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A COMPARATIVE ANALYSIS OF CAPTURE FISHERIES ON THE WESTERN AND EASTERN SHORES OF KAINJI LAKE BASIN, NIGERIA

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ABSTRACT

The study examined fish catch on Kainji Lake in Nigeria. The data for the analysis were obtained through a sample survey of the lake basin.. A total of 252 fishermen were sampled. Multiple regression analysis was adopted in analyzing the data.. The results obtained indicate that on both shores of the lake, family labour, capital expenses, motorized operation, credit and apprentiship or training are significant factors affecting fish catch by the fish-folks.. Family labour has a negative sign. This implies over utilization of this input. Family labour input can thus be reduced without affecting the catch level. The pooled data for the two shores produced a similar result. The catch functions are characterized by decreasing returns to scale.. The Chow's test for equality of parameters of the catch functions indicated no significant difference between the shores.. It is recommended that a reduction in family labour be encouraged among the fishermen. They should be enlightened on the possibility of over-fishing the lake. The provision of credit to the fishermen is also recommended

Key - words: Catch function; capture fisheries, returns to scale, Kainji Lake, Nigeria.

INTRODUCTION

Kainji Dam is one out of a number of multi-purpose man made lakes in Nigeria. It is the fifth or sixth largest of man-made lakes in Africa. The expectations raised by the construction of the dams were many. These include uninterrupted electricity supply, sufficient fish production, water transportation for barges and ship, increase in eco-tourism, industrial development and transformation of the local economy. Most of these have not been achieved so far (Roder, 1994). The Dam was intended to provide electricity-generating capacity of 960,000kw by 12 turbines of 80,000kw each. Up till date (year 2002) only 6 turbines are in place, 4 of these are running while 2 are on stand-by. The remaining 50% of the Dam's turbin slots is thus left unused. For navigational purposes, the locks at the Kainji Dam have never been used in practice (Roder, 1994).

The flooding of the lake's valley in 1967, led to algae blooms and enormous growth in planktonic organisms. This resulted in population explosion among the 90 fish species inhabiting the lake environment. By 1971, dry season fish catch was estimated at 29,000 tons. The fish resource increases attracted fisher folks to the shores of the lake. By 1972, 20,000 to 30,000 people had migrated to live in 233 temporary fishing camps to fish and work with little or no infrastructure. The catch declined to 11,000 tons in 1973 and to 6,000 tons by 1974. This catch level was still within the equilibrium sustainable yield of between 5,000 and 8,000 tons. By 1978, the annual catch had declined to 4,500 tons (Ita, 1982). This situation continues even today due perphaps to over-fishing of the lake. A survey in 1975 counted 3444 boats of which 236 or about 7% had engines. This implies that fishermen are opened to the use of traditional methods mostly. In other words fishing activities on this lake are almost totally artisanal. There were about 10,200 fishermen on the lake for the whole country. Olomola (1984) found that by 1979 only 9% of the 133,728 fishing canoes in operation were motorized. This is about 12,036 cannoes.

Fishing And Fishing Technologies On The Lake

The production aspect is not clear-cut as the Dam though man-made operates like a natural pond. The normal ten-meter drawdown of the lake exposes about one-half of the reservoir's bottom to atmospheric conditions in the course of the rainy season. At the same time about three quarters of the lake's water is removed ensuring that through mixing of the rest, almost the entire lake volume is renewed annually. As a consequence, the biological and chemical conditions of the lake resemble those of the rivers far more than the case in other large reservoirs.

Fishing entrepreneurs are not directly involved in the production process. They are, however, directly involved in the cropping of the resources. It is thus going to be difficult to determine the actual cost of production. Hence, the classical concept of production is not applicable in this instance. Rather, cropping or catch function is adopted for the subsequent analysis.

Fishermen on the lake are not bothered about feeding neither the fish nor the replacement for the breeding stock. They operate under the illusion that the lake fishery is inexhaustible. The danger apparent in this thinking lies in over fishing the lake. Already comments by those long associated with the Yelwa fish market hinted that the big fishes are far and in between (Roder, 1994). The natural ecosystem of the Kainji Basin has changed. Some species of the lake, notably Lates niloticus have drastically reduced in population. One of the downstream effects of the construction of the dam is the phenomenon of reduced spawning and natural production of fish. A 60 – 70 percent decline in catch has been claimed.

Capture fisheries output on the lake depends on the stock of fish, the quantity, quality and types of gears, size and type of boat, type of boat propulsion (motorized or manual), fishing skills, experience; fishing effort and other socio-economic factors. Motorized fishing is here defined to include these using double and/or single engine canoes/boats. Manual fishing is conceptualized in terms of using canoes, paddled manually. The use of motorized boats or outboard engines makes travelling faster and thus more fishing time is gained. In 1973, the National Accelerated Fish Production Project (NAFPP) was established. The impact of this was felt in three key areas of the fishery subsector. These are the canoe mechanization scheme, Inshore Fisheries, Development Project and Fishing Terminal Development (Bolorunduro and Arokoyo, 1994).

The Research Problem

Nigeria is endowed with many rivers, man-made lakes and about 200 nautical miles of marine water under Exclusive Economic Zone (EEZ). Hence, enough fish for home consumption should not be a problem. The production level is however not sufficient to meet local demands. Importation is often used to bridge the supply – demand gap.

Inspite of increasing biological research activities of the Kainji Lake Research Institute (KLRI), New Busa inadequate attention has been devoted to fish management and economic issues on the lake. The profitability of fishing on the lake has not been clearly demonstrated. Furthermore, fishing on the lake in order to attain sustainability and conservation needs to be modernized. However, before this can be done, the existing patterns of resource allocation, degree of resource-use efficiency, productivity, and rate of return on investment must be known. This information will facilitate effective planning by determining what levels of financing, incentives, and infrastructure that are needed to promote increased fish production on the lake. This will help the authorities by, indicating the direction towards which their policies should be manipulated.

Capture fisheries efficiency parameters on the lake are not available. In addition to this, recent studies have indicated evidence of over fishing and decline of catches (Ita, 1982). There have been changes in the fish fauna of the lake and the abundance of the major commercial species (Otobo, 1978). There was an initial fish population explosion, which stood at 28,000 mt per annum. A pre-impoundment estimate of 5,400 mt was made by Daget and Bayagbona (1961) with a prediction of a possible increase to about 10,000mt. Lelek (1971) using canoe counts estimated 4,600mt while Henderson (1971) updated the canoe counts and estimated an annual production of 7,200mt. The general conclusion from all estimates was that with adequate and good resources management an annual yield of 10,000mt is realizable on the lake.

Objectives of the Study

The main objective of this study is to examine the relationship between catch level and the factors used in fishing on the Kainji lake basin and to compare fishing activity between the two shores of the lake. The specific objectives include: to,

i. estimate the catch function on the lake for the western and eastern shores;

ii. determine the returns to scale in fishing on the lake;

iii. test for differences in the catch function parameters for the shores;

iv. make policy recommen-dations based on the findings of this study.

Working Hypotheses

Null Hypotheses

That the factors proposed as influencing fish catch on the lake will have no significant impact.

H_o: $a_1 = a_2 = a_3 = \ldots = a_8 = 0$

H_o: $b_1 = b_2 = b_3 = \ldots = b_8 = 0$

Alternative Hypotheses

That the proposed variables will have significant influence on fish catch on the lake

H_1: $a_1 \neq a_2 \neq a_3 \neq \ldots \neq a_8 \neq 0$

H_1: $b_1 \neq b_2 \neq b_3 \neq \ldots \neq b_8 \neq 0$

Pooled Data Model

H_o: $d_1 = d_2 = d_3 = \ldots = d_8 = 0$

H_1: $d_1 \neq d_2 \neq d_3 \neq \ldots \neq d_8 \neq 0$

Pooled data Chow's Test

Null Hypotheses

There are no significant differences in the catch – input relationships between the shores

$a_i = b_i$, $i = 1, 2, 3, \ldots, 8$

Alternative Hypotheses

There are significant differences in the catch input relationships between the shores

$a_i \neq b_i$, $i = 1, 2, 3, \ldots, 8$

METHODOLOGY

(i) Area of Study

The area of study is the Kainji Lake Basin in Nigeria. The crown of the dam is 144.8 metres above seas level and 65.5 metres above the river bed. Hence, it is 60 metres at its deepest (Ayeni, 1998). It is capable of storing 12.5 km^3 of water of which 11.5 km^3 can be used for power generation. The lake is about 136 km long and about 30 km wide at its widest point. It covers an area of 1,250 km^2 when full (Roder, 1994). The full area is referred to as the kainji lake basin. It is located between latitudes 9° 50' and 10° 55'N and longitudes 4° 21'. and 4o 25'E. The Basin is divided into 3 strata. Bazigo (1971, 1972) showed that stratum 1 covers 20% of the lake's surface area. It accounted for 17.5% of the total fish catches. Stratum II constitutes 70% of the total area of the lake. It could produce about 62.4% of the total fish catches. The last stratum III covers 10% of the area and can produce about 20.1% of fish catches. From development viewpoint strata II and III offer better production/catch prospects. The strata are sub-divided into 6 sub-strata such that sub strata 1, 3, and 5 are located on the western shore while sub strata 2, 4, and 6 are on the eastern shore of the lake.

(ii) Method of Data Collection

The data used in this study were collected from a sample survey of the Kainji Lake Basin in Nigeria. A two-stage sampling procedure was employed in selecting the sample needed for the subsequent analysis. As a first stage of sampling, fishing settlements based on their importance, volume of trade and route accessibility were purposively selected. These include Yauri, Zamare, Wawa, Wara, Kajabal and Fakawa on the eastern shore of the lake. On the western shore, Komala, Rofia, Kokoli, Shagunu, Malale and

Barkin-Dam were selected. This means 6 settlements per shore.

In the second stage of sampling on the western shore 20 fishing households were randomly selected in each settlements based on the list of fishermen sourced from Kainji Lake Research Institute, New Bussa. This gives a sample size of 120 observations. On the eastern shores, 22 fishing units were also randomly selected per settlement for a total of 132 cases. The overall sample size is thus 252 households.

(iii) Method of Data Analysis

Multiple regression analysis was used in analyzing the data. The general form of the catch function is specified as a function of effort and other inputs.

(a) Model Specification

The general model is expressed as

$$Q_w = f(X_1, X_2, X_3, \ldots X_8, U) \ldots (1)$$

$$Q_E = f(X_1, X_2, X_3, \ldots X_8, \varepsilon) \ldots (2)$$

$$Q_P = f(X_1, X_2, X_3, \ldots X_8, e) \ldots (3)$$

Where Q_w = catch on the western shore

Q_E = catch on the eastern shore

Q_p = pooled catch data for the shores

X_i's are the explanatory variables for each model.. The variables hypothesized as influencing fish catch on the lake are age in years (X_1), family labour in hours(X_2), education (X_3) in years, capital expenses in naira (X_4), motorized (X_5), which is a dummy variable, if motorized = 1, otherwise = 0, fishing experience in years (X_6). Credit – use (X_7) a dummy variable, if yes=1,otherwise=0 and apprenticeship training (X_8) a dummy variable .if apprenticed =1,otherwise=0.

The Cobb-Douglas catch function was estimated in each case for the equations. This methodology is adopted because it allows for a direct estimation of the elasticities of catch relative to the inputs.

(b) Chow's Test of Equality of Parameters

This is used to test for equality between coefficients obtained from different samples. If the estimated relationships differ significantly, then the relationship is changing from one sample to the other. If the difference is insignificant, the relationship is stable from sample to sample.

The test – statistics is given by

$$Fcal = \frac{\left[\sum e^2_p - \left(\sum e^2_w + \sum e^2_E\right)\right] / K}{\left(\sum e^2_w + \sum e^2_E\right) / n_1 + n_2 - 2K} \quad (4)$$

]This is compared with the theoretical F – value represented by

$$Ftab = F_{0.05}, V_1, V_2$$

$$= F_{0.05}, K, (n_1 + n_2 - 2K)$$

The theoretical value defines the critical region of the test where K is the number of parameters estimated. If Ftab > Fcal, then null hypothesis is accepted. This implies that the samples give the same relation-ship. Hence, the economic relationship under investigation is stable and the two samples can be pooled as one. If however, Ftab < Fcal, then the null hypothesis is rejected while the alternative hypothesis is accepted.

RESULTS AND DISCUSSION

The estimated equations are presented in Table 1. As regards the western shore, the results in column 1, indicate a negative relationship between family labour inputs (X_2) and fish catch. The coefficient of the variable is significant at the 1% level. This tends to suggest excessive use of the input. The capital expenses (X_4), type of operation whether motorized or not (X_5), credit use (X_7) and apprentiship/training (X_8) are all positive and significant at the 5% level. The R^2 value of 0.6842 indicates a goodness of fit for the estimated equation.

On the eastern shore, the estimated equation column 2 in Table 1 showed that family labour (X_2) is negative but significant at 1% level just like on the western shore. It is also observed that both the capital expenses (X_4) and type of operation (X_5) are positive and significant at the 5% level like on the western shore. However, credit-use (X_7), which is positive is significant at 1% as against 5% on the western shore. Similarly, apprentiship/training variable (X_8) though also positive is only significant at the 10% level as against 5% on the western shore. The R^2 value of 0.7053 shows a goodness-of-fit for the estimated equation. The result for the pooled data for the two shores is presented in column 3 of Table 1. It must be noted here that while five out of the variables used are significant at different levels for the shores, the pooled data showed six significant variables. Here, age (X_1) is found to be negative but significant at the 10%. It is not significant for the other two equations. Family labour variable (X_2) which is also negative is significant at the 5% level capital expenses (X_4) and credit are (X_7) are still positive and significant at the 5% level. The type of operation variable (X_5) and apprentiship/training (X_8) are also positive but significant at 1% level. The R^2 value of 0.8156 for the pooled data indicates a good-fit for the data.

Table 1: Results of the Estimated Functions

Variables	Equation 1 (W) Parameters	Equation 2 (E) Parameters	Equation 3 (P) Parameters
Age(X_1)	−0.4927	-0.5312	-0.5102*
	(1.0043)	(1.1216)	(1.8945)
Family Labour(X_2)	-0.3460***	-0.4009***	-0.4364**
	(2.6332)	(2.4122)	(2.3250)
Education(X_3)	0.0045	0.0052	0.0061
	(1.2500)	(0.9811)	(0.8356)
Capital Expens(X_4)	0.4738**	0.5184**	0.5021**
	(1.9822)	(2.1048)	(2.4505)
Motorized(X_5)	0.2109**	0.3211**	0.2466***
	(2.4269)	(2.0044)	(3.2278)
Experience(X_6)	0.3851	0.3230	0.3032
	(0.7058)	(0.8361)	(1.2974)
Credit(X_7)	0.5862**	0.5214***	0.5689**
	(2.5450)	(3.2446)	(2.5318)
Apprenticeship(X_8)	0.1264**	0.1095*	0.3013***
	(2.3804)	(1.7299)	(3.4045)
Constant (K)	6.3976	7.011	6.4932
R^2	0.6842	0.7053	0.8156
$\sum e^2$	186.3	302.3	531.5
n	120	2	252

Source: Field Survey, 2002 (t-values in parentheses)

*** Significant at 1% ** significant at 5% *significant at 10%

The Chow's Test of equality of parameters was carried out on the western and eastern shore results. The calculated F-value is 2.2829 while the F-tabular is 3.6700. The F-tabular is greater than F-calculated so the null hypothesis is accepted. The catch relationship with these variables is thus stable. The relationship is not changing from one location to the other. The catch function is thus kind of being homogeneous for the fishermen.

The returns to scale of the equations are obtained by adding all the coefficients. For the western shore this was calculated to be equal to 0.8682 while for the eastern shore it was 0.8665. Both signify decreasing returns to scale in fish catch on the lake. The pooled date gave a returns to scale of 0.9816 which is higher than for the individual equations. This is very close to unity. This tends to suggest that there is a movement towards a constant returns to scale in capture fisheries on the lake.

POLICY RECOMMENDATIONS

The results tend to imply that excessive family labour is in used on the lake. The more of this input that is used the less the catch as they are negatively related. There is the policy need to reduce effort into fishing emanating from family labour pool. To allow this to go on may lead to over-fishing of the lake. Capital expenses, motorized fishing, credit availability and use as well as apprentiship/ training all have positive significant impact on capture fisheries on the lake. Fish input provision will go along way in reducing the cost capital expenses. Fishermen will be able to buy more of these inputs and improve their catch performance. Credit availability at and as when needed will also improve their catch level and by extension their level of income and welfare. The benefit of training the fishermen is unquantifiable. This will help them to fish the lake efficiently. The more training that they are exposed to the better their fishing skills and catch performance. There recommendations are made with the hope that they will benefit all the stakeholders of the lake especially there living within the lake basis.

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