin Watson Statistic | 2.19 | 2.21 |
| F – Ratio Calculated | 7.26 | 106.22 |
| Df | 11 | 11 |
| N | 113 | 113 |

() Figures for the standard errors of the b- coefficients
Source: Survey Data

Table 4: Sum of the coefficient from the Linear and Cobb Douglas production functions for fishing categories in Lagos State, Nigeria. (1991).

| Categories | Non-mechanized | | Mechanized | |
|------------|----------------|-------|------------|------|
| Seasons | Dry | Wet | Dry | Wet |
| | -1.15* | 0.15* | 10.21 | 6.89 |

(*) The summed coefficients are devoid of the constants from the linear regression technique.
Source: Survey data (1991).

The range of the summed coefficients for the non-mechanized and mechanized in the dry and wet seasons in Table 4 is between -1.15 (without the constants added) being the least in the dry season for the non-mechanized and 10.21 as the highest by the mechanized category in the dry season. If the constants of the Linear regression outputs of the non-mechanized category in the

wet and dry seasons are added for the purpose of the economies of scale the values would have been in the range of three digit figures, therefore the sums of the coefficients of the non-mechanized category of fishing units would be interpreted with caution.

From the empirical results, the implication of the values in Table 4 is that all the categories of the fishing units whether in the dry or wet seasons and in the small-scale fisheries of Lagos State, Nigeria depict a typical stage one of the production function. This stage represents the irrational region as far as production economics is concerned. The use of the resources therefore can be increased further to increase profit.

According to our empirical result, the non-mechanized category would have had the highest summed values of RTS relative to the mechanized respondents. This is expected because Jinadu (1998) has shown that the non-mechanized operators are limited by their financial ability to engage in a more financially risky operation because they only invested the minimum cost required to be operational in the fisheries unlike the mechanized operators. It was further asserted that the mechanized operators had additional advantages for their fishing expeditions in physical terms like the type, area and size of gear; larger sized and longer craft types; age and the general efficiency of their gears and craft types; ability to engage more hands for their fishing trips; and the advanced motor ability from the outboard engine ownership which allows for multiple fishing trips per day.

5.0 CONCLUSION AND POLICY IMPLICATIONS

The sum of the individual coefficients from the different regression techniques for the categorized fishing units in the seasons was relevant for the economic sustainability of the small-scale fisheries of Lagos State, Nigeria. The implication is that the potential fisheries resources and the benefits from the resource to the society, is not maximized whether mechanized or not. According to our findings there was gross under-exploitation and it can be assumed and concluded that the small-scale operators in the coastal fisheries of Lagos State, Nigeria were in the stage of development of their fisheries and therefore undercapitalized. It is recommended that the State government should look for ways and means to assist the small-scale fishing operators through external interventionary measures. One of these measures could be the rejuvenation of the defunct input subsidy scheme with an improved preparation and organization of operation with phased implementation so that the expected stimulation of the developing fisheries operations through the external intervention could be achieved and the subsequent removal will not traumatize the small-scale fishing operators in Lagos State, Nigeria.

Acknowledgements

The data for this study were collected with the assistance of the Fisheries Extension Agents (FEA's) of the Lagos State Agricultural Development Agency. Appreciation is expressed for the contributions of the late Professor A. F. Mabawonku (Department of Agricultural Economics) who was the architect of the study, Dr. O Akinyemi (Department of Wildlife and Fisheries Management and Professor S. O. Fagade (Department of Zoology, University of Ibadan for their critical review of the draft, comments and suggestions, and the contributions of the Director of the Nigerian Institute for Oceanography and Marine Research, Victoria Island, Lagos State, Nigeria.

REFERENCES.

- Aguero, M., Economic consequences of excessive effort, in Indo Pacific Fishery Commission Symposium on the Exploitation and Management of Marine Fishery Resources in Southeast Asia, IPFC/87/Symp/IV/WP.3,16-169, 1987.
- Ajayi, T. O and O. S. Talabi, The potentials and Strategies for Optimum. Utilization of the Fisheries Resources of Nigeria, Nigerian Institute for Oceanography and Marine (NIOMR) Research Technical Paper 18.
- Ajayi, T.O. and J.G. Tobor, Current Management of Marine Fishery Resources For Sustainable Development in Nigeria, Nigerian Institute for Oceanography and Marine Research (NIOMR) Technical Paper 77, April 1992.
- Akinyemi, O. A., M. Balogun and S. O. Talabi, Catch Assessment of Commercially Important Fin-Fish of Nigeria's Trawling Industry, *Journal of West African Fisheries* Vol 1 (1), April, 1986.
- Anderson, L. G., The economics of fisheries management, Revised ed. Johns Hopkins University Press Baltimore, MD, U.S.A., 1986.
- Bailey, C., The Sociology of Production in Rural Malay Society, New York and Kuala Lumpur Oxford University Press 1983.
- Bailey, C., Social consequences of excess fishing effort in Indo Pacific Fishery Commission Symposium on the Exploitation and Management of Marine Fishery Resources in Southeast Asia, IPFC/87/Symp/IV/WP, 3 1987.
- Bayagbona, E. O., The effect of Fishing Effort on Croakers in the Lagos trawling ground, *Bulletin Ifan* 27(1): 334 – 338, 1965.
- Beddington, J.R. and J. G. Cooke, The potential yield of fish stocks, Food and Agricultural Organization (FAO) Fishery Technical Paper 242, Rome, Italy, 1983.
- Bell, F. W., Food from the sea: The economics and politics of ocean fisheries, Westview Press Boulder, Colorado, 1978.
- Beverton, R.J. H. and S. H. Holt, On the dynamics of exploited fish populations, Fishery Investigation in Ministry of Agriculture Fishery and Food, Great Britain Series 2, Sea Fishery 19, 1957.
- Caddy, J. F., An Alternative to Equilibrium Theory for Management of Fisheries, in Food and Agricultural Organization (FAO) Papers presented at the Expert Consultation on the regulation of Fishing Effort (fishing mortality), Rome, 17-26 January 1983, A preparatory meeting for the FAO World Conference on fisheries management and development, FAO Fishery Report (289) Suppl 2, 1984.
- Cheung, S. N., The Structure of a contract and the theory of a non-exclusive Resource, *Journal of Law Economics*, 13: 49 – 70, 1970.
- Christy, F. T. Jr., The costs of uncontrolled access in fisheries in Limited Entry as a Fishery Management Tool, R. B. Rettig and J. J. C. Ginter, University of Washington Press, Seattle, 201 – 210, 1978.
- Christy F. T. Jr., Territorial use rights in marine fisheries; Definitions and Conditions, Food and Agricultura Organization (FAO), Fishery Technical Paper 227, 1982.
- Christy. F.T. Jr. and A. Scott, The Commonwealth in Ocean Fisheries, Baltimore, Johns Hopkins University Press, For Resources of the Future Inc, 1965.
- Chumpol, N., Social consequences of excessive fishing effort in Indo Pacific Fishery Commission Symposium on the Exploitation and Management of Marine Fishery Resources in Southeast Asia, IPFC/87/Symp/IV/WP 3. 288 – 90, 1987.
- Clark, C. W., Mathematical bio-economics in *The Optimal Management of Renewable Resources*, John Wiley and Sons, New York, 1976.
- Clark, C. W., Bio-economic modelling and fisheries management. New York, John Wiley and Sons, 1985.
- Clark I. N., P. J. Major, and N. Mollet, and implementation of New Zealand's ITQ Management system, *Marine Resource Economics* 5: 325 – 349, 1988.
- Crutchfield, J. A. and A. Zellner, Economic aspects of the Pacific halibut fishery, *Fishery Industry Research* 1:1173, 1963.
- Crutchfield, J. A., and G. Pontecorvo, The Pacific salmon fisheries: A study of irrational conservation. Johns Hopkins University Press, Baltimore, 1969.

- Elliot, O., Nigerian Coastal Fisheries Resources in Proceedings of the National Conference on Conservation of Aquatic Resources Organized by the National Advisory Committee on Conservation of Renewable Resources in Cooperation with the Federal Department of Fisheries (FDF), Abuja and the Nigerian Institute for Oceanography and Marine Research (NIOMR), Lagos, Nigeria Egborge, A. B. M., O. J. Omoloyin, A. Olojede, and S. A. Manu, eds, 1993.
- Fagade, S.O., Studies of the Biology of Some Fishes and the Fisheries of the Lagos Lagoon, PhD Thesis. University of Lagos, Nigeria, 1969.
- FAO. Fishery Country Profiles Rome, Italy, FAO. FIP/CP/BGC (rev.1),1979.
- Federal Department of Fisheries (FDF), Fisheries Statistics of Nigeria, Victoria Island, Lagos, Nigeria, 1985.
- Federal Department of Fisheries (FDF), Fisheries Statistics of Nigeria, 2nd Published ed. Victoria Island, Lagos, Nigeria, 1988.
- Federal Department of Fisheries, (FDF), Fisheries Statistics of Nigeria, 2nd Published ed. Victoria Island, Lagos Nigeria, 1991.
- Firth, R., Malay Fishermen: Their Peasant Economy. (2nd edition, revised), Hamden CT: Archon, 1946, 1966.
- Fox, W. W. Jr., An exponential model for optimizing exploited fish populations, *Transactions of the American Fisheries Society* 99: 80-88pp, 1970.
- Francis, R. C., Relationship of fishing mortality to natural mortality at the level of maximum sustainable yield under the logistic stock production model, *Fishery Board of Canada*, 31, 15341-15342, 1974.
- Frederick, C. J. and S. Nair, Production Technology of Small-scale Fisheries in Peninsular Malaysia in *Small-scale Fisheries in Asia: Socioeconomic Analysis and Policy*, ed. Panayotou T., IDRC – 229e, Ontario, Canada 1985.
- Garcia, S., The Problems of Unstable Resources Management, Food and Agricultural Organization (FAO), CECAF/ECAF Series 82/28 (En), Rome, Italy, 1984.
- Garcia, S. and L. Le Reste, Life Cycles Dynamics, Exploitation and Management of Coastal Penaeid Shrimp Stocks, Food and Agricultural Organization (FAO) Fishery Technical Report (203) 1981.
- Geen, G. and M. Nayar, Individual transferable quotas in the Southern bluefin tuna fishery: An economic appraisal, *Marine Resource Economics* 5: 365 – 387, 1988.
- Gordon, S. H., The Economic Theory of a Common Property Resource, *The Fishery Journal of Political Economy*, Vol. 62, No. 2 ppl 124-142, 1954.
- Gulland, J. A., Manual of methods for fish stock assessment. Part 1. Fish population analysis, Food and Agricultural Organization (FAO) Manual of Fishery Science, (4), 3, Pag. Var., Rome, Italy, 1969.
- Gulland, J. A., ed. The Fish Resources of the Oceans, Food and Agricultural Organization (FAO) Fishery Technical Paper 97, Rome, Italy, 1970.
- Gulland, J. A., The management of Marine Fisheries, *Scientifica*, Bristol, 1974.
- Gulland, J. A., Towards the management of the resources of the CECAF region, Rome, Food and Agricultural Organization (FAO) CECAF/ECAF Series 79/12 (En), 1979.
- Haakonsen M. J., West African Artisanal Fisheries in Fishing For Development: Small – Scale Fisheries in Africa, Tredten, I. and B.Hersoug, eds. The Scandinavian Institute of African Studies, Uppsala, Motala, Grafisca AB Motala, 1992.
- Hannesson, R., Optimum fishing effort and economic rent: a case study of Cyprus, Food and Agricultural Organization (FAO) Fishery Technical Paper 299, 1988
- Harcourt, G. C., Some Cambridge Controversies in Theory of Capital, Cambridge: Cambridge University Press, 1972.
- Hardin, G., The tragedy of the Commons, *Science Wash.*, 162: 1234-48, 1968.
- Huppert D. D., Limited access alternatives for the Pacific groundfish fishery, US Department of Commerce, National Oceanographic and Atmospheric Administration (NOAA), Technical Report of National Marine Fisheries Service 52, 1987.
- Jinadu O. O. Bio-economic analysis of the coastal Small-scale Fishing Operations in Lagos State, Nigeria, PhD. Thesis, University of Ibadan, Ibadan, Oyo State, Nigeria,
- Kane, E. J., Economic Statistics and Econometrics, Harper International, 1969.
- Keen, E. A., Ownership and productivity of marine fishery resources: An essay on the resolution of conflict in the use of the ocean pastures, McDonald and Woodward Publishers Company, Blacksburg, Virginia, 1988.
- Khaled, M., Production Technology of the Riverine Fisheries In Bangladesh in *Small-scale Fisheries in Asia: Socioeconomic Analysis and Policy*, ed., Panayotou, T., IDRC – 229e, 113 – 120, 1985.
- Kusemiju, K., The Hydrobiology and Fishes of Lekki Lagoon, Nigeria, *Nigerian Journal of Natural Science*, 3; 135-146, 1981.

- Kusemiju, K., Man, Fishes and the Aquatic Environment, Inaugural Lecture Series, University of Lagos Press, Nigeria, 1991.
- Kusemiju, K., Development, Utilization and Conservation of Aquatic Resources in Nigeria, in Proceedings of the National Conference on Conservation of Aquatic Resources, eds. Egborge A. B. M.; O. J. Omoloyin, A. Olojede, and S. A. Manu, Organised by National Advisory Committee on Conservation of Renewable Resources In Cooperation with Federal Department of Fisheries, Abuja and the Nigerian Institute for Oceanography and Marine Research, Lagos, 313pp, 1993.
- Lagos State Government of Nigeria, Progress Report, 1984-85, Ministry of Agriculture and Cooperative Public Information Division, Lagos State Ministry of Information and Social Development, Youth and Sports, 1985.
- Longhurst, A. R., Mesh selection factors in the trawl fishery off Tropical West Africa, *Journal of Conservation International Exploration Meridian*, (25) 318-25, 1960a.
- Longhurst, A. R., A summary survey of food of West African demersal fish, *Bulletin of the Institute (fr). Africa Noire*, (A) 22: 276-82, 1960b.
- Longhurst, A. R., Preliminary bionomic data from West African fisheries, *Nature London*, 192: 620-22pp, 1962.
- Longhurst, A. R., The bionomics of the fisheries resources of the Eastern Atlantic, *Fishery Publication, London.*, (20): 1-66, 1963b.
- Longhurst, A. R., A study of the Nigerian trawl fishery, *Bulletin of Institute (fr), Africa Noire* (26): 686 - 700, 1964a.
- Mabawonku, A. F., Fishing efforts and Earnings in the Nigerian Artisanal Fisheries, *Journal of Rural Economics and Development*, 12: (2), 10, 1979.
- Mabawonku, A. F., Programmes and Strategies for the Development of Artisanal Fisheries in Nigeria, *Indian Journal of Agricultural Economics*, Vol. XXXV: (4), 1981.
- Mabawonku, A. F., The Process of Fisheries Development Plan Formulations for West African Coastal States *Journal of West African Fisheries*, (1): 1, April 1986.
- McGoodwin, J.R., Some examples of self-regulatory mechanisms in unmanaged fisheries, in Food and Agricultural Organization 1984 Papers presented at the Expert Consultation on the regulation of Fishing Effort (Fishing mortality), Rome, January 17-26, 1983, Food and Agricultural Organization (FAO) Fishery Report (289) Supplementary, 2: 214, 1983.
- Mollet, N. (ed), Fishery Access Control Programs Worldwide in Proceedings of the Workshop on Management Options for the North Pacific Longline Fisheries, University of Alaska Sea Grant Report: 86: 4, 366, 1986.
- Norbeck, E., Takashima: a Japanese Fishing Village, Salt Lake City, University of Utah Press, 1954.
- Nsentip, U. N., A review of the commercially exploited marine fishery resources in Nigeria, in Proceedings of the Second Annual Conference of the Fisheries Society of Nigeria (FISON), Calabar, 25-27th Jan, 1983, 35-57, 1983.
- Ogunmoroti, T., Fish Wholesale Price Determination of the Inshore Fishing Companies in Lagos State, Nigeria, Unpublished M Sc. Dissertation, University of Ibadan, Nigeria, 1989.
- Okiya-Alfred, J. F. and E. A. Allison-Oguru, Resource use Efficiency in Traditional Canoe Fisheries of the Rivers State of Nigeria, *Journal of West Africa Fisheries (IV)*: 207 - 213, 1991.
- Olomola, A., Capture Fisheries and Aquaculture in Nigeria: A comparative Analysis in Issues in *African Rural Development*, Doss Cheryl and Carol Olson eds., Winrock International Rural Economic Development, 1991.
- Padilla, J. E. and A. T. Charles, Bioeconomic Modeling and the Management of Capture and Culture Fisheries, *NAGA The ICLARM Quarterly*, 1: (1), 18-20, 1994.
- Panayotou, T., Management concepts of small-scale fisheries: economic and social aspects, Food and Agricultural Organization Fishery Technical Paper (228): 53, 1982.
- Panayotou, T., ed. Production Technology and Economic Efficiency: A Conceptual Framework, in *Small-scale Fisheries in Asia; Socioeconomic Analysis and Policy*, Ottawa, Ontario, IDRC, 1987, c 1985, 95-100, 1985.
- Pauly, D., Theory of tropical multispecies stocks: a review, with emphasis on the southeast Asian Fisheries ICLARM studies and Reviews 1, Manila: International Center for the Living Aquatic Resources Management, 35, 1979.
- Pauly, D., On the inter-relationship between natural mortality growth parameters and mean environmental temperature in 175 fish stocks, *Journal of Conservation International Exploration Meridian* 39 (3): 175-190, 1980.
- Pauly, D., Fish population dynamics in tropical waters: a manual for use with programmable calculators, *ICLARM Studies and Reviews* 8, 325, 1984.
- Pauly, D., Theory and practice of overfishing: a southeast Asian perspective in Indo-Pacific Fishery Commission Symposium on the Exploitation and Management of Marine Fishery Resources in Southeast Asia, (IPFC/87) Symp/IV/WP 1, 1987.

- Pauly, D., On Malthusian Overfishing, *NAGA ICLARM Quarterly* 3-4, January 1990.
- Rettig, R. B., License limitation in the United States and Canada: An Assessment, *North American Journal of Fisheries Management* (4): 231-248, 1984.
- Rettig, R. B. and J. J. C. Ginter, eds., Limited entry as a fishery management tool, University of Washington Press, Seattle, 1978.
- Ricker, W. E., Linear regression in fishery research, *Journal of Board of Fishery Research of Canada*, 30: 409 - 434, 1973.
- Ruangrai, T.; T. Panayotou and K. Adulavidhaya, Production Technology and Economic Efficiency of the Thai Coastal Fishery, in *Small-scale Fisheries in Asia: Socio-economic Analysis and Policy*, Panayotou T., ed. Ottawa, Ontario, Canada, International Development Research Centre (IDRC) (in press), 1987.
- Scott, A., The Fishery: The objectives of sole ownership, *Journal of Political Economics*, 63:116- 124, 1955.
- Schaefer, M. B., A study of the dynamics of the fishery for yellowfin tuna in the eastern tropical Pacific Ocean, *International American Tropical. Tuna Commission Bulletin*, 2: 247- 268, 1957.
- Smith, I.R. and T. Panayotou, Territorial use rights and economic efficiency: The case of the Philippine fishing concessions, Food and Agricultural Organization (FAO) Fishery Technical Paper 245, 1984.
- Thompson, D.B., Conflicts within the fishing industry in Food and Agricultural Organization Paper presented at the Expert Consultation on the regulation of fishing effort (Fishing mortality) Rome, 17-26 Jan., 1983, FAO Fishery Report (289) Suppl 2: 1983.
- Tobor, J. G., Bathymetric distribution of some Nigerian demersal fish, Annual Report of the Federal Department of Fisheries (FDF), Nigeria, 1973.
- Tobor, J. G., The fishing industry in Nigeria - Status and potential for self -sufficiency in fish production, Nigerian Institute for Oceanography and Marine Research, (NIOMR) Technical Paper 54, 1990.
- Tobor, J. G., Finfish and Shellfish of Conservation Interest in Nigeria, in Proceedings of the National Conference on Conservation of Aquatic Resources organized by the National Advisory Committee on Conservation of Renewable Resources in Cooperation with the Federal Department of Fisheries (FDF), Abuja and the Nigerian Institute for Oceanography and Marine Research, Lagos, eds. Egborge, A.B.M., O.J. Omoloyin, A. Oloyede and S. A. Manu, 1993
- Townsend, R. E., Entry restrictions in the fishery: A survey of the evidence, *Land Economics* 66: 359-378, 1990.
- Tredten I. and Hersoug B., eds. Fishing For Development: Small-scale Fisheries In Africa. The Scandinavian Institute of African Studies, Uppsala 1992 Motala Grafiska AB, Motala 1992.
- Troade, J. P., Introduction to fisheries management, advantages, difficulties and mechanisms, Food and Agricultural Organization (FAO) Fishery Technical Paper 224, 1982.
- Udolisa, R. E. K. and B. B. Solarin, Design characteristics of Cast Nets and Gill Nets in the Lagos Lagoon, Nigeria, Nigerian Institute for Oceanography and Marine Research (N.I.O.M.R), Lagos, Nigeria Occasional Paper 31: 1979.
- Waters J. R., Restricted Access vs. Open Access Method of Management: Toward More Effective Regulation of Fishing Effort, *Marine Fisheries Review*, 53 (3), 1991.
- Waugh, G., Fisheries management, Theoretical developments and contemporary applications, Westview Press, Boulder, Colorado, 1984.