 J Agri Sci, 3(2): 85-94 (2012)

# Resource-use Efficiency among Selected Fish Farms in Lagos State, Nigeria

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**KEYWORDS** Fish Farming. Resource-Use Efficiency. Elasticities

**ABSTRACT** This study was carried out in Lagos State, Nigeria. The research investigated the resource use efficiency of fish farming by examining the socio- economic characteristics of the respondents, estimated the resource use efficiency of the respondents and identified problems affecting fish farming enterprise. This was achieved through random selection of 50 respondents. The method of analysis used was descriptive analysis to determine the socio economic characteristics of the fish farmers; production function was applied to examine resource use efficiency. The results showed that majority of the respondents (92%) were married and 60 percent were males. It also revealed that 76 percent went through tertiary education. 68 percent had about 5 years experience in the business, 74 percent started their business with their own personal savings and 64 percent purchased their land. 84 percent of the total costs were used on variable items, of which feed cost accounted for 59 percent of the variable costs. The lead equation was the double log model which was chosen based on econometric and statistical criteria. Fish seeds and scale of production were significant and positive indicating that increase in these inputs would increase revenue by 42.8 percent and 42.4 percent respectively. The elasticities of the coefficients indicated decreasing returns to scale. The efficiency ratios of fish seed was greater than one indicating underutilization of resources while the remaining resource inputs were over-utilized having efficiency ratios less than one. With a ratio of net profit to total cost being 1.29 showed that a naira invested would yield N1.29 indicating the profitability of fish farming business in the study area.

## 1. INTRODUCTION

Fishery is an important sector in the economic development of many developed and developing countries. About 40 million people are employed directly in the fishery sub-sectors of artisanal, fish farming, processing, preservation and marketing worldwide. Fish is a source of high-quality protein that can be produced more cheaply than any other animal protein for human consumption. It is also medically recommended for pregnant women, children and adults because of its high-level protein, digestibility and lack of cholesterols, preventive resource for heart attack or failure and stroke (Kareem 2011).

In Nigeria like in most coastal developing nations, fish is an important source of food and income to its peoples. It plays a very important role in improving their food security and nutritional status. Also, as much as 5 percent of the population (that is about 35 million people) in Africa were dependent wholly or partly on fisheries for their livelihoods. This also means that it is a source of revenue generating activity for several African nations. The African continent also accounts for 7.4 million metric tonnes (8 percent of the world's total annual production) of around 92 metric tones.

Nigerians are large fish consumers with per capita consumption of 7.512kg, giving a total consumption of more than 1.2 million metric tonnes. With fish imports making up about two thirds of the fish supply, the government seeks import substitution through programs targeting increased domestic fish production. The estimated national demand for fish is estimated as high as 1.4 million metric tonnes with a wholesale value of more than $1billion. Of this, the Federal Department of Fisheries (FDF) indicates 511,000 metric tonnes are provided domestically (FOS 2004).

The per capita consumption of fish has been on the increase for the past decades. The overall demand for inadequate supply of fish is on the rise. The fact that this level of demand may not be met, the government in an attempt to solve this problem introduced various policies, programmes and institutions like Nigerian Institute for Freshwater Fisheries Research (NIFFR), Nigerian Institute of Oceanography and Marine Research (NIOMR) and of recent

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the New Partnership for Africa Development (NEPAD) in collaboration with the World Fish Center and FAO, all in an effort to help combat food insecurity. Continuing population growth has also been observed to be a major factor in meeting the challenge of the increasing demand.

Aquaculture has the potential to contribute to sustainable development and poverty reduction in the study area by generating income and employment. The production of this fish as an economic resource is undertaken by a large number of people especially the small-scale farmers in Nigeria (Oladejo et al. 2010). To create a system with continuous returns, one needs good management, policies directed towards the efficient use of resources, as these will not only sustain fisheries but will also heighten the level of food security in our environment. Similarly, efficiency with which farmers use resources available to them are important in agricultural productivity measurement. The main issue in the Nigerian agriculture has been that of low productivity. Despite all forms of external intervention and development plans, the fisheries sector still shows a decrease in the supply and increase in the demand by the population. To have a stable and productive fisheries sector, information is required on the allocation and utilization of all the available input resources. This study is also very crucial since increased productivity is directly related to production efficiency or inefficiency given the state of technology. This will assist policy makers and the country as a whole in pointing the right direction of future development and management. Therefore, the general objective of this study is to examine the resource use efficiency among fish farms in Lagos State. The specific objectives are, to: (i) examine the socio-economic characteristics of the respondents in the study area; (ii) estimate the resource-use efficiency of the respondents and identify the problems affecting fish farming in Lagos State.

## 2. REVIEW OF LITERATURES: THEORETICAL AND EMPIRICAL REVIEW

### 2.1 Development Prospects of Fish Farming in Lagos State

The Lagos State Government had recently expressed its readiness to support fish farming on a large scale so that the sector can develop its capacity to meet at least 80 percent of the demand by the year 2005 and 100 percent by 2006. Though, this has yet to be achieved, the government then intended to train about 10,000 youths in any agricultural enterprise as part of the proposed Youth Empowerment Programme. This was as a result of the fact that fish import claimed about ₦25 million yearly in Nigeria. The State government has renewed its determination to promote aquaculture in all parts of the state. This would supplement fish supplies from natural resources at all levels of the community. Efforts have been made for the local production of fishing input such as netting materials of all sizes, sinkers, floats, hooks, other boards and simple spare parts for outboard engines through artisanal method. For aquaculture boost, there is construction of the Ikorodu fish farm estate which has already built concrete ponds and other facilities and enough ground space to build more concrete ponds of specific size and dimensions. These plots of farms are for outright sale at good prices. The local production of these inputs will not only save scarce foreign exchange, but would lead to the overall production of industrial development and foreign exchange earnings from exports of products from the auxiliary industries to neighboring countries (Oluwasola 1999).

An inventory of 2,600 private fish farms in Nigeria revealed that 50 percent of fish farmers integrate animal rearing with fish production. Also, integrated rice/fish farming is being adopted in several states (AIFP 2003). Integrated aquaculture was adopted in Nigeria to reduce feeding and labour costs; this has helped in minimizing the difficulty in getting fish feed. The National Institute for Freshwater Fisheries Research (NIFFR) conducted a National Aquaculture Diagnostic Survey and noted that 48 percent of all the fish farms evaluated practiced integrated agriculture. Fishponds are integrated with poultry, pigs, rabbits, sheep, goats, and cattle as well as with rice, plantains and bananas, fruit trees, vegetable crops, etc. Poultry was the most popular integration as 50 percent of the fishponds were associated with chicken farming. This was followed by sheep/goats/cattle at 38 percent, while pigs were integrated with 14 percent of the ponds surveyed. Rice farming was observed to be the least integrated with fish farming at only 1.6 percent. Since 1995, inte-

gration of fishponds with poultry, pigs and livestock has become more popular and this includes many of the 1940 fish farms in the country [Aquaculture and Inland Fisheries Project (AIFP 2003)]. The estimated potential for irrigated lands in Nigeria is up to 868,000 ha, offering much potential for private investors in agriculture. Development of the commercial aquaculture industry and inland fisheries remained the best solutions for increasing domestic fish production and meeting the large demand for fish.

### 2.2 Resource Efficiency

Measuring efficiency is an important issue in the use of scarce resources in production. This is because it is a firs step in a process that might lead to substantial resource savings. This resource savings have important implications for both policy formulation and firm management (Rahji 2003). Efficiency, according to Olayide and Heady (1982), agricultural productivity is defined as the index of the ratio of the value of total farm output to the value of total resource used in farm production. Hence, optimal productivity of resources implies efficient utilization of resources in the production process. Thus, three forms of efficiency were identified: "technical efficiency", as the measure of a firm's success in producing maximum output from a given set of inputs. Second, he defined "price or allocative efficiency" as the measure of firm's success in choosing an optimal set of inputs. Third is "overall efficiency", which is the product of the technical and price efficiency. Therefore, technical efficiency is a ratio of total output to total input, while price or allocative efficiency is defined by the tangency of the price line and isoquant. The tangency indicates that a minimum possible amount of each input is being used to produce a unit of output at a given level of prices. Overall efficiency is a product of technical efficiency and price efficiency and it indicates the cost per unit of output for a firm which perfectly attains both technical and price efficiencies (Kareem et al. 2008). Resource use efficiency generally starts with the assumption of profit maximization which is an ideal framework against which the various forms of efficiencies can be adequately measured or tested (Aromolaran 2000). The price or allocative efficiency can be measured by either simple input- output ratio, linear programming (Data Envelopment Analysis) etc. Measurement in terms of the input- output method depends on the contribution of each resource used to the output, the disadvantage of this method is that it ignores the quality of resources and also that the results obtained are not amenable to statistical test of reliability (Kareem et al. 2008).

The production function approach seems to be the most appropriate due to the short comings of the two methods of measuring resource use efficiency already mentioned because one of the production function technique is that the estimated coefficient can be tested statistically for significance. Production function can be measured using estimated coefficient. Marginal value products are computed and compared with the value of marginal factor cost, where the ratio of marginal value to the marginal factor cost is equal to one, production is said to be efficient. If the ratio is less than one, it implies that the resources have been excessively used, where as a ratio of more than one indicates under utilization of resources (Aromolaran 2000).

## 3. METHODOLOGY

### 3.1 The Study Area

The study was carried in Lagos State. The State is situated in the southwestern geo-political zone of Nigeria. It shares its boundaries with Ogun State with its northern and eastern borders and to her west is the border of Benin Republic. Its southern border stretches for about 180 kilometers (km) along the coast of the Atlantic Ocean. The State occupies an area of 3,577 $km^2$ landmass of which 786.94 $km^2$ which is about 22 percent of it being the Lagos lagoons. This makes the State very rich in different forms of aquatic ecological zones that support different varieties of fish species and aquatic organisms thereby providing productive fishing opportunity for fishermen/women.

### 3.2 Source of Data

The primary data was obtained through the use of a well structured questionnaire given to the respondents and this was augmented with oral interview.

### 3.3 Sample Size and Technique

The sample size for this study was 50. Fifty respondents were randomly chosen from the list

of registered members of the Catfish Farmers Association (CFA) in the study area. The information scope of the questionnaire was based on the personal profile of respondents; education; prior knowledge of aquaculture system vis- a-vis, operating systems; stocking density; type of fish species stocked; variable and fixed costs; problems; record keeping and suggestions.

### 3.4 Method of Data Analysis

(i) Descriptive analysis was used to capture the socio-economic characteristics of the respondents. Data were analyzed using percentages and frequency tables. (ii) The Ordinary Least Square (OLS) multiple regression analysis was used to determine the resource-use efficiency. The marginal value product (MVP) of each input was analyzed for each input from the OLS multiple regressions. The ratio of MVP to MFC of each input was computed to give the resource-use efficiency. (iii) Budgetary analysis was used to compute the costs; net revenues and net returns to management of the fish farm enterprise. From the net revenues, inferences were drawn on the profitability of the enterprise. Budgetary analysis was used for this study which comprised of the following costs components and their measurements:

***(i) Fixed costs (FC):*** These are costs, which do not vary with output. They include land; pond construction; building and fencing; harvesting gears; pumping machines and other types of fixed costs. However, the values of these fixed cost items were not used directly but subjected to depreciation.

***(ii) Depreciation (D):*** This is the allowance in monetary terms, for the value of fixed costs been used up in production. The straight line method of depreciation was used in this study.

D = C-S / N

D is annual depreciation

C is cost of the fixed item

S is salvage value

N is the useful life of the fixed cost item

***(iii)Salvage Value:*** This is the value of items after their useful life. In this study, the salvage values of the fixed cost items are assumed to be zero because they are not sold after its use.

***(iv)Useful Life:*** This is the amount of time that an item is used until it's no longer useful for its purpose. The values used for this project are those given by the respondents.

***(v)Variable Costs:*** These are costs that vary positively with output. They rise as more output is produced and fall as less is produced. The annual values of these variable costs are used.

*Brood stock cost:* This could either be the annual cost of breeding fingerlings till time for use or the annual cost of procuring the brood stock from the market.

***(vi)Revenue:*** The annual revenue is gotten by the market price of selling the market size fish per kilogram multiplied by the total kilogram gotten from the fish farm. This price of fish per kilogram is dictated by general forces of supply and demand. Added to this revenue is revenue gotten from any integrated activity practiced by the farmer.

Net revenue = total revenue – total cost.

### 3.5 Production Function

The production function was used to examine resource productivity and efficiency. This allows for computation of marginal value productivity for the estimated coefficients of the production function.

Using ordinary least squares regression, the observation on the variables was used to determine the least square regression estimates of the b's, $R^2$ (multiple coefficient of determination) and the standard errors of the estimated parameters. The regression coefficients were the production elasticities ($^a$p). Their addition indicates the nature of returns to scale. Thus if $^a$p of bi>1, there is increasing returns to scale; if $^a$p bi <1, there is decreasing returns to scale and if $^a$p of bi=1, there is constant returns to scale. If the t-calculated is greater than t-tabulated of 1.96 at 5 percent level of significance then such input contributes significantly to fish farming. The significance of the parameters from zero, the magnitude of F-value and $R^2$ will indicate the overall significance of the relationship between the explained and explanatory variables. The production function was fitted using three functional forms, which are linear, semi-log and double log. The lead equation from the three functional forms was chosen based on the "a prior" expectations of the parameters, statistical as well as econometric criteria.

The production function for fish farming enterprise in Lagos State is as stated below:

Linear function:

$$Y= b_0+ b_1X_1+b_2X_2+ b_3X_3+ b_4X_4+ b_5X_5+ b_5X_6+ b_7X_7+ b_8X_8+ b_9X_9+ b_{10}X_{10}+ \ln U.$$

Semi- log function:

$Y = \ln b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_5 \ln X_6 + b_7 \ln X_7 + b_8 \ln X_8 + b_9 \ln X_9 + b_{10} \ln X_{10} + \ln U.$

Double log function:

$\text{Ln}Y = \ln b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_5 \ln X_6 + b_7 \ln X_7 + b_8 \ln X_8 + b_9 \ln X_9 + b_{10} \ln X_{10} + \ln U.$

Where;

Y is the value of gross output that is revenue of fish in a year and is in naira (₦).

$X_1$ is the total value of feed cost for a year (₦)

$X_2$ is the total value of fertilizer cost for a year (₦)

$X_3$ is the total value of liming for a year (₦)

$X_4$ is the total value of labour costs for a year (₦)

$X_5$ is the total value of land cost for a year (₦)

$X_6$ is the total value of harvesting nets costs (₦)

$X_7$ is the total value of drugs cost (₦)

$X_8$ is the total value of fish seed cost (₦)

$X_9$ is the pond dimensions in $m^2$ (or ha)

$X_{10}$ is the scale of production

U= stochastic random error

$b_0$ is the constant term

$b_i$ (i = 1…10) are the elasticities of production with respect to input

ln =natural logarithm.

## 4. RESULTS AND DISCUSSION

This part of the paper discusses the result of findings of the socio-economic characteristics of the 50 respondents; the budgetary analysis; resource efficiency and the problems militating against the respondents in the study area.

### 4.1 Socio-economic Characteristics

***4.1.1 Age of Respondents:*** Table 1 revealed that out of 50 respondents, 26 percent were in the age bracket of 51 to 55 years. These were older and more matured individuals who established this type of business as a result of retirement.

***4.1.2 Distribution of Respondents by Sex:*** It was observed that the fish farming enterprise in Lagos State is male-dominated. More than half of the respondents were males (60%) while the female constituted barely 40 percent (Table 1).

**Table 1: Socio-economic characteristics of the fish farmers in the study area**

| *Variables* | *Frequency* | *Percent* |
|---|---|---|
| *Age* | | |
| 26-30 | 2 | 4.0 |
| 31-35 | 4 | 8.0 |
| 36-40 | 7 | 14.0 |
| 41-45 | 7 | 14.0 |
| 46-50 | 11 | 22.0 |
| 51-55 | 13 | 26.0 |
| 56 and above | 6 | 12.0 |
| Total | 50 | 100.0 |
| *Sex Distribution* | | |
| Male | 30 | 60.0 |
| Female | 20 | 40.0 |
| Total | 50 | 100.0 |
| *Marital Status* | | |
| Single | 1 | 2.0 |
| Married | 46 | 92.0 |
| Widowed | 2 | 4.0 |
| Widower | 1 | 2.0 |
| Total | 50 | 100.0 |
| *Educational Status* | | |
| Secondary | 12 | 24.0 |
| Tertiary | 38 | 76.0 |
| Total | 50 | 100.0 |
| *Years of Experience* | | |
| 1-5 | 34 | 68.0 |
| 6-10 | 11 | 22.0 |
| 11-15 | 2 | 4.0 |
| 16-20 | 1 | 2.0 |
| >20 | 2 | 4.0 |
| Total | 50 | 100.0 |
| *Sources of Capital of Respondents* | | |
| Personal savings | 37 | 74.0 |
| Loans from relatives, friends | 4 | 8.0 |
| Bank loan | 2 | 4.0 |
| Informal sources | 3 | 6.0 |
| Cooperatives | 4 | 8.0 |
| Total | 50 | 100.0 |
| *Mode of Land Acquisition by Respondents* | | |
| Inheritance | 6 | 12.0 |
| Purchase | 32 | 64.0 |
| Lease | 9 | 18.0 |
| Joint ownership | 3 | 6.0 |
| Total | 50 | 100.0 |
| *Pond Type* | | |
| Concrete | 39 | 78.0 |
| Earthen | 8 | 16.0 |
| Others | 3 | 6.0 |
| Total | 50 | 100.0 |
| *Integrated Farming Practiced by Respondents* | | |
| Fish farming only | 23 | 46.0 |
| Rice/Fish Farming | 1 | 2.0 |
| Pig/Fish Farming | 1 | 2.0 |
| Poultry/Fish Farming | 14 | 28.0 |
| Goat/Fish Farming | 1 | 2.0 |
| Vegetable/Fish Farming | 8 | 16.0 |
| Other/Fish Farming | 2 | 4.0 |
| Total | 50 | 100.0 |
| *Fish Specie Cultivated* | | |
| Heterobranchus | 2 | 4.0 |
| Tilapia | 3 | 6.0 |
| Clarias | 45 | 90.0 |
| Total | 50 | 100.0 |

*Source:* Field Survey

***4.1.3 Marital Status****:* Table 1 revealed that 92 percent of the respondents were married. Four (4) percent were widowed while the remaining 2 percent were single. This implies that the respondents would have access to family labour in their fish farming business

***4.1.4 Educational Status of Respondents:*** Table 1 shows that all the respondents have formal education. Thirty-eight (38) of the 50 respondents (that is 76%) earned University education while 24 percent ended their formal education at the secondary school level. This indicates that the respondents would not pose any difficulty incase of any introduction of innovation by the extension agent.

***4.1.5 Years of Experience:*** Table 1 shows that sixty-eight (68) percent of the respondents have between 1 to 5 years of farming experience. Thus, majority of the respondents are relatively new in the study area's fish farming by experience. About 22 percent of them have been in the business for between 6 and 10 years; only 2 percent of them have much longer experience (that is between 16 and 20 years). However, the recent involvement might be as a result of State Government is very interested in the commercialization of fish farming in the state and local governments. Thus, government has invested in cash and in kind into the technical know-how of the respondents through running of training workshops, seminars and extension visits.

***4.1.6 Source of Capital:*** Majority of the respondents (74%) showed that money gotten from personal savings was used to finance the business. Eight (8) percent reported that they requested for loans from relatives, friends and from their Cooperatives Societies. Six (6) percent received capital used from informal sources (Money Lenders) while only 4 percent applied and received bank loans. This might as a result of the bureaucracy in obtaining loan from the financial institutions or it could be as a result of high rate of interest which discouraged farmers.

***4.1.7 Mode of Land Acquisition by Respondents:*** Table 1 shows that majority (64%) of the respondent purchased their land, Eighteen (18) percent operated on leased or rented land while 12 percent have their land inherited and 6 percent have joint ownership. This showed that majority of the respondents used the bulk of their start up capital to purchase the farmland used for the fish farming enterprise.

***4.1.8 Pond Types in the Study Area:*** Table 1 shows that seventy-eight (78) percent of the respondents used concrete ponds for their enterprise. Thus, this revealed that the concrete type of pond is the most popular system used in the study area compared to the earthen pond which was used by 16 percent of the respondents and 6 percent of the remaining respondents used other types of pond like tanks and plank ponds. The use of concrete pond might be due to its convenience, easy to clean and manage, and ease of harvesting and draining.

***4.1.9 Integrated Fish Farming System Practiced in the Study Area:*** Table 1 shows that almost half (46%) of the respondents did not combine their fish farming with any agricultural activity. Twenty-eight percent (28%) combined fish farming with poultry; others were into vegetable cum fish farming (16%), other activities combined with fish where at 4 percent while fish with pig, rice and goat rearing at 2 percent respectively. Fish farmers are into integrated farming because of its compatibility and it is also economical. It is efficient in the use and management of resources and more profitable.

***4.1.10 Fish Specie Cultivated:*** 95 percent of the respondents cultivated Clarias species which is popularly known as catfish, Tilapia with 6 percent while 4 percent cultivated *heterobran-chus* species. The reason might be because the species commands a large market, hence, most preferred and more income to fish farmers. It is tasty in whatever form prepared and has high nutritional values. This fact is also corroborated by Aromolaran (2000) and Kareem (2008).

All the above findings of the socio-economic characteristics identified are in line with the findings of Banjo et al. (2009) and Adewuyi et al. (2010) in their study of improving Clarias productivity towards achieving food security in Ijebu-Ode, Ogun State, Nigeria and analysis of profitability of fish farming in Ogun State, Nigeria respectively.

The results seen in Table 2 reveal that feed cost accounts for 59.1 percent of the total variable cost of production. It was noted that the fish farmers spent a lot in feeding with imported feed which is usually costly. Labour accounts for 24 percent of the variable cost followed by fish seed which was 8.65 percent of the variable cost. Percentage costs on miscellaneous is 6.18 percent while costs on integrated activity, drugs, fertilizer and liming uses 1.30 percent,

**Table 2: Summary of variable costs of an average fish farmer per season**

| *Items* | *Cost(₦)* | *Percent to variable cost (%)* |
|---|---|---|
| Fish seed | 2,231,300 | 8.65 |
| Feed cost | 15,260,200 | 59.1 |
| Fertilizer | 65,100 | 0.25 |
| Drug | 91,400 | 0.35 |
| Labour | 6,193,600 | 24.0 |
| Liming material | 33,700 | 0.13 |
| Integrated activity | 336,500 | 1.30 |
| Miscellaneous | 1,594,800 | 6.18 |
| Total variable cost | 25,806,600 | 100.0 |

*Source:* Field Survey 2007

0.345 percent, 0.25 percent and 0.13 percent respectively.

Results as seen in Table 3 reveal that land cost accounts for over half of the total fixed cost at 63.5 percent this may be because majority of the fish farmers purchased their land while costs on building and fencing accounted for 25.7 percent. Cost on pumping machine, harvesting nets, pond construction and other fixed items accounted for 7.17 percent, 1.47 percent, 1.43 percent and 0.68 percent respectively.

**Table 3: Summary of fixed cost of an average fish farmer per season**

| Items | Cost(₦) | Percentage to total fixed cost (%) |
|---|---|---|
| Depreciation on pond | 65,100 | 1.43 |
| Depreciation on land | 2,899,570 | 63.55 |
| Depreciation on building/fencing | 1,172,300 | 25.70 |
| Depreciation on harvesting nets | 67,250 | 1.47 |
| Depreciation on pumping machine | 327,350 | 7.17 |
| Others | 31,000 | 0.68 |
| Total | 4,562,570 | 100.0 |

*Source:* Field Survey

## 4.2 Ratio Analysis

The results of ratio analysis as seen in Table 4 reveal that the ratio of fixed cost to variable cost is 0.18(4,562,570 / 25,806,600) while the ratio of fixed cost to total cost is 0.15(4,562,570 / 30,369,170). The ratio of variable cost to total cost was 0.85(25,806,600 / 30,369,170). These ratios show that the ratio of VC/TC was higher than FC/TC implying that the cost of running the business after establishment annually is very high. It also revealed that the total variable cost consumes 84.98 percent of the total cost and fixed cost is 15 percent of the total cost.

**Table 4: Summary of ratios of variable costs, fixed costs to total costs of an average fish farmer per season**

| *Cost* | *Cost (N)* | *Percentage to total cost* | *Ratio to variable cost* | *Ratio to total cost* |
|---|---|---|---|---|
| Total variable cost | 25 806 600 | 84.98 | 1 | 0.85 |
| Total fixed cost | 4 562 570 | 15.02 | 0.18 | 0.15 |
| Total cost | 30 369 170 | 100.00 | | |

*Source:* Field Survey

The results of annual average benefit-cost analysis of an average fish farmer revealed that N4,562,570 was spent on depreciation costs, rents and interests and N25,806,600 was spent on operational cost (Table 5). An annual receipt was N69, 409,600 and net revenue was N3, 904,430.

**Table 5: Annual average benefit-cost analysis of an average fish farmer**

| *Item* | *Cost (₦)* |
|---|---|
| *Receipts* | |
| Fish | 68 649 600 |
| Integrated activity | 760 000 |
| Total revenue | 69 409 600 |
| *Variable cost* | |
| Feed seed cost | 2 231 300 |
| Feed cost | 15 260 200 |
| Fertilizer cost | 65 100 |
| Drug cost | 91 400 |
| Labour cost | 6 193 600 |
| Liming | 33 700 |
| Integrated activity | 336 500 |
| Miscellaneous | 1 594 800 |
| Total variable cost | 25 806 600 |
| Gross profit(total revenue-total variable cost) | 43 603 000 |
| *Fixed cost* | |
| Depreciation on pond | 65 100 |
| Depreciation on land | 2 899 570 |
| Depreciation on building/fencing | 1 172 300 |
| Depreciation on harvesting nets | 67 250 |
| Depreciation on pumping machine | 327 350 |
| Others | 31 000 |
| Total fixed cost | 4 562 570 |
| Total cost (TVC+TFC) | 30 369 170 |
| Net profit (TR-TC) | 39 040 430 |

*Source:* Field Survey

From the analysis, N54.07 was spent on variable cost per table fish, N9.58 on fixed costs per table fish. Expenditure on fish feed accounted for the largest proportion of total variable cost of production with 59 percent while seed cost accounted for 8.65 percent.

The ratio of the net profit to total cost 39,040,430 / 30,369,170 is 1.29. This shows that for every N1 put into the business, the business

returns N1.29 which shows that though the cost of running the business is high, a relatively high profit could still be gotten from it.

### 4.3 Regression Analysis

The results of the lead equation of the Double Log production function is shown thus:

$LnY = 5.7^{***} + 0.12\ln X_1 - 0.13\ln X_2 + 0.09\ln X_3 + 0.03\ln X_4 - 0.01\ln X_5 - 0.05\ln X_6 + 0.08\ln X_7 +$
(2.91) (0.19) (0.18) (0.09) (0.18) (0.07) (0.16) (0.12)
$0.428^{*}\ln X_8 - 0.125\ln X_9 + 0.424^{**}\ln X_{10} + \ln U$
(0.146) (0.177) (0.125)

From the above production function:

Figures in parenthesis are the standard errors of the estimated coefficient.

$R^2 = 0.515$

F= 4.133 which is significant at 1 percent

* means significant at 1 percent

** means significant at 5 percent

*** means significant at 10 percent

The estimated double log production function shows that the F-calculated is significant at 1 percent. The $R^2$ of 0.515 shows that 51.5 percent of the variation in the value in fish output is caused by the inputs considered in the equation. $X_2$, $X_5$, $X_8$ and $X_9$ have negative signs implying that a 100 percent increase in fertilizer cost, land costs, harvesting nets and pond area will reduce revenue by 12.6 percent, 1 percent, 12.5 percent and 42.4 percent respectively. The pond area has a negative sign which contrasts the fact that increase in area should increase production output, the otherwise is the case here because cost of pond construction is very high and increasing area definitely increases costs therefore reducing revenue.

**Table 6: Estimated double-log function**

| *Variables* | *Estimated coefficient* | *T ratio* |
|---|---|---|
| Constant term | 5.73 | 1.97* |
| Feed cost | 0.12 | 0.74 |
| Fertilizer | -0.13 | -1.03 |
| Liming | 0.09 | 0.74 |
| Labour | 0.03 | 0.24 |
| Land cost | -0.01 | -0.08 |
| Harvesting nets | -0.05 | -0.36 |
| Drug cost | 0.08 | 0.61 |
| Fish seed | 0.43 | 2.91* |
| Pond area | -0.13 | -0.93 |
| Total stocked | 0.42 | 2.64* |

*Source:* Field Survey

* means t-values are significant at greater or equal to 1.96 at 5 percent.

The results of estimated double-log function revealed that the constant term, $X_8$ (fish seed cost) and $X_{10}$ (total fish seed stocked) are significant. This shows that seed costs and scale of productions contributed significantly to the fish farming in the study area (Table 6).

The results of efficiency of resource use and elasticities of the fish farmers in the study area showed the double-log function (Table 7). The elasticity is given directly as the coefficients of the X's. Only fish seed has its efficiency ratio to be greater than one indicating that it is below optimum level which therefore indicates under utilization and increase in the amount of fish seed will increase revenue. Feed cost, fertilizer, liming, labour, land cost, harvesting nets, drug costs, pond area and total stocked or scale of production have their efficiency ratios to be less than one indicating that they are being over utilized, hence, in stage III of production and reduction in their use levels will increase revenue.

**Table 7: Efficiency of resource use and elasticities of the fish farmers in the study area**

| *Resource input* | *Estimated regression coefficient* | *Mean output value (₦)* | *Mean input value (₦)* | *MVP(B.C/D)* | *MFC(₦)* | *Efficiency ratio (E/F)* |
|---|---|---|---|---|---|---|
| *A* | *B* | *C* | *D* | *E* | *F* | *G* |
| Feed cost | 0.116 | 1372992 | 305204 | 0.52 | 286 | 0.001818182 |
| Fertilizer | -0.126 | 1372992 | 1302 | -132.87 | 1000 | -0.133 |
| Liming | 0.087 | 1372992 | 674 | 177.23 | 1000 | 0.177 |
| Labour | 0.029 | 1372992 | 123872 | 0.32 | 344.08 | 0.000930016 |
| Land cost | -001 | 1372992 | 57991.4 | -0.24 | 57991.4 | 4.13E-06 |
| Harvesting net | -0.048 | 1372992 | 1345 | -4.9 | 1345 | -0.03643 |
| Drug cost | -0.079 | 1372992 | 1828 | -59.34 | 500 | -0.11868 |
| Fish seed | 0.428 | 1372992 | 44626 | 13.17 | 11.1 | 1.18648 |
| Pond area | -0.125 | 1372992 | 29.04 | -5909.92 | 29.04 | -203.509 |
| Total stock | 0.424 | 132992 | 9545.3 | 60.99 | 9545.3 | 0.00638 |
| Total | 0.696 | | | | | |

*Source:* Field Survey N:B:1USD= ₦150

The sum of the elasticities which indicates returns to scale is less than one, positive and greater than zero therefore indicating decreasing returns to scale.

The summary of problems encountered by fish farmers in the study area showed that 44 percent of the respondents agreed that unstable electricity constituted a major problem associated with running of the business enterprise. Table 8 also revealed that 16 percent of the respondents encountered management problems. 14 percent of the respondents have security problems, 10 percent agreed that proximity to perennial water was a constraint. 4 percent of the respondents had problems of mortality.

**Table 8: Summary of problems encountered by fish farmers in the study area**

| *Problems* | *Frequency* | *Percent* |
|---|---|---|
| Marketing | 1 | 2.0 |
| Lack of security | 7 | 14.0 |
| Proximity to water | 5 | 10.0 |
| Funds | 2 | 4.0 |
| Management | 8 | 16.0 |
| Mortality | 2 | 4.0 |
| Land availability | 3 | 6.0 |
| Electricity | 22 | 44.0 |
| Total | 50 | 100.0 |

*Source:* Field Survey

This study investigated the resource use efficiency of fish farming in Lagos state. The specific objectives included: (i) to examine the socio economic characteristics of the respondents in the study area; (ii) estimate the resource use efficiency of the respondents; (iii) identify the problems affecting fish farming in Lagos state. This was achieved through the random selection of 50 respondents and interviewing them using them using a structured questionnaire. The method of analysis used was descriptive analysis to determine the socio economic characteristics of the cat fish farmers. The quantitative technique adopted was production function which examined resource productivity and efficiency allowing for computation of marginal value productivity for the estimated coefficients.

The results showed that majority of the respondents (92%) were married and 60 percent are males. It also revealed that 76 percent went through tertiary education and few youths were engaged in this enterprise. 68 percent had about 5years experience in the business, 74 percent started their business with their own personal savings and 64 percent purchased their land. 84 percent of the total cost was used on variable items, of which feed cost accounted for 59 percent of the variable cost. The lead equation was the double log model chosen based on econometric and statistical criteria (that is, $R^2$, parameters estimate, significant levels etc. Fish seed and scale of production were significant and positive indicating that increase in these inputs would increase revenue by 42.8 percent and 42.4 percent respectively. The total elasticities of the coefficients summed up to 0.696, positive but less than unity indicating a decreasing returns to scale. The efficiency ratios of fish seed was greater than one indicating underutilization while the remaining resource inputs were overutilized having efficiency ratios less than one. With a ratio of net profit to total cost of 1.29 showed that fish farming is a profitable business in the study area.

## 5. CONCLUSION

The study has examined the resource-use efficiency of fish farming. The study concluded that, years of experience had a significant effect on the efficiency of the fish farming enterprise in the study area. This also corroborated the findings of Kareem et al. (2008) who also concluded that years of experience contributed significantly to the technical efficiency sources of fish farmers operating concrete ponds. Also, it was noted that the fish farmers were not efficient in their use of resources of variable and fixed items. Major problem that affected the sector was lack of basic infrastructural facility. The results showed that fish farming is highly profitable business.

In view of the research findings, it is therefore suggested that government should encourage youths to go into fish farming enterprise so as to ensure sustainability of the fishery subsector with a view to improving food security in the nation. The power supply in the area should be kept constant so as encourage the compounding of fish feeds by fish farmers since feed constituted a major part of variable cost in fish farming business. Monetary policies should be made to encourage lending institutions to administer loans to fish farmers at a lower interest rate as well as the timely release of funds. More fishery specialist, extension officers should be encouraged through incentives, training and finan-

cial support to carry out their duties through regular and constant seminars, workshops, and conference to fish farmers with respect to the adoption of new technology(ies) that would enhance fishery productivity in the study area.

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