

Analysis of the Resource Management Ability by Catfish Farmers in Nigeria: A Case of Ogbaru Local Government Area, Anambra State

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Abstract: The study was on the analysis of the resource management ability by catfish farmers in Nigeria: A case of Ogbaru Local Government Area, Anambra State. The study focused on the five objectives which investigated the socioeconomic characteristics, costs and net returns, production function, determinants of the returns, resource use efficiency of the farmers, and the challenges facing fish farmers. Data for the study was collected from a cross-section of 240 randomly selected catfish farmers using a well-structured questionnaire and facial interview. The study was able to reveal that male (72.1%) farmers dominated the industry. The study recorded an average age, household size, level of education, farming experience, and output as 46 years, 11 people, 11 years, 13 years and 5.297 tons respectively. Fish farming was profitable with a net returns of 5,057.02 USD and returns on investment of 1.82 implying 1.82 USD returns upon every USD investment. The double-log was the lead functional form for the production functions, pond size (2.64)**, utilities (1.99)**, fingerlings (2.92)***, fertilizer (-1.97)***, and labour (-3.31)*** were the significant production factors. The ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC) was less than one for all the resources used apart from fingerlings cost which was greater than one. The relationship between net returns and socioeconomic variables, semi-log was the lead equation and sex, farming experience, level of education, household size, and primary occupation were the significant variables. Furthermore, the study identified the following grey areas inherent in fish farming in the area to include; high cost of feed among others.

Keywords: Catfish Farming, Management, Optimal Allocation, Relative Change, Marginal Value Product, Efficiency

1. Introduction

Fish farming is very important in the economic development of many nations. It plays an important role in the diets, livelihoods, and income of many developing countries. It is well accepted that fish is a good source of animal protein and a major source of vitamins and minerals to the human body [1], the Federal Department of Fisheries (FDF) assert that, the fact that fish is found in most water bodies around the world makes

it readily accessible, cheap and a renewable form of resources found in wide coverage [2].

The consistent increase in the world population resulted to a serious increase in the demand for animal protein, essentially higher in quantity than plant protein. The nutritional requirement in the developing countries are particularly critical when compared to the developed countries [3]. Malnutrition and starvation are the major problems faced by Millions of rural dwellers in the developing countries such as Nigeria. Since fish avails the

cheap source of animal protein, its demand in Nigeria due to the continuous population growth has not been able to matchup. The Food and Agricultural Organization Statistics (FAO) in 2018 reported that Nigeria population was estimated at about 193.976 million people with an estimated annual per capita fish consumption of 17.5kg. Therefore, projecting annual fish demand of 3.61 million metric tonnes [4]. As the most populous country in Africa, Nigeria is the largest consumer of fish products in Africa. The country has relied on importation of fish to meet her ever increasing demand. Over USD 1.2 billion is spent annually to offset the deficit demand-supply gap [1]. Annual fish demand and supply in Nigeria was projected as 3.48 million metric tonnes and 1.95 million metric tonnes respectively, this leaves a demand-supply deficit of 43.9 per cent [4, 1]. This empirical result suggested that employment opportunities abound in the fishery subsector of the Nigerian economy.

The three sources of fish production in Nigeria include; artisanal (inland rivers, lakes, coastal and brackish water), industrial fishing and aquaculture (fish farm) [5-7]. The domestic fish contributions of the three sources over the years explicitly involves; 67.7 per cent artisanal, 30.8 per cent aquaculture and 1.5 per cent industrial fishery [5]. This fact affirmed the assertion of [6], who noted that the majority of fishes supplied to the markets in most cases come from the artisanal subsector. Scholars defined artisanal fishery as a traditional or crude system of fishing which employs a very low level of technology [8]. The common fish species produced in Nigeria include Torpedo-shaped catfishes (*Clarias spp.*), Tilapias (*hemichromis/ oreochromis. spp.*), Smoked fishes, Torpedo-shaped catfishes (*heterobranchus. spp.*), African carps (*cyprinidae*), Marine fishes (*osteichthyes*) Elephantsnout (*mormyridae, gnathonems spp.*) Nile/Niger perch (*lates niloticus*), Bonga shad (*ethmalosa fimbriata*), Torpedo-shaped catfishes (*clarias lazera*) and Bonytongue fishes (*heterotis spp.*) [1].

Among all the fish species mentioned, this study is interested in the African catfish (*Clarias gariepinus*). African catfish is a diverse group of ray-finned fish known by its prominent barbells and is considered to be one of the most important tropical catfish species for aquaculture in West Africa [9, 10]. In Nigeria, catfish farming is proving to be a lucrative option for small-scale inland fisheries and the consumption of its products is on the increase [6].

The production of fish as an economic resource is undertaken by a good number of people especially the small scale farmers in Nigeria [10]. Therefore, to create a system with good returns, one needs good and continuous management policies directed towards efficient use of resources as this will not only sustain fisheries but will also heighten the level of food security in our society. For a sustained production and supply of fish and its other products, there is a need to investigate the managerial ability of the fish farmers otherwise called resource use efficiency. The importance of this assessment cannot be overemphasized seen that productive resources are scarce and expensive yet continuous supply must be maintained. The resources needed

in fish production in the study area include land for pond construction and building, labour, capital and other production and maintenance inputs. The input market to support fish production is poorly developed or nonexistent. Most farmers have little or no access to credit to supply the required quantity of fingerlings, feeds, among others. The resultant effect is low productivity which makes it difficult to rise above the vicious cycle of poverty and improve the standard of living of the fishing household. The researchers, therefore, deemed it necessary to:

- 1) examine the socioeconomic characteristics of the farmers,
- 2) determine the costs and returns of fish farming,
- 3) estimate the production function and the determinants of the returns from fish farming,
- 4) evaluate the resource use efficiency of the farmers, and
- 5) identify the challenges facing fish farmers in the study area.

2. Review of Related Literature

Much scholarly work supports resource use efficiency of fish farmers both in Nigeria and around the globe. A study was carried out on comparative analysis of technical efficiency of catfish farms using different technologies in Lagos State, Nigeria. The findings show that the profit realized from earthen, cage and plastic pond was 41,904 USD, 5,441 USD, and 9,841 USD respectively at ₦380 per USD. Their study equally revealed that the determinants of productivity were sex, age, and marital status [12]. Also, analysis of artisanal fishing operations in Degema Local Government Area of Rivers State, Nigeria reported that the majority (86.7%) of the farmers are male with a household size within 6 – 10 people (53.0%). The study equally shows that a greater proportion (30.0%) of the farmers are within the age of 40 – 49 years, and 55.6% of them have been into the enterprise for over 15 years. As high as 42.3% of the farmers attended secondary school. The study further shows that the farmers averagely realized 181 USD profit from the enterprise [5]. Furthermore, Cobb Douglas was the lead equation in their result with labour, capital, operating cost, farming experience, level of education and household size been the significant exogenous variables. Not minding 65.6% of the farmers reporting storage facility as their major challenge [5].

A survey on the profitability analysis of fish production from concrete pond system in Benue State, Nigeria reported that the greater number of the farmers are above 50 years. Also, the study further revealed 50.8% have 1 – 5 years farming experience, 40.8% attended tertiary education, 50.8% have a household size between 6-10 people, and the mean pond size was 35m² [3]. The study reported 432 USD as the profit realized from the enterprise. The explanatory variables significant to the production function were; pond size, feed, and fingerling, while the determinant of productivity among farmers were; age, farming experience, household size, number of extension contact, and annual

income [3]. Furthermore, Unekwu *et al.* on the assessment of the constraints to catfish farming in Kogi State, Nigeria revealed that the mean age and farming experience was 46 years and 5 years respectively [13]. The major problems challenging catfish farming in the area were inadequate finance, high cost of feed, predators, marketing challenge, poor storage facilities, lack of government support, and high cost of transportation, disease, and high temperature.

Resource Use Efficiency

Resource use efficiency is either measured by simple input-output ratio or using Cobb Douglas functional form. Measurement in terms of input-output ratio depends on the individual contributions of each resource used. Efficiency of resource use can also be defined as the ability to derive maximum output per unit of resources [14, 15], which is the key to effectively address the challenges of achieving food security when resources are stock or supply of money, materials, staff, and other assets that can be drawn on by a person or organization. Resource productivity is a concept that is used to mean allocation of resources such as land, labour, capital, management and water for irrigation between competing alternative [16]. This resource productivity has remained a very complex concept and most difficult to interpret in the agricultural sector [17, 18] due to the diversity of capital being utilized in production, this suggests that, the use of each factor of production should not depend solely on its availability [19]. It is therefore necessary for the rural farmers to be abreast with the knowledge of resource allocation or allocative efficiency in agricultural production to help bring about increased agricultural productivity [20, 21]. Researchers have suggested that poor technical knowledge might be hindering the production and productivity of rural farmers due to poor understanding about the efficient resource allocation [15].

Measuring efficiency is very important in the use of scarce resources in the production process [22]. Combining production inputs efficiently to yield output is the primary task of a farm manager. When two firms in the industry use the same level of inputs and employ the same technology, and produce a different volume of output, it is an indication that at least one of the firm is producing inefficiently. Scholars should, therefore, concentrate on evaluating the efficiency of different fish production system with a view of identifying the most economically viable one for fish sustainability. Other authors assumed that efficiency is the same as optimal productivity since it is the index of the value of total farm output to the value of total resource utilized in the production process [23]. Far back in late 90s, Adesina and Djato opined that the optimal productivity of resources implies efficient utilization of the alternative resources available in the production process [24]. The existence of efficiency is in three forms which are technical, allocative and economic efficiency, despite that this study centres on allocative efficiency, it is worthy to define the three for academic contribution.

The measurement of a farm's technical efficiency is based on deviations of observed production from the efficient

frontier. The ratio of the potential production to actual production defines the level of efficiency of the individual farm [25]. Technical efficiency is the measure of a firm's success in producing a maximum level of output from a given set of inputs. Also, technical efficiency describes the ability of a firm to achieve a higher level of physical output given a small level of production input [26]. On the other hand, allocative efficiency as the extent to which firms make an efficient decision in the use of input to the level which the value of the marginal contribution to production is equal to their marginal factor cost [27]. Allocative efficiency is equally the measure of a firm's success in choosing an optimal set of production inputs. Furthermore, economic efficiency is the product of technical and allocative (price) efficiency.

3. Materials and Methods

The Study Area

The study was conducted in Ogbaru Local Government Area of Anambra State, Nigeria. Anambra State is one of the 36 States in Nigeria, it is located in the South-Eastern part of the country, and comprises of 21 Local Government Areas (LGAs). The State is sub-divided into four agricultural zones to aid planning and rural development. Ogbaru is a humid (23°) tropical rain forest zone, it is located between longitude $6^{\circ}31^1$ and $7^{\circ}03^1$ E and latitude $5^{\circ}45^1$ and $6^{\circ}46^1$ N. It has a boundary with Asaba in Delta State and Ndoni in River State. Ogbaru is located by the bank of River Niger. Ogbaru people are mainly fishermen and women, farmers and are traditionally known as warriors. The LGA has 16 communities which include: Atani, Akili-Ogidi, Akili-Ozizor, Amiyi, Mputu, Obeagwe, Ohita, Odekpe, Ogbakugba, Ochuche-Umuodu, Ossamala, Ogwu-Aniocha, Umunankwo, Umuzu, Okpoko and Ogwu-Ikpele. Atani is the LGA headquarter. Ogbaru is neighbored by Onitsha, a major commercial city in Southeast Nigeria and that gives Ogbaru people quick access to the market.

Sampling Technique and Sample Size.

All the communities in the LGAs were actively involved in the study. A multistage sampling technique was employed; in the first stage, 3 villages were randomly selected from each community to make it a total of 48 villages. In the second stage, 5 fish farmers were randomly sampled to realize a total of 240 farmers. Primary data was collected by the use of a well-structured questionnaire administered to the fish farmers through personal interview alongside personal observations by the researchers. The information sourced from the farmers includes background data of the respondents (occupation, farm size, extension contact, annual farm income, cooperative membership, access to credit, educational level, sex, age, household size and farming experience), variable inputs (feeds (kg), fingerlings (No), labour (man-day), and fertilizer (kg)), and fixed inputs (capital inputs, interest on a loan, depreciation on fish pond, electricity, and other equipment).

Methods of Data Analysis

The study utilized a combination of analytical tools which include; descriptive statistics, budgetary methods, and inferential statistics. The objective i and v was achieved with descriptive statistics, objective ii was achieved with a budgetary method, objective iii was achieved with multiple regression analysis, and objective iv was achieved with allocative efficiency method. These models are mathematically defined as:

a) Budgetary method is defined as:

$$GM = TR - TVC \quad (1)$$

$$NR = TR - TC \quad (2)$$

$$TC = TFC + TVC \quad (3)$$

Where: GM is the gross margin, NR is the net returns, TR is the total revenue, TC is the total cost, TVC is the total variable cost, TFC is the total fixed cost. All the variables are measured in USD.

b) The multiple regression model defined by Ohajianya *et al.* as the mathematical relationship between output and input factors is implicitly stated as:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, e) \quad (4)$$

Where: Y is the total output produced (kg), X_1 is the pond size (m^2), X_2 is the utility (electricity and water cost) (USD), X_3 is the fingerling (Number of fish stocked), X_4 is the quantity of feed (kg), X_5 is the quantity of fertilizer (kg), X_6 is the capital input (depreciation on implements and fish pond) (USD), and X_7 is the labour input (man-days).

Four functional forms of the model; linear, exponential, semi-log, and double-log were tried and the lead equation selected based on the functional form with the best result that had the highest R^2 , t-ratios, highest number of significant variables, and in conformity to *a priori* expectations.

c) The researchers adopted the allocative efficiency method defined by Fasasi, Goni & Baba and Awumyo-Victor as:

$$r = \frac{MPP_{xi} * P_y}{P_{\bar{X}_i}} \quad (5)$$

$$MVP = MPP_{xi} * P_y \quad (6)$$

$$MFC = P_{\bar{X}_i} \quad (7)$$

Where: r is the efficiency ratio, MVP is the marginal value product (incremental contribution to revenue), MPP_{xi} is the marginal physical product (coefficient), P_y is the unit price of fish (output) in USD, MFC is the marginal factor cost, P is the unit price of input, and \bar{X}_i is the geometric mean value of ith resources used. Note that, when: $r = 1$ (implies efficient utilization of resources), $r < 1$ (implies over utilization of resources), and $r > 1$ (implies under-utilization of resources). The relative percentage in MVP of each resource required for optimal resource allocation ($r = 1$) defined in Mijindadi, and Ochi *et al.* was adopted as:

$$D = \left(1 - \frac{P_{\bar{X}_i}}{MPP_{xi} * P_y}\right) * 100 \quad (8)$$

Where: D is the percentage change in MVP

d) The multiple regression model for the relationship between net returns and socioeconomic variables is implicitly defined as:

$$NR = f(Z_1, Z_2, Z_3, Z_4, Z_5, Z_6, Z_7, Z_8, e) \quad (9)$$

Where; NR = net return (USD), Z_1 = sex (dummy, Male = 1; Female = 2), Z_2 = age (years), Z_3 = farming experience (years), Z_4 = level of education (years), Z_5 = marital status (dummy; married = 1, otherwise = 0), Z_6 = household size (Number of persons), Z_7 = cooperative membership (dummy, member = 1, not a member = 0), Z_8 = occupation (dummy, full time = 1, part-time = 0) and e = error term.

4. Results Discussion

Socioeconomic characteristics of fish farmers

Table 1 reflects the socioeconomic characteristics of the farmers in the area, the study revealed that fish farming is dominated by male farmers with 72.1%, this male dominance in the enterprise is in agreement with the finding of Tasie *et al.* with 55.8% of them married, been married also helps to increase the supply of family labour [5]. The majority (53.5%) of the farmers are within the age of 38-57 years, while the remaining 27.9% and 18.6% are within the age of ≤ 37 years, and ≥ 58 years respectively. The mean age of 46 years is an indication that the farmers are still in their active farm age with an average farming experience of 13 years. This result in age is in agreement with Unekwu *et al.* [13]. The study shows that greater proportion of the farmer's household size fall within > 11 people, while the remaining 30.2% and 27.9% have household size within the range of 6-10 people and 1-5 people respectively. The mean household size was 11 people, large enough to increase the supply of family labour in the enterprise.

The study equally revealed that greater number (37.2%) of the farmers attended secondary school, while the remaining 27.9%, 18.6%, and 11.6% attended Tertiary education, Primary education and postgraduate respectively. Only 4.7% of the farmers had no formal education. The average years the farmers spent in school was 11 years and agreed with [5]. Hence the farmers averagely attended secondary school, it means they are fairly literate and will be able to adopt agricultural technology. A greater number (48.8%) of the farmers are primarily traders, while the remaining 39.5% and 11.6% are primarily farmers and civil servants. This result reveals the true nature of the study area as artisanal fishing (fishing in the wild) is often practiced in the area while only those not fully engaged in agriculture might attempt fish farming. 81.4% of the farmers practice catfish farming with concrete ponds while the remaining 18.6% uses earthen ponds, with the annual mean fish output of 5.297 tons. This result corroborates Oluwatayo & Adedeji [12]. Furthermore, 67.4% of the farmers rear *Clarias/Heterobranchus* to corroborate with the study of Otubusin [6].

Table 1. Socioeconomic characteristics of fish farmers.

Sn.	Variable	Frequency	Percentage (%)	Mean
1	Gender			
	Male	173	72.1	
	Female	67	27.9	
2	Age			
	≤ 37	67	27.9	
	38 - 57	128	53.5	46
	≥ 58	45	18.6	
3	Marital status			
	Married	134	55.8	
	Otherwise	106	44.2	
4	Household size			
	1 – 5	67	27.9	
	6 – 10	73	30.2	11
	≥ 11	100	41.9	
5	Level of education			
	No formal education	11	4.7	
	Primary	45	18.6	
	Secondary	89	37.2	11.44
	Tertiary	67	27.9	
	Postgraduate	28	11.6	
6	Primary occupation			
	Farmers	95	39.5	
	Traders	117	48.8	
	Civil servant	28	11.6	
7	Farming experience (years)			
	≤ 10	89	37.2	
	11 – 20	112	46.5	13.12
	≥ 21	39	16.3	
8	Type of pond			
	Concrete	195	81.4	
	Earthen	45	18.6	
9	Species stocked			
	<i>Clarias/Heterobranchus</i>	162	67.4	
	<i>Tilapia/Heterobranchus</i>	11	4.7	
	Both (<i>Tilapia</i> & <i>Clarias</i>)	67	27.9	
10	Fish output (tonne)			
	≤ 4	89	37.2	
	4.1 - 8	112	46.5	5.297 tons
	≥ 8.1	39	16.3	

Source: Field Survey Data, 2020.

Costs and Returns of Fish Farming

The researchers adopted the US dollar to attain international standard and ease of readability across the globe. Table 2 represents the profit realized from fish farming in Nigeria. A sales revenue of 7,839.56 USD was reported, while the total cost incurred by the enterprise was 2,782.54 USD. The gross margin of 5,253.13 USD and net returns of 5,057.02 USD is an indication that fish farming is profitable which justifies the assertion of FAO and Giwa *et al* that reported an estimated annual per capita fish consumption of 17.5kg and 43.9% demand-supply deficit [1, 4]. The profit realized was also in agreement with Oluwatayo & Adediji [12]. The BCR of 2.82 is an indication that the profit realized can finance the next production 2.82 times. Also, the ROI of 1.82 implies that for every 1 USD investment made will

generate 1.82 USD profit in return.

Table 2. Cost and returns of fish farming.

Item	Quantity	Price (USD)	Value (USD/farmer)
Total Revenue			
Sales of fish (kg)	5297	1.48	7,839.56
Variable Cost			
Labour (Man-day)	109.68	0.78	85.55
Medication	-	-	33.19
Transportation	-	-	34.75
Utility	-	-	167.93
Fingerlings	4286.6	0.05	214.33
Feed (kg)	316.44	4.66	1,474.61
Fertilizer (kg)	124.42	4.63	576.06
Total Variable Cost (TVC)			2,586.43
Fixed Cost			
Depreciation on Capital Items			145.02
Depreciation on Fish Pond	37.44		51.09
Total Fixed Cost (TFC)			196.11
Total Cost (TC)			2,782.54
Gross margin (GM)			5,253.13
Net returns (NR)			5,057.02
Benefit-cost ratio (BCR)			2.82
Return on investment (ROI)			1.82

Source: Field Survey Data, 2020.

Estimation of production functions of fish farmers.

The double-log functional form had a better result with the highest R² (0.756), more number of significant variables (t-ratios) and in conformity with the *a-prior* expectation was chosen as the lead equation (Table 3). The coefficient of multiple determinants; R² (0.756) implies that 75.6% of the fish output was explained by the joint action of the explanatory variables (production factors) while the remaining 24.4% unexplained was as a result of the error beyond the control of the farmers. The lead equation is therefore defined as:

$$\ln Y = 0.123 + 0.089 \ln X_1 + 0.082 \ln X_2 + 0.736 \ln X_3 + 0.161 \ln X_4 - 0.017 \ln X_5 + 0.35 \ln X_6 - 0.141 \ln X_7.$$

The coefficient of pond size (0.089) was positive and significant at 5% alpha level of probability, this implies that a unit increase in pond size will increase fish output by 0.089 unit. Pond size contributed 471kg to the total fish output of 5297kg (Table 2). The coefficient of utilities (0.082) was positive and significant at 5% alpha level of probability, this implying that a unit increase in the amount spent on utilities by the farmers will increase fish output by 0.082 unit, these utilities include; water and electricity. The finding is in agreement with Tasi *et al*. Utilities contributed to the total fish output by 434kg. The coefficient of fingerlings (0.736) was positive and significant 1% alpha level of probability, this implies that a unit increase in the number of fingerling stocked will increase the fish output by 0.736 unit. The number of fingerlings stocked contributed to the total fish output by 3899kg, the high-value contribution by fingerlings could be attributed to a good breed stock.

Also, the coefficient of feed (0.161) was positive and significant at 5% alpha level of probability, this implies that a

unit increase in the quantity of feed used will directly increase the fish output by 0.161 unit. Feed contributed 853kg to the total weight of the fish produced by the farmers. The coefficient of fertilizer (0.017) was negative and significant at 5% alpha level of probability, this implies that a unit increase in the quantity of fertilizer used by the farmers will reduce fish output by 0.017 unit. Fertilizer reduced the weight of total fish produced by 90kg. Furthermore, the

coefficient of labour (0.141) was negative and significant at 1% alpha level of probability, this implies that an increase in labour employed in fish farming will reduce output by 0.141 unit. This findings aligned with the study of Tasié *et al.* Labour reduced total fish output by 747kg. This is an indication that many workers on the farm are idle and their impact is not being felt in the enterprise.

Table 3. Estimation of production functions of fish farmers.

Explanatory variable	Linear	Exponential	Semi log	Double log
Constant	-156.26 (-0.33)	7.268 (39.48)	-16028.768 (1.68)	0.123 (0.10)
Pond size (M ²)	14.847 (2.88)***	0.001 (2.28)**	3340.845 (2.74)**	0.089 (2.64)**
Utilities (USD)	0.011 (2.53)**	3.993 (1.97)**	541.755 (0.77)	0.082 (1.99)**
Fingerlings (No)	0499 (3.11)***	0.003 (1.78)*	837.306 (0.42)	0.736 (2.92)***
Feed (kg)	1.743 (4.63)***	1.002 (1.14)	305.99 (0.51)	0.161 (2.12)**
Fertilizer (kg)	0.412 (0.65)	0.001 (1.73)*	-76.297 (1.06)	-0.017 (1.97)**
Capital depreciation (USD)	0.001 (0.64)	5.015 (1.25)	-156.724 (-0.39)	0.35 (0.69)
Labour (man-day)	-3.688 (2.93)***	-0.001 (1.29)	-1443.086 (4.29)***	-0.141 (-3.31)***
R ²	0.738	0.674	0.643	0.756
F-values	110.55***	35.43***	46.79***	124.78***
Sample size	240	240	240	240

Source: Field Survey Data, 2020. Figures in parenthesis are t – ratios (*) significant at 10%, (**) significant at 5%, and (***) significant at 1%.

Resource Use Efficiency of Fish Farmers

The resource use efficiency of the farmers presented in Table 4 was computed from the lead equation (Cobb Douglas) in relation with inputs and outputs (Table 3). The result shows that major inputs in catfish farming such as pond size, utilities, feed, fertilizer, capital depreciation, and labour were overused and the farm managers need to decrease their cost for its optimum allocation. The study equally revealed that fingerlings were under-used, this suggests the need to increase the cost of fingerlings by at least 95% for optimum resource allocation. A better argument might be put forth that the farmers are not aware of stocking

rate, the researchers, therefore, call on the agricultural extension agents to organize training on fingerlings stocking rate among other innovative measures needed to improve performance in the industry. The farmers may still organize themselves into a cooperative to ensure networking for easy access to information. Being that the ratio of MVP (Marginal Value Product) to MFC (Marginal Factor Cost) was less than one for all the resources used in fish farming apart from fingerlings cost which was greater than one, the researcher opined that resources are not used for optimum economic advantage, we further call for an adjustment in the marginal value product of all the resources to ensure optimal use.

Table 4. Resource use efficiency of fish farmers.

Variables	MPP _{xi}	MVP	Mean input	MFC	r	D-value	Efficiency
Pond size	0.089	0.13	37.44	1.36	0.10	936	Over-used
Fingerlings	0.736	1.09	4286.6	0.05	20.61	95	Under-used
Utility	0.082	0.12	1	1.00	0.12	724	Over-used
Feed	0.161	0.24	316.44	4.66	0.05	1857	Over-used
Fertilizer	-0.017	-0.03	124.42	4.63	-0.01	18502	Over-used
Capital dep.	0.35	0.52	240	1.00	0.52	93	Over-used
Labour	-0.141	-0.21	109.68	0.78	-0.27	473	Over-used

Source: Field Survey Data, 2020. Mean price of output: 1.48 USD.

Determinants of Net Returns of Fish Farming.

Table 5 reflects the relationship between the net returns and farmer’s socioeconomic characteristic analyzed with a multiple regression to produce the best result. Semi-log had the best result with R² of 0.632, implying that 63.2% variation in net returns was explained by the explanatory variables (socioeconomic variables) while the remaining 36.8% was as a result of the error beyond the control of the farmers. The F-value of 3.23 shows the general significance of the model distribution at 1% alpha level of probability. The coefficient of sex (0.1448) was negative and significant at 5% alpha level of probability, this implies a shift on sex

target say from male to female farmers will reduce net returns by 0.1448 unit. The negative relationship between sex and net returns reduced the total net returns (Table 2) realizable with 732.26 USD. These findings could be attributed to the physicality and the rigorous jobs required in the enterprise. The significance of sex was expected and is consistent with Oluwatayo & Adedeji.

Also, the coefficient of farming experience (0.2682) was positive and significant at 1% alpha level of probability, this implies that a unit increase the number of years the farmers spend in fish farming will increase the net return by 0.2682 unit. The farming experience contributed 1,356.29 USD to

the total profit from the enterprise. More experienced farmers are by every means expected to perform better than less experienced farmers. This result is in agreement with Penda *et al.*, Tasie *et al.*, and Unekwu *et al.* The coefficient of the level of educational (0.5149) was positive and significant at 5% alpha level of probability, this implies that a unit increase in the number of years the farmers spend in school will increase net returns by 0.5149 unit. Level of education contributed 2,603.86 USD to the total profit from fish farming in the industry. This result was expected as the extent of agricultural technology adoption is easier with an increased years of schooling. This finding was in agreement with Penda *et al.* and Taie *et al.*

Furthermore, the coefficient of household size (0.1777)

was negative and significant at 5% alpha level of probability, this implies that a unit increase in the number of household people will reduce net returns by 0.1777 unit. Household size reduced the profit realizable by 898.83 USD. This result was expected as more number of the fish produced will be used for home consumption. The finding is equally in agreement with Penda *et al.*, Tasie *et al.*, and Unekwu *et al.* Finally, the coefficient of primary occupation (0.0407) was negative and significant at 5% alpha level of probability, this implies that as the number of fish farmers that are not primarily engaged in agriculture increases, net returns will reduce by 0.0407 unit. Primary occupation reduced total profit by 205.75 USD. A farmer who is not 100% committed to the industry may not be able to put in their best as this will harm profit.

Table 5. Determinants of net returns of fish farming.

Explanatory variables	Linear	Exponential	Semi-log	Double-log
Constant	-4501328 (-0.28)	1359581 (1.13)	-3.6E+07 (-1.01)	-2.58338 (-0.09)
Sex	0.1097 (1.75)*	0.755718 (1.63)	0.1448 (-2.25)**	9.13713 (1.98)**
Age	0.5748 (1.51)	0.0384 (1.37)	2.297 (1.38)	1.5613 (1.28)
Experience	0.7349 (-2.56)**	-0.1015 (1.83)*	0.2682 (2.93)***	-1.2520 (1.87)*
Level of education	0.7349 (1.49)	0.0740 (2.30)**	0.5149 (2.79)**	0.5728 (2.78)**
Marital status	-0.0320 (-0.30)	-0.7584 (-0.97)	11.1597 (0.10)	-5.395 (-0.67)
Household size	0.3274 (2.43)**	0.2378 (2.39)**	-0.1777 (2.63)**	1.3372 (2.70)**
Cooperative membership	-0.8305 (1.76)*	-0.4762 (1.37)	-0.6277 (0.89)	-2.60965 (-0.76)
Primary occupation	0.0350 (0.78)	0.2432 (0.73)	0.0407 (-2.34)**	3.1084 (0.93)
R ²	0.3912	0.3780	0.6321	0.4275
F – ratio	2.72**	2.58**	3.23***	3.17***
Sample size	240	240	240	240

Source: Field Survey Data, 2020. Figures in parentheses are the t-ratios, (*) significant at 10%, (**) significant at 5%, and (***) significant at 1%.

Challenges Faced by Fish Farmers

Table 6 represents the challenges faced by fish farmers in Nigeria, due diversity of challenges facing fish farming sector of agriculture, the researchers allowed for multiple responses. The challenges were ranked to enable the policymakers to identify those that need urgent attention. From the 10 challenges captured, the first five that may need

urgent policy interventions include; high cost of feed (88.3%), inadequate capital (82.5%), poor management (52.5%), poor of extension services (41.7%), and high cost of labour (31.7%). A belief in the improvement of the identified challenges will improve the farmer's ability for optimum resource allocation. These findings were in agreement with Tasie *et al.* and Unekwu *et al.*

Table 6. Challenges Faced by Fish Farmers.

Sn.	Identified constraints	Frequency	Percentage%	Ranking
1	Lack of infrastructure	18	7.5	10
2	Lack of government support	24	10.0	9
3	Pest and disease	48	20.0	8
4	Poor veterinary	54	22.5	7
5	Lack of storage facility	67	27.9	6
6	High cost of labour	76	31.7	5
7	Poor of extension services	100	41.7	4
8	Poor management	126	52.5	3
9	Inadequate capital	198	82.5	2
10	High cost of feed	212	88.3	1

Source: Field Survey Data, 2020. (*) Multiple responses were recorded.

5. Conclusion and Recommendations

The recent COVID-19 pandemic forced many industries to lay-off workers. The world is also battling with the economic challenges and no nation is exempted from the devastating effect of the pandemic, while many countries have deported foreigners as the few jobs available may not be enough for

her citizens. Also, the agricultural sector has been predicted by many scholars as the only economic sector that will continue to absorb the labour force since food security is still a global problem, especially in developing countries. To attain self-sufficiency in food supply especially among those rich in proteins, farmers in developing countries like Nigeria are advised to venture into fish farming since it is one of the cheapest sources of non-plant protein. It is therefore

important to understand the farmer's ability to allocate scarce resources that will lead to maximum profit. Every participant in the agricultural sector should know the exact time to vary production inputs. This study on the analysis of the resource management ability of catfish farmers in Nigeria is therefore necessary at this time. An understanding of this concept, as well as the challenges inherent in the industry, will help policymakers to further advice on the way forward. The study, therefore, presents the following recommendations:

- 1) Governmental and non-governmental agencies should please help to subsidize the cost of inputs needed in the fishing industry.
- 2) Extension agents should be engaged to train the farmers especially in the areas of stocking rate and other relevant technologies
- 3) Farmers should be sensitized on the need to take agriculture as their primary occupation to avoid unnecessary distractions created by engaging in other activities
- 4) Women should be empowered to key into fish farming, this will help to reduce male dominance and introduce healthy competition.

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