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Determinants of Efficiency and Income Distribution in Fish Farming: A Case Study of Urban Maiduguri Metropolis

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ABSTRACT
This study examined the efficiencies and income distribution of fish production in Maiduguri Metropolis, Nigeria. The specific objectives were to determine the pure technical efficiencies in fish farming; examine the farm income distribution of fish farming; determine the effects of the socio-economic characteristics of the farmers on their technical inefficiencies in the study area. Questionnaire and oral interview were used to collect data from sixty (60) respondents selected purposively. Data were analysed using Data Envelopment Analysis (DEA), Tobit model, the Ginni coefficient and the Lorenz curve. The ginni-coefficient of 0.5193, showed unequal income distribution. The DEA result revealed a mean pure technical efficiency of 0.84 indicating inefficiencies in fish production in the study area. Socio-economic variables that were found to positively influence inefficiency in fish farming were age, farming experience, household size and extension contact, while education influenced inefficiency negatively. It was recommended that government should provide affordable educational services as it was found to negatively influence inefficiency in fish farming.

Keywords: Efficiency, Fish Production, income, urban, fish.

INTRODUCTION
Fish is an important component of the population's diet in many parts of the world, because it is a relatively cheap and available protein source. It is an important dietary supplement for the poor who cannot afford animal protein and depend mainly on food of low nutritional value (Glaser, 1999). The growth in the world fish catches, however, decreased some 20 years due to lack of improved technology (Carballo *et al.*, 2008). The need to increase fish production by farming (aquaculture) became therefore, an urgent matter as only a third of the developing world's population meets 40% or more of their animal protein requirements from fish consumption (Glaser, 1999) .

In Nigeria, there are about 2000 rural fish ponds, 3000 homestead ponds and over 50 commercial farms with more than 30 hatcheries, a large pool of trained manpower, as well as training and research facilities for aquaculture (Agboola, 2011). Most units were however, operating below capacity due to inadequate and unreliable releases of funds, shortage of input supplies, problems of management and insufficient motivation of staff, inadequate supply of quality fingerlings and feeds, extension services, land and institutional credit.

Nigeria is one of the largest importers of fish with a per capita consumption of 7.52kg and a total consumption of 1.2million metric tons with imports making up about 2/3 of the total consumption (Adewuyi *et al.*, 2010). This indicates a large deficit in fish supply in Nigeria. Aquaculture, however, has the potentials to increase the production of fish above the level that would be produced naturally. With fish production in the country leaving much to be desired, it, therefore, becomes expedient to examine the technical efficiencies of fish farming to determine whether productivity can be substantially increased in the study area.

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The main objective of the study was to undertake an economic analysis of fish production in Maiduguri, Nigeria. The specific objectives were to:

(i). estimate the pure technical efficiencies of fish farms in Maiduguri;

(ii). determine the effects of socio-economic characteristics of the farmers on their technical efficiencies of production, and

(iii). examine the farm income distribution of fish farmers in Maiduguri.

METHODOLOGY

Study area and sampling technique

The study was conducted in Maiduguri Metropolis, Borno State of Nigeria. Maiduguri Metropolis is made up of two Local Government Areas i.e. Maiduguri Metropolitan Council Area and Jere Local Government Area. Maiduguri Metropolis has a population density of 1,738 people per square kilometer (BOSG, 2009).Urban agricultural activities have continued to receive the attention of many of the inhabitants of the state to make ends meet in the face of global economic meltdown and the decreasing purchasing power of the naira. Residents engage in agricultural activities such as rearing and/or fattening of animals (sheep, goats and cattle), poultry keeping, vegetable production, cereal, ornamental plants production as well as fish farming in and around the Metropolis.

Simple random sampling was used to select sixty (60) fish farms for the study. A list of members engaged in fish farming enterprises obtained from fish farmers' association in Maiduguri formed the sampling frame for the study. Questionnaires were used to collect data on socio-economic characteristics of respondents, inputs used (quantities and costs), outputs obtained (quantities and prices), revenue as well as problems faced by the urban farmers were collected.

Analyses of Production Efficiencies

The envelopment form of the input-oriented variable returns to scale Data Envelopment Analysis (DEA) model that was used to determine the pure technical efficiency is specified as follows:

$\min \theta,\lambda\ \theta$, subject to:

$-yi + Y\lambda \geq 0$,

$xi - X\lambda \geq 0$,

$N1/\ \lambda = 1$,

$\lambda \geq 0$ ……...(1)

where $N1/\ \lambda = 1$ is a convexity constraint which ensures that an inefficient firm is only benchmarked against firms of a similar size. θ is the technical efficiency score of the ith firm. This method was used by (Gul *et al*., 2009).

The fish farmer's socio-economic variables were modelled as determinants of technical inefficiency after Javed (2009), using the Tobit regression. The model was specified as:

$$Te_i = \beta_o + \beta_1 Z_1 + \beta_2 Z_2 + \beta_3 Z_3 + \beta_4 Z_4 + \beta_5 Z_5 + \mu_i \quad \text{…….. (2)}$$

Where Te_i = technical inefficiency score from DEA of the jth farm, Z_1 = age of the farmers (years); Z_2 = educational attainment (years); Z_3 = farming experience (years); Z_4 = household size (no of persons); and Z_5 = extension contact (Dummy; 1= yes and 0 otherwise). This model was used in order to identify sources of technical inefficiency obtained by subtracting the efficiency score of each respondent from one (1). The coefficients of the explanatory variables were used in explaining the inefficiency differentials among the farmers. A negative sign indicates that the coefficient reduces inefficiency while a positive coefficient means that the variable increases inefficiency.

Income distribution

The Ginni co-efficient was used to measure the distribution of incomes generated by fish enterprises in the study area. It is a standardized co-efficient such that zero implies perfect equality in earnings, while a co-efficient of one means inequality in earnings. The result was presented graphically using Lorenz curve. The extent to which the Lorenz curve diverges from the line of equal income distribution shows the level of income inequality. The Ginni co-efficient is expressed as follows:

$GC = 1 - \Sigma xy$ …….(3)

Where:

GC = Ginni co-efficient,
X = Percentage of broiler farmers,
Y = Cumulative percentage of farm income.

This method was used by Sulumbe *et al.* (2007).

RESULTS AND DISCUSSION

Technical efficiency of fish farmers in urban Maiduguri Metropolis

The pure technical efficiencies of fish producers are presented in Table1. The table showed that more than 88% of the fish farmers had pure technical efficiency of 0.61-1.0, with a mean pure technical efficiency of 0.84.

Table 1: Pure technical efficiency of fish farmers in urban Maiduguri

Efficiency Score	Frequency	Percentage %
0.01 – 0.10	5	8.33
0.11 – 0.20	-	-
0.21 – 0.30	1	1.67
0.31 – 0.40	-	-
0.41-0.50	1	1.67
0.51 – 0.60	-	-
0.61 – 0.70	5	8.33
0.71 – 0.80	3	5.00
0.81 – 0.90	3	5.00
0.91 – 1.0	42	70.00
Total	60	100.00
Min 0 .02		
Mean 0 .84		
Max .1.0		

Source: Computed from field data, 2011.

The mean technical efficiency of 0.84 indicates that there are some opportunities for improving resource use efficiency. The sampled fish farms may reduce their input usage by 16 % on the average, and still be on the same level of production.

Socio-economic characteristics and technical inefficiency in fish farming in urban Maiduguri Metropolis

Table 2 shows the relationships between the socio-economic variables of the fish farmers and inefficiency in fish production in Maiduguri.

Table 2: Sources of technical inefficiency in fish farming in urban Maiduguri

Variable	Coefficient	Standard error	Probability
Constant	-22.998	6.521	0.001***
Age	0.436	0.067	0.000***
Education	-0.052	0.076	0.497^{NS}
Farming experience	0.784	0.269	0.005***
Household size	2.114	4.395	0.632^{NS}
Extension contact	7.495	4.451	0.098*
Sigma	0.395	0.042	0.019**

***= significant at 1%, **= significant at 5%, *= significant 1%, ^{NS} =not significant. Source: Computed from field data, 2011.

The coefficient of age was positive and significant at 1%, in line with *a priori* expectation. This means that as age increases, inefficiency also increases in fish production. The possible reason for this could be that younger people are more receptive to innovations and are also known to be more energetic, agile and aggressive in farming compared to their older counterparts. This agrees with the findings of (Javed, 2009).

The coefficient of education variable was negative in line with *a priori* expectation but statistically not significant. This implies that as the level of education increases, inefficiency in fish farming decreases. The reason is because educated farmers would likely have better access to information which they could use to improve on their productivity.

The coefficient of farming experience, household size and extension contact were positively related to inefficiency. The meaning is that as farming experience and household size increases, the technical inefficiency also increases. A reason why inefficiency could increase with household size is the tendency of over-utilizing family labour in farm operations, thereby decreasing its efficiency in production.

The positive relationship inefficiency had with farming experience can be explained in terms of conservatism. With more years of experience farmers become sceptical of innovations and more conservative refusing to try anything new that may be introduced to them.

The extension contact variable indicates that inefficiency increases with agent's visit. The possible reason could be that most of the advices given by the agents were not implemented by the fish farmers because of factors such as availability and affordability of inputs.

Income distribution

The Ginni-coefficient for fish production in Maiduguri was 0.5193 (Table 3), implying income inequality and the concentration of income in the hands of a few participants. The table reveals that 43.3% of the participants controlled over 79% of the income generated from fish production. Considering the few number of participants in the market and the fact that a few of them control a larger percentage of income generated in fish farming, fish production in the study area can be said to be oligopolistic in nature.

Figure 1 shows the Lorenz curve of income generated from fish farming. The more the divergence of the Lorenz curves from the line of equal income, the more the degree of income inequality.

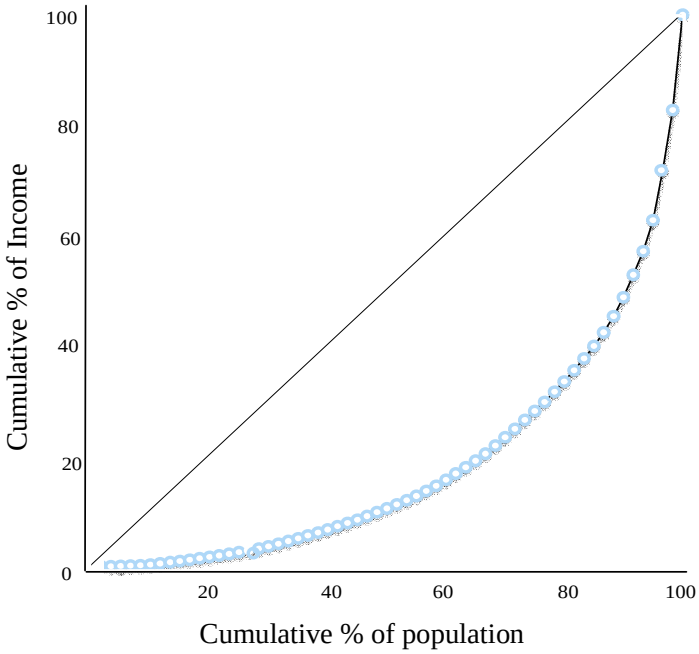

Fig. 1: Lorenz curve of income generated from fish production.

Table 3: Farm Income Distribution of Fish Farmers in Maiduguri

Income Categories(₦)	No of farmers	Percentage farmers(x)	Cumulative Percentage	Total Income (₦)	Percentage of total income	Cumulative % (y)	XY
<100,000	6	10.0	10.0	81825	0.2	0.2	0.0002
100,000-200,000	11	18.3	28.3	1264734	3.7	3.9	0.0071
201,000-300,000	7	11.7	40.0	1887672	5.5	9.4	0.0110
301,000-400,000	7	11.7	51.7	2474731	7.3	16.7	0.0195
401,000-500,000	3	5.0	56.7	1331200	3.9	20.6	0.0103
>500,000	26	43.3	100.0	26993443	79.3	99.9	0.4326
Total	60	100.0		Total	100.0	-	0.4807

Source: Computed from field data, 2011.

$$G.C = 1 - \sum xy$$

= 1-0.4807, = 0.5193.

Conclusion and Recommendations

The study has shown that inefficiencies exist in fish farming enterprises in urban Maiduguri Metropolis, Nigeria and are influenced by the socio-economic characteristics of the fish farmers. It has shown that efficiency can be improved by reducing the inputs used in fish farming by 16% without altering the level

of production. Incomes generated by the enterprises were, however, unequally distributed among the producers. This could not be unconnected with differences in the socio-economic characteristics of the farmers, the nature of the enterprises and the legions of problems faced by the fish farms in the study area. Based on the findings of the study, it is recommended that resources used in fish farming enterprises be appropriately re-organized with the view of improving technical efficiencies. Educational services should be made affordable as it was found to positively influence inefficiency in fish farming.

REFERENCES

Adewuyi, S. A, Phillip, B. B., Ayinde, I. A., and Akerele, D. (2010).Analysis of Profitability of Fish Farming in Ogun State, Nigeria *Human Ecology*, 31(3): 179-184.

Agboola, W.L (2011). Improving Fish farming Productivity towards Achieving Food Security in Osun State, Nigeria: A Socio-economic Analysis. *Annals of Biological Research*, 2(3): 62-74.

BOSG (2009). Borno State Government. Report of the Vision 2020 Stakeholders' Development Committee for Borno State, Governor's Office, Maiduguri, Borno State, 1-4.

Carballo, E., Eer, A., Schie, T.,and Hilbrands, A. (2008). Small-scale Freshwater Fish Farming, *Agrodok* 15. Agromisa Foundation and CTA, Wageningen.

Glaser, N. (1999). Small Scale Fisheries: Fish Protein and Income, Technology and Development, Gate No. 1.

Gul, M. , Koc, B., Dagistan, B., Akpinar, M.G. and Parlakay, O. (2009).Determination of Technical Efficiency in Cotton Growing Farms in Turkey: A Case of Cukurova Region. *African Journal of Agricultural Research*, 4(10): 944-949.

Javed, M. I. (2009). Efficiency Analysis of Cotton-Wheat and Rice-Wheat Systems in Punjab, Pakistan. Unpublished *Ph.D Thesis*, Department of Agricultural Economics and Rural Sociology, University of Agriculture, Faisalabad, Pakistan.

Sulumbe, I.M., Hussaini, R. and Goni, M. (2007). Structure and Performance of Rice Marketing in Maiduguri and Jere Local Government Areas of Borno State, Nigeria. *African Journal of Sciences*, 8(1): 1776-1785.