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# Cost Consciousness and Fish Farming Sustainability in Cross River State, Nigeria

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***Abstract*** **- The study determines the cost consciousness and fish farming sustainability in Cross River State, Nigeria. The specific objectives of the study were; to identify breeds of fish reared by fish farmers for sustainable fish production, to determine the methods used by fish farmers for sustainable fish farming/production and to identify constraints affecting fish farming in Cross River State, Nigeria. A two stage sampling techniques was used to select 729 fish farmers from the 18 Local Government Areas of the State. Data from a well-structured questionnaire, budgetary techniques were analyzed using Descriptive and Inferential Statistics. The study estimated the cost and return of fish farming based on 18,000 fingerlings and multiple regression analysis was carried out in three (3) functional forms; Linear, exponential and semi-log forms. The findings of the study showed that 34% of fish farmers were between the ages of (45 to 54), 6% were between the ages of (25 to 34), 29% were between the ages of (35 to 44), 18% were between the ages of (55 to 64), 13% falls in the age bracket of 65 and above. Furthermore, 2% were fish farmers with First School Leaving Certificate, 11% with Senior Secondary School Certificate, 40% with OND/NCE and 47% with HND/University degree. The study also showed that 35% were civil servants, 16% were traders, 29% were fish farmers 14% were Business Men/Women, 3% were Teachers and 3% were in the category of others. The study also revealed that 29% of fish farmers in the study area were single, 42% were married, 12% were divorced and 17% were widow(er). The result also showed that 100% of fish farmers in the study area used intensive farming methods and that; Cat fish/Clarias, Poly-culture (Claria/Tilapia) and Hetero branch us hybrids were commonly reared in the research area with the use of collapsible, earthen and concrete ponds and a total profits of N1,890,000.00 was made at the time of the research with the cost of production of N9,810,000.00 and total revenue of N11,700,000.00, which implied that, fish farming venture in the study area is highly profitable. The study identified; high cost of feeds, lack of funds, predation, lack of awareness, skilled personnel, and inadequate water quality/availability as major constraints to fish farming and recommends among others that the Government of Cross River State should partner with Non-Governmental Organizations (NGOs) and International Organizations to provide facilities like loan, drilling of boreholes (for those in the remote areas to have access to water), introducing new breeds of fish, feeds etc for fish farmers in the area to be able to sustain or meet up with the demands for fish consumption.**

***Keywords:*** Cost consciousness, Fish Production, Fish Farmers, and Sustainability.

## 1. Introduction

### 1.1 Background to the study

Fish farming has the potential to help expand the resource base for food production and reduce the pressure on conventional sources of fish which are harvested faster than they can be regenerated. For developing countries like Nigeria where the economy is largely agrarian, fish farming can generate significant employment, enhance the socio-economic status of the farmer as well as generate foreign exchange. As observed by Davies (2008), the involvement of small scale aquaculture projects in the towns and villages will create employment and thereby alleviate poverty among youths. With dwindling food production, degrading agricultural environment, widespread poverty and insecurity in Africa, fish farming, even at the backyard provides the poor and hungry with a low cost and readily available strategy to increase food production using less land per caput, and less water without further damage to the environment, (Pretty et al., 2003).

Fish farming also has enormous potentials of improving the nutritional standard of the masses of the people. The average protein intake in Nigeria is about 19.38 grams/caput/day which is far below the FAO requirement of 75 g/caput/day, (FAO, 1995). Fish contains higher percentage of protein than meat and is important for its high nutritive

 

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value and significance in improving human health. Fish farming is uniquely placed to reverse the declines in supplies experienced from capture fisheries and has notable potentials for new livelihood opportunities, providing mechanism for lower priced fish, enhanced nutritional security and employment for poor communities (Jagger and Pender, 2001). Recognizing the benefits of fish farming and the existing potentials, the government of Nigeria has shown its interest through setting up various national programmes and projects such as the Aquaculture and Inland Fishery Project (AIFP), National Accelerated Fish Production Project (NAFPP), Fishing Terminal Projects (FTP), Fisheries Infrastructures provision/Improvement (FIP), and the Presidential Initiative on Aquaculture (PIA), (FAO, 2005a).

Part of the plan of government is to distribute fingerlings to small scale fish farmers free while large scale farmers will be subsidized up to 50% of the cost, (FMAWR, 2008). This is in addition to sensitizing Nigerians to the various methods of fish farming. Interests in fish farming have increased over the years as a result of the awareness of its importance both to the household to increase protein in-take and to the national economy to reverse the N150 billion (US$1billion) spent annually to import the product. In Nigeria however, fish farming is predominantly an extensive land based system practiced majorly at small scale subsistent level, (Theophilus et al, 2020).

Large scale commercial fish farming is yet to become widespread with most fish farmers operating small scale fish farm enterprises ranging from homestead concrete ponds (25 to 40 m) to small earthen ponds (0.02 to 0.2 ha), (Fagbenro, 2005). In spite of the growing interests shown by the government and the private sector, the gap between the demand of fish in Nigeria (1.3 million metric tons annually) and the supply of fish from domestic production (about 0.45 metric tons annually) has continue to widen, (FAO, 2000).

Fish is a high-protein, low-fat food that provides a range of health benefits. White-fleshed fish, in particular, is lower in fat than any other source of animal protein, and oily fish are high in omega-3 fatty acids, or the "good" fats. Since the human body can't make sufficient amounts of these essential nutrients, fish is an important part of the diet. Also, fish is low in the "bad" fats commonly found in red meat, called omega-6 fatty acids.

Fish farming is a profitable venture and has the potential to help expand the resource base for food production and reduce the pressure on conventional sources of fish which are harvested faster than they can be regenerated. Fish is acclaimed to be the principal source of animal protein for over a billion people globally and provide many important nutritional health benefits. For Nigeria where the economy is largely agrarian, fish farming can generate significant employment, enhance socio-economic status of the farmers as well as generate foreign exchange, reduce poverty, develop entrepreneurship, for which will optimize the use of the unexploited resources and self-sufficiency.

Presently, fish farming has become important because fishing in the wild cannot replenish itself to meet up societal demands, fish is cheap and a major source of protein consumed by Nigerians especially Cross Riverians living in coastal communities, as it is high in nutritional value with complete array of amino acids, vitamins and minerals. It is evident that the resources suitable for fish farming in Nigeria are grossly unexploited, yet all through the years the amount of fish produced has been lower than demand. The need for increased production of fish to bridge this gap has been a major concern. Nigeria can be self-sufficient in fish farming and production if her fishery resources are adequately developed, managed and conserved.

Nigeria is rich in oil and other natural resources and is believed to be among the rich countries in the world; yet, there is widespread poverty with close to 70% of the population living below the poverty line. Problems facing the fast growing population of Nigeria ranges from: high level of unemployment, idleness and restiveness resulting to militancy in the South-South, Boko-Haram, Bandits and Herds Men in the North, IPOB in the South-East, Kidnapping, Stealing, Sea piracy, corruption and other vices.

This study intends to highlight the importance of eating fish and the needs for cost conscious fish production and farming as well as empirically create awareness on the effects of eating red and processed meats in Cross River State and Nigeria as a whole.

### 1.2 Statement of the Problem

Many different studies have suggested that eating red meat regularly can lead to a higher risk of heart disease. For years, experts have established that the link between red meat consumption and heart disease is due to the saturated fat that is present in red meat. Therefore, there is need for fish production and farming culture which is believed to be the way of bridging the gap in the short fall between total domestic fish production and total domestic demand. Despite this perceived role, there is a low level of fish production which is due to a resource use constraints such as feed supply, low managerial know-how, and low capital have retarded the pace of development in the fish farming sub-sector, but great deal of opportunity still abounds in small scale fish farming. Taking this situation into considerations the low level of production, Nigerian needs to rise beyond the level of

 

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subsistence fish farming to higher level profitability through more efficient use of their production resources.

According to Fapohunda (2005), in Nigeria, a large number of farms have failed to attain profitability one or more years after because of major disruptions in the production process. It could be due to delay in supplies of fingerlings and other related services, lack of adequate technology or technical information expertise as regards hatchery propagation, etc remains the bane of this venture. There are also financial risks the farmers must contend with; these are due to unstable government financial policies. Changes in government policies are risk to the utilization of capital by the farmers.

### 1.3 Objectives of the study

The main objective of this study is to determine cost consciousness approaches for enhancing fish farming sustainability in Cross River State and Nigeria as a whole. The sub objectives include:

- To identify Breeds of fish reared by fish farmers for a sustainable fish production in Cross River State, Nigeria.
- Methods used by fish farmers for a sustainable fish farming and production in Cross River State, Nigeria.
- Identify constraints affecting fish farming in Cross River State, Nigeria.

## 2. Literature Review

### 2.1 Conceptual framework

#### *2.1.1 Concept of Cost Consciousness*

Andrew Cordner, (2018), explained that creating a cost conscious culture means being aware of your entire value proposition. It means stepping aside from a 'point in time' procedure or a one off cost cutting exercise and working to protect and generate value on an ongoing basis. Regardless of where the organization is in its business cycle, procurement should constantly be playing a role.

According to Robert Peace (2019), anyone can cut a cost that is the easy part. The difficult part is ensuring that the value you add to your end customer is not in the process. That is having a cost conscious culture is important.

According Donovan et al, (2023), in my opinion the word 'cost' could easily be replaced with the word 'value'. A cost conscious culture really comes down to the way everyone in an organization behaves and works together to create value for business. It's not just about price. It's imperative to equip your people with the right blend of technical and commercial leadership skills to manage the complex cost decisions necessary to deliver your vision.

According to Santiago et al, (2015), 'to me cost consciousness means creating and enduring corporate culture focused on strong and sustainable cost discipline. Of course this is also requires universal and tireless efforts to engage and motivate the entire organization to deliver on that vision. Simply, it's about being commercially minded having a sensible lens that looks at cost in context with market drivers and an understanding that meaningful changes to your business' financial performance require more than a fine tuning of your cost base. A cost conscious culture is about helping everyone from C-level to those in the field understand how they can optimize their cost base and empower them to take action.

#### *2.1.2 Concept of fish farming*

Fish farming is the farming of aquatic organisms in controlled environment, (FAO, 2007) introduce to Nigeria in the early 1950s. It is the principal form of aquaculture while other methods may fall under Mari culture. Fish farming involves raising fish commercially in tank or enclosures, usually for food. Fish farming is the fastest growing animal based food production sector, particularly in the developing countries Green Facts, 2004 in (7). Fisheries occupy a unique position in the agricultural sector of the Nigeria economy. In terms of GDP, the fishery subsector has recorded the fastest growth rate to GDP.

Fish contributes significantly to the Nigerian economy when viewed from the perspective of supply of high dietary protein, income generation, and creation of employment especially at the grassroots and enhanced inflow of foreign earnings through shrimp export.

#### *2.1.3 Concept of sustainability*

Sustainability could be defined as an ability or capacity of something to be maintained or sustain itself (https//:www.dp.gov.au/forest/management). It is about taking what we need to live now without jeopardizing the potential for people in the future to meet their needs. Sustainability means development that meets the needs of the present without compromising the needs of the future generations to meet their own needs (world commission on Environment and Development (WCED). At the heart of the concept is the belief that social, economic and environment objectives should be complementary and independent in the development process.

This indicating three principal dimensions; economic growth, social equity and protection of the environment, underlying the economic dimensions is the principle that society's well-being would have to be maximized and poverty eradicated through the optional and efficient use of natural

 

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resources. The social aspect refers to the relationship between nature and human beings, uplifting the welfare of people, improving access to basic health and education services fulfill food security needs and respect for human rights. The environmental dimension, on the other hand is concerned with the conservation and enhancement of the physical and biological resources base and ecosystems Vorley, (8) in (South Africa Department of Agriculture Discussion Document 8th Draft, 2002).

**2.2 Theoretical framework**

The theories relevant to this study are the theories of production and cost functions. Production function relates output (Q) to input variables ($X_1$, $X_2$) (see Quandt, 1958) that is:

$Q = F(X_1, X_2)$ … (1)

From equation (1),the total productivity of $X_1$ in the production of Q can be secured from the input of $X_1$ if $X_2$ is assigned the fixed value $X_2^0$ :

$Q = F(X_1, X_2^0)$ … (2)

The input level $X_2^0$ is treated as a parameter, and Q becomes a function of $X_1$ alone. The relation between Q and $X_1$ may be altered by changing $X_2^0$.

For the cost function, if the entrepreneur purchases $X_1$ and $X_2$ in perfectly competitive markets at constant unit prices, the entrepreneur total cost of production (c) is established thus:

$C^0 = r_1x_1 + r_2x_2 + b$ … (3)

Where $r_1$ and $r_2$ are the respective prices of $x_1$ and $x_2$, and b is the cost of the fixed inputs and the input combinations purchased for specified total cost becomes:

$C^0 = r_1x_1 + r_2x_2 + b$ … (4)

Where $C^0$ is a parameter and solving equation (4) for $x_1$ becomes:

$x_1 = r_1 \frac{c0-b}{} - r_1 \frac{r2}{}$ … (5)

For the entrepreneur to make the revenue, he sells his output at a fixed price, which is a function of the output (Q).Therefore, its profit function becomes:

$\pi = PQ - \Phi(Q) - b$ …(6)

Therefore to maximize profit, π, and set its derivative with respect to Q equal to zero is given by:

$\frac{d\pi}{dQ} = 0$ …(7)

And moving the MC to the right becomes:

$P = \Phi'(Q)$ .... (8)

From the above sets of equations, the entrepreneur must equate the MC (marginal cost) with the constant selling price of his output. Note that he can increase his profit (π) by expanding his output if the addition to his revenue (p) of selling another unit exceeds the addition to his cost (MC).

**2.3 Empirical literature**

Several studies have been carried out in recent times with respect to cost consciousness and fish farming sustainability in Cross River State, Nigeria and such researches are briefly reviewed as follows:

Shamima, I. A., Sandip, M.B., Akhtaruzzaman K. M. D (2023), examined the Technical and cost efficiency of pond fish farms: Do young educated farmers bring changes? The study investigates how the involvement of young and educated farmers in commercial aquaculture in Bangladesh influences the technical and cost efficiency using data obtained from 100 interviews with fish farmers in Bangladesh. The trans log stochastic frontier production function was employed to determine the technical efficiency while Cobb-Douglas cost function was used to determine cost efficiency. Younger farmers often used fewer inputs than older farmers did while farmers with higher levels of education used inputs more effectively. Technical efficiency of pond fish farmers is 84% while the cost efficiency of pond fish farmers is 53%.

Fish productivity increases with the quantity of fingerlings, interaction between labor and feed, feed and water cleaning cost, labor and water cleaning cost, water cleaning cost2 while fish productivity reduces with labor, water cleaning cost and feed2. Besides, technical inefficiency lessens with years of schooling and increases with the age of the farmers. In addition, the price of labor, feed, and fingerlings has a significant positive impact on the cost of production. Cost efficiency reduces with the feed conversion ratio (FCR) while it increases with education and when using water only for fish culture.

Sangchoul, Y. (2019), the article examined the willingness-to-Pay for Sustainable Aquaculture Products: Evidence from Korean Red Seabream Aquaculture. Ecological Paradigm scale was used as a measurement tool to determine consumer perception of the environment through the context of red seabream (Pagrus major) aquaculture and the use of copper-alloy nets. The estimation results indicate that demographic variables and one consumer perception variable

 

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are insignificant. However, the economic variable, one consumer perception variable and seafood preference are significant. Finally, willingness-to-pay was estimated for sustainable aquaculture products by comparing the mean willingness-to-pay within New Ecological Paradigm-level groups.

Edet, Udoe, & Uwah(2018), examined the costs and returns analysis of fish farming in Calabar Metropolis, Cross River State. A two stage sampling technique was used to select 30 fish farmers from two Local Government Areas in the Calabar Metropolis. Data for the study were sourced via structured questionnaire and were analyzed using descriptive and inferential statistics alongside budgetary techniques. Results showed that more men (70%) were involved in fish farming and that 33% were between the age bracket of 40-49 years, operating majorly (56,70%) on small scale basis with 40% of them having a family size of 2-4 persons and most (83.3%) being literates. The results of the budgetary analysis showed that the average total cost (ATC) of N525, 000 was incurred and total revenue (TR) of N650, 000 was realized giving a returning gross margin (GM) of N425, 000 with a net farm income (NFI) of N125, 000 per cycle. This is an indication that fish farming is profitable in the study area using a minimum of 1,000 fingerlings for a start.

Brown, Agbudu, & Amonjenu, (2017); determined approaches for enhancing sustainable fish production in Bayelsa State. The study adopted survey research design using a target population of 401 made up of 377 fish farmers and 24 extension agents. A sample size of 220 respondents (196 fish farmers and all the 24 extension agents) was drawn using multistage sampling technique. The study revealed that there was no statistical significant difference between the mean ratings of responses of fish farmers and extension agents on the breeds of fish reared by fish farmers, methods used by fish farmers for sustainable fish production and approaches adopted by fish farmers for enhancing sustainable fish production in Bayelsa State.

Nzewi, & Ojiagu (2017), explored the relationship between Industrial Policy on Fish Farming and Economic Growth in Nigeria (1990 – 2016). Ordinary Least square technique of regression was used for analysis of time series data generated from Federal Government statistical Bulletin and Bureau of Statistics. The study applied econometrics model for estimating hypothesized relationship through causality and co-integration producers. The study revealed that there is a significant positive relationship between subsidies on fish farming and real gross domestic product. The study concluded that robust industrial policy on fish farming will enhance sustainable economic growth in Nigeria. The study recommended that Industrial policy on fish farming should consider in detail the long run nexus between fish farming subsector and other sectors of the Nigeria Economy.

Shava, E. & Gunhidzirai, C. (2017), the article examines the implementation of fish farming as an innovative strategy and economic strategy for promoting food security and dietary diversities among vulnerable households in drought risk areas of Zimbabwe. The article used a qualitative research approach that includes semi-structured interviews and secondary data. The purposive sampling technique was adoptedto interview participants in Mwenzi district who were involved in fish farming to assess and explorethe experiences and benefits they derive from such development projects. Results for the article revealed that fish farming was well embraced by local communities as it led to improvements in food security, household income and employment generation. The article concludes that although fish farming was instrumental in generating employment, some participants fail to participate because of laziness and desire to maintain dependency syndrome.

Rajee, O &Alicia T. K. M. (2017), the study investigate the Assessing the efficiency of different sustainable farming practices in reducing the environmental impacts caused by Aquaculture. Sustainability of aquaculture is achieved when aquaculture farming systems are capable of preserving the natural resource base and involves an institutional change to the environment by the attainment and continued satisfaction for present and future generations. Sustainable farming practices produce sufficient aquaculture output to satisfy the seafood demand while not burdening the environment more. The potentiality and efficiency of different sustainable aqua farming practices in reducing anthropogenic impacts to the environment by aquaculture are assessed in this paper. Poly-culture is mostly adopted by small-scale rural farmers as it requires low entry barrier and help in income diversification.

The input of inorganic fertilizer in poly-culturing should be also minimized, replacing with efficient nitrogen use for better sustainability means. While green technologies like Recirculating aquaculture system (RASs), designed integrated aquaculture-wetland ecosystem (AWE) and Bioflocs involves more complicated interactions between the water treatment, the feed, and the fish. Hence, results with more variables in results and higher cost of adoption. However, the implications are much wider, not limited no nutrient uptake, salinity and pH, but the removal of total dissolved solids. While GIS analysis could serve as a guide for the site-selection in minimizing environmental impacts and preventing aquaculture failure. Different approaches should be adopted to fulfil different needs depending on the species being cultured and adjacent environmental context.

 

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Akanbi, S. O. (2016), the study was designed to analyzed the Technical efficiency of cultured fish production in Kwara state, Nigeria. The study estimated the technical efficiency of cultured fish farms; examined cost efficiency and long term elasticity of cultured fish production. The data collected was over one production cycle in 2013 using a well-structured questionnaire. Analytical tools used for the study was Stochastic Frontier Model (SFM). The findings of the study revealed that cultured fish farms in Kwara States operated with mean Technical Efficiency (TE) of 83.62%; cost efficiency in cultured fish production among farmers was less than unity; long-run total cost elasticity of production was less than one in all cases implying that cultured fish production process in the study area is in the zone of increasing returns.

The study recommended that the government should facilitate a policy of reduction in the cost of inputs. A reduction in costs may lead to an increased output and thereby reduce the supply-demand gap for fish in the state. , the fish farmers should be provided with the services of well-trained extension workers who will be there to guide them appropriately on production best practices to enable farmers improve upon farm efficiency.

Okpeke, & Akarue (2015), carried out a study, designed to assess the profitability of fish farming in Warri South Local Government Area of Delta State, Nigeria. A purposive sampling technique was used to select fifty (50) fish farmers from the study area. Data collected were analyzed using descriptive statistics – frequency, percentages, while budgetary and gross margin was used to determine Farm Net Income (FNI). The study indicates that variable cost accounted for 72.95% of the total cost while fixed cost of production accounted for 27.05%. The result revealed that a total cost (TC) of N592, 316 was incurred by a respondent per farming season while total revenue (TR) of N976, 622 was realized with a returning gross margin (GM) of N544, 528 and a net farm income (NFI) of N384, 306 per farmer per annum.

It indicates that fish farming is profitable in the study area. Constraints encountered by the farmers includes: insufficient funds, high cost of feed, lack of processing/preservation/storage facilities and market price fluctuations. The study recommended that government and other stakeholders should help provide cheap sources of fish feeds, while also making funds available amongst others.

Olapade O. J., Foday T. M., Kpundeh, M.D., Sellu, M., Bashiru,M., Momoh, R. R., Musa, P. D., Mornya P. M. P , Melvin, S. G. & Mattia, S. B. (2015), The study examined the Environmental and Economic Impact of Fish cum Rice and Poultry Production Integration System, The economic viability and environmental friendliness of integrating fish with rice and poultry was evaluated in a fish pond (520m2 ); a paddy platform (8 x 25m 2 ) sown with 1.00kg NERICA 19; a poultry house (3.5 x 11m in dimension) and a maggoty. Integrated pond was stocked at 1.923 fish per m 2 (25g mean weight) while 400 dayold broilers were housed. Water quality parameters determined were within recommended range for the culture of tropical fish species and statistically non-significant ($p < 0.05$).

The synergy gave positive Net Present Value NPV of Le 18,520,661.51 (US$4,161.95) in the third year; a benefit-cost ratio of 1.23 and two year payback. Sensitivity calculated was 23.6% an indication of the sensitivity of the investment to survival rate. Integrating fish with rice and poultry is environment friendly, and economically viable with potential to create employment, augment income and improve the living standard of sub Saharan poor population.

Oluwemimo, O. & Ajayi D. (2013), this study attempted to examine the factors determining the sustainability of fish farming in Nigeria with a view to stimulating private investment in the sector. Regression and budgetary analyses were used to analyze data obtained from 100 fish farmers in ten local governments' area of Osun State. The result showed that the average net income in the study area was N318, 640.75 while the gross margin was N457, 327.95. The benefit-cost ratio was 1.5 indicating that every N100 invested, the enterprise yields additional N50

Adeji, O. B., Okocha, R. C., (2011), examined constraint to aqua culture development in Nigeria and way forward. The studies state categorically that Nigeria offers the largest market for fisheries product in Africa. That fish production from capture are poor in spite of its being expensive and risky in the coastal line regions of Nigeria has been erratic and decline in recent years, resulting in increase in poverty and nutritional deficiency. Aquaculture production remains the best option to bridge the gap between the total fish demand and total domestic production face of high cost of production input and unstable government policy. The study enumerates the affecting aquaculture production in Nigeria with emphasis of fish seed, diseases, education, production management, feed and feeding, government policy, veterinary care and breeding, infrastructure suggested way forward for profitable and sustainable aquaculture in the country.

## 3. Methodology

### 3.1 Research design

The researchers employed primary and semi-structured research questionnaire design to investigate and analyze the relationship between cost consciousness and fish farming

 

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sustainability across the eighteen (18) local government of Cross River State, Nigeria.

### 3.2 Area of the study

The study was conducted in the eighteen (18) local government areas of Cross River State, Nigeria. Cross River State is a State in the south-south geopolitical zone of Nigeria. The named for the Cross River State was formed from the eastern part of the Eastern Region on 27th May, 1967. Its capital is Calabar.

### 3.3 Population of the study and method of population determination

The targeted population that was used for the study, comprised of all fish farmers across the eighteen (18) local government areas of the state.

### 3.4 Sampling Technique

A purposive sampling technique was used to select twenty (20) fish farmers each from the eighteen (18) local government areas of the State.

### 3.5 Sample size of the study

From all the fish farmers across Cross River State, the study focused on 360 fish farmers because of time constraints and vastness of the area.

### 3.6 Sources/methods of data collection

Well-structured questionnaire were administered to selected 360 respondents fish farmers from the 18 Local Government Areas which were used for primary data collection. The questionnaire were divided into four sections; section 'A' contained the cost consciousness of fish farmers in the study area, section 'B' the type of culturing system used in the area; section 'C' costs and returns involved in fish farming and section 'D' the constraints faced by fish farmers in the areas.

### 3.7 Analytical Frame Work

Various analytical tools were used to achieve the objectives of the study and they included: simple descriptive statistics, inferential and budgetary technique was used to analyze the data. Descriptive statistics such as tables, frequency and percentages was used to examine objective 1 and 3. Objective 2 was analyzed using budgetary techniques analysis such as gross margin. This enable the estimation of the total costs cum total revenue accrued to the fish farmers within a specific production period. The difference between revenue (returns) and total variables cost (TVC) makes up the gross margin (GM).

$$GM = TR - TVC \quad \ldots (9)$$

Where:

GM = Gross Margin
TR = Total Revenue
TVC= Total Variable Cost

$$\text{Net Farm Income} = TR - TC \quad \ldots (10)$$

Objective 4 was analyzed using the ordinary least square method (3, 1977). The semi-log production function was chosen as the lead equation. Gujarati and Sangeetha (2007) gave the implicit model as:

$$Y = b_0 + b_1 LogX_1 + b_2 LogX_2 + b_3 LogX_3 + b_4 LogX_4 + b_5 LogX_5 + b_6 LogX_6 + b_7 LogX_7 + U \quad \ldots (11)$$

For this study, the implicit function was estimated using variables influencing fish farming in the study area as follows:

$$\text{Log QOFP} = b_0 + b_1 \text{ Log AG} + b_2 \text{ Log EDU} + b_3 \text{ Log FE} + b_4 \text{ Log SD} + b_5 \text{ Log LB} + b_6 \text{ Log CF} + b_7 \text{LogPS} + U \ldots (12)$$

Where:

QOFP = Quantity of fish produce in Kilograms
AG= Age (years)($b_1$>0)
EDU = Education (No. of years in school)($b_2$>0)
FE = Farming experience (years)($b_3$>0)
SD = Stocking density (number of fish per pond size)($b_4$<0)
PS= Production system ($b_7$>0)
U = Error term

Note that $b_1$ to $b_7$ parenthesis are a priori expectations.

### 3.8 Results

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

| Variable | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 494 | 68 |
| Female | 235 | 32 |
| | **729** | **100** |
| **Age (years)** | | |
| 25 – 34 | 41 | 6 |
| 35 – 44 | 213 | 29 |
| 45 – 54 | 245 | 34 |
| 55 – 64 | 132 | 18 |
| 65 and above | 98 | 13 |
| | **729** | **100** |
| **Marital Status** | | |
| Single | 214 | 29 |
| Married | 305 | 42 |
| Divorced 89 | 12 | |
| Widow(er) | 121 | 17 |
| | **729** | **100** |
| **Household size** | | |
| >2 | 58 | 8 |
| 3 – 5 | 264 | 36 |
| 6 – 8 | 289 | 40 |
| 9 and above | 18 | 16 |
| | **729** | **100** |

 

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**Table 1: Continued**

| Education Level | Frequency | Percentage |
|---|---|---|
| No formal Education | 0 | 0 |
| Primary Education | 17 | 2 |
| Secondary Education | 81 | 11 |
| NCE/OND | 289 | 40 |
| HND/University | 342 | 47 |
| | **729** | **100** |
| **Primary Occupation** | | |
| Civil Servant | 258 | 35 |
| Trading | 118 | 16 |
| Fish farming | 208 | 29 |
| Business | 105 | 14 |
| Teaching | 19 | 3 |
| Others | 21 | 3 |
| | **729** | **100** |
| **Years of Experience** | | |
| >1 | 58 | 8 |
| 2 – 4 | 157 | 21 |
| 5 – 7 | 158 | 22 |
| 8 and above | 356 | 49 |
| | **729** | **100** |

**Source: field survey data compilation (2023)**

Table 2 shows the socio-economic characteristics of fish farmers in the study area. The survey indicates that all the respondents in the study area used intensive system of farming, because profit making is the prime motive of the farmers. This is in line with the findings of Edet et al. (2018). The concrete ponds (28%) and mobile pond also known as collapsible pond (41%) were mostly preferred by the fish farmers in the study area. This because concrete pond has the advantage of lasting over ten years and is not affected by climate changes (i.e. when the water table is low the concrete pond would not dry up during dry seasons). This findings is in disagreement with the findings of Ideba et al (2013), whose findings states that earthen pond/production system was mostly preferred in fish farming (aquaculture). The number of active or functional ponds in the study area per individual farmer was mostly on small size less than 4 pond (41%), 33% of the farmers had between 5 – 9 ponds while 26% had above 10 ponds.

Water availability is one of the important factors to be considered when choosing a location for fish farming.70% of the respondents had borehole as their major source of water, 28% depend on well, and 2% depend on stream as source of water for the fish farming. The type of fish stocked in the study area, 46% of the fish farmers stocked Claria (catfish), catfish species is also followed by 32% of poly-culture (Claria/tilapia), 21% of fish farmers in the study area stocked Heterobranchus with just 1% of fish farmers that stocked Tilapia also known as lady fish.

This finding agrees with the findings of Emmanuel et al (2014), Olayode et al (2013), and Edet et al (2018). Catfish was mostly preferred in the study area because of its good taste, fast physiological maturity and gives higher reproductive capacity in ponds, greater demand preferences and high feed conversion ratio.87% which is the majority of the fish farmers stocked between 2000 – 3000 fish per pond followed by 10% of fish farmers that stocked less than 2000 while 3% of them stocked above 4000. The finding also shows that the major feeds used by fish farmers in the study area are (75%) formulated feeds which are very expensive to buy. And only 25% of the fish farmers used locally-made feeds. The locally-made feeds are not only less expensive but also contain substandard nutrient value owing to paucity of active ingredients in locally-made feeds, but such feeds may add value or increase the mortality and morbidity rates in most fish farmers in the area (Ideba et a., 2013).

**Table 2: Survey results of fish farmers in the study area**

| Variable | Frequency | Percentage |
|---|---|---|
| **Type of farm** | | |
| Intensive | 729 | 100 |
| Extensive | - | - |
| **Total** | **729** | **100** |
| **Type of pond** | | |
| Earthen | 133 | 18 |
| Concrete | 202 | 28 |
| Collapsible | 297 | 41 |
| All of the above | 97 | 13 |
| **Total** | **729** | **100** |
| **Number of pond/productions** | | |
| <4 | 301 | 41 |
| 5 – 9 | 242 | 33 |
| 10 and above | 186 | 26 |
| **Total** | **729** | **100** |
| **Sources of water** | | |
| Well | 206 | 28 |
| Stream | 14 | 2 |
| Borehole | 509 | 70 |
| Total | 729 | 100 |

**Table 2: Continued**

| Variable | Frequency | Percentage |
|---|---|---|
| **Type of stocked** | | |
| Cat fish/Clarias | 335 | 46 |
| Poly-culture (Claria/tilapia) | 233 | 32 |
| Tilapia | 8 | 1 |
| Heterbranchus | 153 | 21 |
| **Total** | **729** | **100** |
| **Stocking density per pond** | | |
| < 2000 | 73 | 10 |
| 2000 – 3000 | 634 | 87 |
| 4000 and above | 22 | 3 |
| **Total** | **729** | **100** |
| **Sources of feeds** | | |
| Local feeds | 182 | 25 |
| Formulated feeds | 547 | 75 |
| **Total** | **729** | **100** |

**Source: field survey data compilation (2023)**

Table 3 gives the estimates of cost and returns analysis made from fish farming using fixed cost and variable and farm yielding returns generated by 729 fish farmers sampled in of the eighteen (18) local government areas of cross river state per season. The analysis shows that the fixed cost represent the largest proportion (55%) of the total cost of fish farming in the study area. This show that large amount of money spend by fish farmers in the study area was majorly for the construction of the pond. Fish farmers in the study area spend 7% of their resources on fingerlings, 5% on labour and 33% on the cost of feeding the fishes in the study area.

The largest proportion of spending goes to fixed cost (55%), Feeds (33%), fingerlings (7%) and labour (5%) respectively. This finding agrees with Edet, et al. (2018). From

 

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their survey, total cost (TC) of N525, 000 was incurred by a respondent per fishing cycle while Total Revenue (TR) of N650, 000 was realized with a returning gross margin (GM) of N425, 000 and net farm income (NFI) of N125, 000. This shows that fish farming in the area of study was profitable, (see Adewunmi et al. (2005), Olayoye et al., (2013) and Ashaolu et al. (2006) whose respective research shows that fish farming businesses is very profitable according to their various level of investment and minimization of cost).

**Table 3: Estimated of cost and returns of fish farming based on 18000 fingerlings in the study area**

| Items | Amount (₦) | Total cost (%) |
|---|---|---|
| **A. Variable cost** | | |
| ++ Feeds | 3,240,000 | 33 |
| Labour | 450,000 | 5 |
| *Fingerling | 720,000 | 7 |
| **Total Variable cost** | **4,410,000** | |
| **B. Fixed cost** | | |
| **cost of constructing the pond | 5,400,000 | 55 |
| Total fixed cost | 5,400,000 | |
| Total Cost (A+B) | **9,810,000** | |
| Total revenue | 11,700,000 | |
| Gross Margin | 7,290,000 | |
| Net farm income | 1,890,000 | |

Notes: * = per stocking cycle/period for 18000 fingerlings;
cost of feed per 15kg = ₦5, 800; ++ = ₦180 per feed to market weigh;
sales per kilo = ₦650; ** = inclusive of labour, cement, chippings etc.
**Source: field survey data compilation (2023)**

**Table 4: Some constrains encountered in the study area by fish farmers**

| Constraints | No. of respondent | Percentage |
|---|---|---|
| High cost of feeds | 321 | 44 |
| Lack of funds | 124 | 17 |
| Predation | 51 | 7 |
| Lack of awareness and skilled Personnel | 168 | 23 |
| Water quality/availability | 65 | 9 |
| **Total** | **729** | **100** |

**Source: field survey data compilation (2023)**

Table 4 indicates the constraints fish farmers faced in the study area. 44% represent the numbers of fish farmers interviewed complained of high cost of feeds. This was in line with Edet et al. (2018) and Ike et al (2003) whose findings show the high cost and scared fish feeds in the area and this can lead to unproductive farming. 17% of respondent frown at lack of fund to input in the fish farming to improve or expand their farming, 23% of the fish farmers interviewed complained of lack of skilled personnel and awareness of new farming methods or the new species or feeds in the market to coup/compete with modern fish farming in the area and this is one of the reasons for the failed attempts resuscitate the aquaculture business in the early 90s by the then Federal Military Government of Nigeria.

**Table 5: Summary results showing factors that affect fish output in the study area**

| Variables | Linear | Exponential | Semi Log |
|---|---|---|---|
| Age in years | .095 (.024) | .059 (.009) | .023 (.007) |
| Educational Level | -.057 (.031) | .009 (.006) | -.015 (.009) |
| Years of Experience | .259 (.026) | .147 (.016) | .072 (.007) |
| Stock Density Per Pond | -.286 (.034) | -.063 (.043) | .084 (.007) |
| Type of pond | .257 (.000) | .640 (.040) | -.088(.010) |
| Variable cost, Labour, Feeds, & Fingerlings | -3.033E-007 (.098) | -.189 (.024) | -4.909E-008 (.000) |
| Constant | 1.677(.000) | .762 (.329) | .069 (.028) |
| $R^2$ | .912 | .842 | .879 |
| Adjusted $R^2$ | .911 | .841 | .878 |
| F-Ratio | 1239.8** | 769.7** | 875.5** |
| S.E | .2397 | 2.779 | .069 |
| DW | .080 | .050 | .057 |

**Note**: **significant at .05 level; DW = Durbin Watson; Unstandardized coefficients were used; Values in parenthesis (…) are Standard errors

## Result in linear form

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | | Durbin-Watson |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change | |
| 1 | .955[a] | .912 | .911 | .23969 | .912 | 1239.877 | 6 | 722 | .000 | .080 |

a. Predictors: (Constant), VARIABLE COST, LABOUR, FEEDS, & FINGERLINGS, Stock Density Per Pond, Years of Experience, Type of pond, Educational Level, Age in years
b. Dependent Variable: Number of Ponds/Production

**ANOVA[a]**

| Model | | Sum of Squares | D.F | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 427.380 | 6 | 71.230 | 1239.877 | .000[b] |
| | Residual | 41.478 | 722 | .057 | | |
| | Total | 468.859 | 728 | | | |

a. Dependent Variable: Number of Ponds/Production
b. Predictors: (Constant), VARIABLE COST, LABOUR, FEEDS, & FINGERLINGS, Stock Density Per Pond, Years of Experience, Type of pond, Educational Level, Age in years

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Tolerance | VIF |
| 1 | (Constant) | 1.677 | .098 | | 17.162 | .000 | | |
| | Age in years | .095 | .024 | .131 | 3.872 | .000 | .107 | 9.386 |
| | Educational Level | -.057 | .031 | -.054 | -1.865 | .063 | .145 | 6.912 |
| | Years of Experience | .259 | .026 | .325 | 10.123 | .000 | .119 | 8.399 |
| | Stock Density Per Pond | -.286 | .034 | -.126 | -8.460 | .000 | .550 | 1.819 |
| | Type of pond | .257 | .026 | .301 | 10.030 | .000 | .136 | 7.371 |
| | VARIABLE COST, LABOUR, FEEDS, & FINGERLINGS | -3.033E-007 | .000 | -.438 | -22.774 | .000 | .331 | 3.025 |

a. Dependent Variable: Number of Ponds/Production

## Result in exponential form

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | | Durbin-Watson |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | D.F1 | D.F2 | Sig. F Change | |
| 1 | .924[a] | .855 | .853 | 2.66701 | .855 | 706.730 | 6 | 722 | .000 | .073 |

a. Predictors: (Constant), PONDS_EXP, STOCKING_DENSITY, EDUC_EXP, VARIABLE_EXP, EXPERIENCE_EXP, AGE_EXP
b. Dependent Variable: PRODUCTION_EXP

 

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**ANOVA[a]**

| Model | | Sum of Squares | D.F | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 30161.667 | 6 | 5026.944 | 706.730 | .000[b] |
| | Residual | 5135.559 | 722 | 7.113 | | |
| | Total | 35297.225 | 728 | | | |

a. Dependent Variable: PRODUCTION_EXP

b. Predictors: (Constant), PONDS_EXP, STOCKING_DENSITY, EDUC_EXP, VARIABLE_EXP, EXPERIENCE_EXP, AGE_EXP

**Coefficients[a]**

| Model | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | | | Tolerance | VIF |
| (Constant) | .762 | .329 | | 2.318 | .021 | | |
| AGE_EXP | .059 | .009 | .394 | 6.457 | .000 | .054 | 18.498 |
| EDUC_EXP | .009 | .006 | .066 | 1.393 | .164 | .090 | 11.081 |
| 1 EXPERIENCE_EXP | .147 | .016 | .463 | 9.495 | .000 | .085 | 11.794 |
| STOCKING DENSITY | -.063 | .043 | -.024 | -1.444 | .149 | .739 | 1.353 |
| VARIABLE_EXP | .640 | .040 | .585 | 15.799 | .000 | .147 | 6.808 |
| PONDS_EXP | -.189 | .024 | -.436 | -7.924 | .000 | .067 | 15.002 |

a. Dependent Variable: PRODUCTION_EXP

**Result in semi-log form**

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | | Durbin-Watson |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | D.F1 | D.F2 | Sig. F Change | |
| 1 | .938[a] | .879 | .878 | .06900 | .879 | 875.547 | 6 | 722 | .000 | .057 |

a. Predictors: (Constant), VARIABLE COST, LABOUR, FEEDS, & FINGERLINGS, Stock Density Per Pond, Years of Experience, Type of pond, Educational Level, Age in years

b. Dependent Variable: PRODUCTION_SMLOG

**ANOVA[a]**

| Model | | Sum of Squares | D.F | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 25.014 | 6 | 4.169 | 875.547 | .000[b] |
| | Residual | 3.438 | 722 | .005 | | |
| | Total | 28.452 | 728 | | | |

a. Dependent Variable: PRODUCTION_SMLOG

b. Predictors: (Constant), VARIABLE COST, LABOUR, FEEDS, & FINGERLINGS, Stock Density Per Pond, Years of Experience, Type of pond, Educational Level, Age in years

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Tolerance | VIF |
| 1 | (Constant) | .069 | .028 | | 2.463 | .014 | | |
| | Age in years | .023 | .007 | .131 | 3.306 | .001 | .107 | 9.386 |
| | Educational Level | -.015 | .009 | -.058 | -1.707 | .088 | .145 | 6.912 |
| | Type of pond | .072 | .007 | .342 | 9.742 | .000 | .136 | 7.371 |
| | Years of Experience | .084 | .007 | .427 | 11.393 | .000 | .119 | 8.399 |
| | Stock Density Per Pond | -.088 | .010 | -.157 | -9.002 | .000 | .550 | 1.819 |
| | VARIABLE COST, LABOUR, FEEDS, & FINGERLINGS | -4.909E-008 | .000 | -.288 | -12.805 | .000 | .331 | 3.025 |

a. Dependent Variable: PRODUCTION_SMLOG

## 4. Results and Discussion

Table 1 shows that the distribution of fish farmers with respect to their socio-economic characteristics. The results revealed that male (68%) are actively engaged in fish farming than the female (32%). This shows that the activities of fisheries are mostly dominated by Men. This result can be justified by the assertion of Brummett, et al. (2010). Majority (34%) of the fish farmers fall within the age bracket 45 – 54 years, 29% fall within the age of 35 – 44 years, 6% fall within the age of 25 – 34 years, 18% fall within the age of 55 – 64 years while 13% fell within the age of 65 years and above. This age bracket is a productive age which portends better future for fish production also it is considered as economically active age, (Olowosegun et al., 2004). The result revealed that very few old people are involved in fish farming. This result is in line with the findings of Edet et al. (2018). It was also discovered that majority of the farmers were married (40%), 29% were single, 17% were widow(er) and 12% were separated. These results show that marriage confers some level of responsibility and commitment on individual who are on it, (Fakoya, 2000; Oladoja et al., 2008).

The result revealed that 8% represent household size of >2, 36% represent the household size of 3 – 5, 40% represent household of 6 – 8 and 16% represent the household of 9 and above. All respondents were educated as all of them had attended tertiary education with 40% of those with NCE/OND and 47% with those with HND/university degrees. This means that fish farming is a highly technical enterprise that requires learned farmers (Penda, et al., 2013). It also requires a lot of technical and scientific knowledge to be successfully undertaken. Assessing the primary occupational status of the respondent, 35% were civil servants while others were 16% trading, 29% fish farming, 14% Business, 3% teaching and 3% represent others. This finding is in line with Ideba et al. (2013) and Adewuyi et al. (2010).

The result also revealed that the most experienced of 8 years and above were 49%, those with 5 – 7 years' experience 22%, those with 2 – 4 years' experience 21% and those with less than one year 8%. This result agreed with Olaoye et al. (2013) that opined that respondents with the highest number of years of experience perhaps have good skills and better approaches to fish farming business. From the respondents, shows comparatively longer years of experience were able to forecast market situation in which they sell their products at higher prices. Those with less years of experience, faces many risks in the early stage of their fish farming business.

Table 5, the multiple regression analysis for this study was carried out in three functional forms (linear, exponential and semi-log forms). Based on the statistical significance of

 

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the coefficients and the economic theory that support production concept, the semi-log production function was chosen as the lead equation. The semi-log was particularly chosen because it recorded the lowest standard errors compared to linear and exponential forms. The semi-log from has a much higher R-square value (.879) and F-ratio (875.5), which comes after that in linear form. Stocking density had a positive relationship with output and was significant at .05 thereby conforming to the a priori expectation.

## 5. Conclusion

Fish farming is a profitable venture and has the potential to help expand the resource base of Cross River State for food production and reduce the pressure on conventional sources of fish which are harvested faster than they can be regenerated. Fish is acclaimed to be the principal source of animal protein for over a billion people globally and provide many important nutritional health benefits. There is need for the Government and stakeholders of Cross River State to transform fish farming venture from its present production level to the stage of sustainability.

The study analyzes the cost consciousness and fish farming sustainability in Cross River State, Nigeria and the study conclude that cat fish/Clarias, poly-culture (Claria/Tilapia) and heterobranchus hybrids are commonly reared in Cross River State, Nigeria with the use of collapsible, earthen and concrete ponds and the total profits of N1,890,000.00 was made at the time of the research with the cost of production of N9,810,000.00 and total revenue of N11,700,000.00, meaning fish farming venture in the study area is highly profitable and the following constraints were identified; high cost of feed, lack of funds, predation, lack of awareness and skilled personnel, and water quality/availability.

## 6. Recommendation

i. Government of Cross River State should partner with Non-Governmental Organizations (NGOs) and International Organizations to provide facilities like loan, drilling of boreholes (for those in the remote areas to have access to water), by introducing new breeds of fish, feeds etc for fish farmers in the area to be able to sustain the demand for fish consumption.
ii. Cross River State government and the stakeholders should try by all means to make environment conducive for fish farmers in the area in terms of stealing and other vices in the area.
iii. The government should organize workshops from time to time to update fish farmers on the trending farming methods and how to tackle any outbreak of fish diseases in the study area.
iv. Government of Cross River State should establish research institute in the State for fish farmers to contact at any point in time in terms of remedy for problems that needs urgent attention.

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