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Research Article

EMPIRICAL ANALYSIS OF CATFISH PRODUCTIVITY AMONG SMALLHOLDERS IN EKEREMOR, BAYELSA STATE, NIGERIA

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ABSTRACT. Catfish farmers are facing new barriers in both their production and returns on investment. Despite its potentials, the level of fish production has failed to meet domestic demand. Profitability and productivity analysis are important considerations in measuring efficiency or performance of a farm business. This study therefore analyzed Catfish Productivity among Smallholders in Ekeremor, Bayelsa State, Nigeria. Primary data collected via random sampling were evaluated using descriptive statistics, farm budgeting model and Total Factor Productivity (TFP) techniques. The study revealed that net farm income of catfish production was ₦478,000/cycle; suggesting a relatively profitable venture with prospects for improved economic potentials. The estimated percentage profit margin and benefit-cost ratio were 40.2% and 0.67 respectively. Furthermore, most (68.3%) of catfish farmers were sub-optimally productive as their TFP indices were below the optimal scale; attributable to sub-efficient input mix and cost of production inputs. In addition, constraints of catfish production in the study area include high cost of feeds (95%), inadequate capital (80%), high cost of pond construction (73.3%); poor market linkages (70%), poor access to modern technologies (65%), high labour cost (51.7%), fish mortality (46.7%), water pollutants (38.3%), Seed (fingerling) scarcity (30%) and inadequate extension contact (25%). Alternative feed sources, adoption of modern practices and technology, improved financial and credit information; feed and pond construction materials /equipment subsidy, improved market linkages and extension contact; access to and adequate supply of water, production inputs, technological innovations and cooperative formation are strongly recommended.

Keywords: *Aquaculture, constraints, smallholders, profitability, total factor productivity*

INTRODUCTION

The aim of fish farming (husbandry) or aquaculture is generally for fish production for human consumption. The term fish is a diverse group of animal that lives and breathe in water by means of gills. Aquaculture continues to grow rapidly. Understanding the general aspects of aquaculture is of increasing importance for all those working in this industry. Aquaculture requires specific knowledge and skills on general aspects of fish production [1]. In the past, rural fish farming in Africa concentrated on tilapia fish production however catfish production is also on the rise [2]. Population growth is usually accompanied by increase in demand for basic necessities of life (i.e. food, clothing and shelter). This is the case with the unrestricted increases in the demand for protein rich food items of animal origin [3]. However, the ability of catfish production to reach optimal level has been on the decline, yield (output per unit water area) for catfish farmers and the profit margins have decreased overtime. The Food and Agriculture Organization [4], recommended that an individual takes 35g (grams) of animal protein per day for sustainable growth and

development. However, the animal protein consumption in Nigeria is less than 8g (grams) per day per person, which is a deficit from the FAO minimum recommendation [5]. Fish especially the catfish species are widely consumed in Nigeria. Currently, domestic fish production is put at 600,000 metric tonnes as against the present national demand of about 1.5 million metric tonnes per annum; over 50% of fish supply requirement is met through importation, which constitutes a huge and avoidable drain of Nigeria's scarce foreign exchange resources. Hence a demand deficit of 900,000 metric tons per annum in a population growing at an estimated 2.5% annually [6]. The shortfall is said to be bridged by the importation of 700,000 metric tonnes annually for domestic consumption. Increased awareness of the need for adequate fish protein in human diets, assessment of productivity, management practices and constraints are approaches of improving production so as to achieve self-sufficiency in catfish production [7]. The government at various occasions have adopted different programs and policies aimed at improving firm efficiency and fish productivity. These programs and policies place the smallholders in central focus, hence, this subsector is particularly dominated by the smallholders who represent a substantial proportion of the total fish farmers and contribute to over 80% of the total output. Animal protein sources include cattle, goats, sheep, poultry and fish. According to [8] fish and fish products constitute more than 60% of the total protein intake especially in rural areas. Therefore, the importance of fish farming particularly catfish production, to the sustainability of animal protein supply cannot be over-emphasized [4]. Smallholder farmers are facing new barriers in both their production and returns on investment. Despite its potential, the level of catfish production has failed to meet the country domestic demand [4]. Catfish farming remains a viable investment in Nigeria; with proper management [9]. The ability of catfish farmers to reach optimal production level has been on the decline over the years, despite the efforts of the government and other interventions from stakeholders, yield has remained low in the country and particularly in the study area; there is still a deficit in the supply and demand for catfish [10]. This has been attributed to inadequate supply of production inputs, poor quality of fingerlings, inadequate extension services, high cost of feeds, poor adoption of improved techniques, prevalence of smallholder fish farmers, poor infrastructural facilities and low capital investment. These factors account for the decline in the fish population dynamics and therefore the need to increase fish production through intensification of aquaculture systems. The contribution of domestic fish farming cannot be over emphasized; catfish farming has the potential of contributing to domestic fish production and reducing expenditures on fish importation. Hence, this research will fill the gap and provide empirical information on catfish productivity in the study area; within this framework this study will seek to provide answers to the following research questions; What are the cost and returns of catfish production? What is the level of catfish productivity? What are the constraints of catfish production?

MATERIAL AND METHODS

Study Area

The study was carried out in Ekeremor Local Government Area (LGA), Bayelsa State, Nigeria. The LGA is one out of the eight in Bayelsa State; its headquarters is in the town of

Ekeremor. It has an area of 1,810 km^2 and lies on the geographical coordinates of latitude 5º3' N and longitude 5º47'E [11]. Mean annual rainfall of the area is 2,200mm for upland or dry regions where water bodies are few and 3,500mm for wetland or lowland regions which comprises of land areas being surrounded by water bodies. Temperature range is between 23-31°C and vegetation found in the area includes saline water swamp, mangrove swamp and rain forest [11]. The seasonal condition of the area presents a healthy environment for fish production; hence adequate supply of water for catfish ponds in the study area. The inhabitants of the LGA are predominantly fish farmers.

Sampling Technique

Random sampling technique was employed in selecting sixty (60) respondents for this study. The respondents were randomly selected from a compiled list of catfish farmers from Bayelsa state Agricultural Development Program (BYADEP) with the assistance of extension agents and local enumerators.

Method of Data Collection

Data was collected using well-structured questionnaire designed in line with the objectives of the study.

Analytical Techniques

Primary data collected were evaluated using descriptive statistics, farm budgeting model and Total Factor Productivity (TFP) technique. The farm budget technique (costs and returns analysis) was used to determine the costs, returns and profitability of catfish production in the area. The Total Factor Productivity (TFP) technique was used to estimate agricultural productivity by comparing an index of agricultural inputs to an index of outputs. Thus, combinations of statistical and budgetary techniques were used in the analysis of data collected.

Farm Budget (Profitability) Analysis

The farm budgeting models used are presented in Eqn.1, Eqn.2, Eqn.3 and Eqn.4 respectively:

$$N.F.I = T.R - TC \quad \textbf{(Eqn.1)}$$

Where; N.F.I= net farm income, T.R=Total revenue (₦), TC=total cost (₦)

$$TR = P_Y . Y_I \quad \textbf{(Eqn.2)}$$

Where; P_Y = unit price of output produced (₦), Y_I = quantity of output (kg)

$$Total\ Cost\ (TC) = TVC + TFC \quad \textbf{(Eqn.3)}$$

Where; TC = Total cost (₦), TVC=total variable cost (₦), TFC=total fixed cost (₦)

$$TVC = P_X . X_I \quad \textbf{(Eqn.4)}$$

Where; P_X = unit price of variable inputs (kg/liter), X_I = quantity of i_{th} input (kg/liter)

TFC = Total fixed cost (₦) (pond construction and equipment)

Where; GM = Gross Margin (₦/Sq.m.); GFI = Gross Farm Income (₦/Sq.m.); and TVC = Total Variable Cost (₦/Sq.m.).

To further substantiate the profitability of this enterprise, profitability ratios such as: percentage (%) profit margin and benefit-cost ratio (BCR), fixed and operating ratios were estimated and specified in Eqn.5 and Eqn.6 respectively;

Percentage Profit margin (%PM) = Net farm income/Total revenue x 100% ***(Eqn.5)***

Benefit-cost ratio (BCR) = Net farm income/Total cost ***(Eqn.6)***

Total Factor Productivity

Total factor productivity (TFP) is a method of calculating agricultural productivity by comparing an index of agricultural inputs to an index of outputs [12]. This can be computed following [13] as the ratio of the output to the total variable cost (TVC), specified implicitly in Eqn.7:

$$\frac{TFP}{TVC}=\frac{Y}{TVC}=\frac{Y}{\sum PiXi} \quad \textbf{(Eqn.7)}$$

Where:

Y = quantity of output; TFP = Total Factor Productivity; TVC = total variable cost; Pi = unit price of the ith variable input; and Xi = quantity of ith variable input.

This methodology ignores the role of total fixed cost (TFC) as it does not affect either the profit maximization or the resource-use efficiency conditions [12], expressed mathematically in Eqn.8:

$$TFP=\frac{Y}{AVC} \quad \textbf{(Eqn.8)}$$

The interpretations of TFP index are given as follows;

(< 0.1) = Sub-optimal; (1.0 – 1.09) = Optimal; and (≥ 1.10) Super-optimal.

RESULTS AND DISCUSSION

Costs and Return Analysis

According to the respondents, harvesting is carried out twice in a year, i.e., bi-annual production (every six (6) months). The following analysis is done based on one production cycle (1000kg) for 400 sqm pond size in the study area.

Table 1. *Profitability Analysis of Catfish Production per Production Cycle*

Variables	Frequency	%
1. Variable cost:		
Catfish feeds	260,000	36.5
Fertilizer	17,000	2.4
Liming	11,000	1.5
Labour	59,000	8.3
Catfish seeds(fingerlings)	55,000	7.7
Total variable cost(TVC)	402,000	56.5
2.Fixed cost:		
Pond construction	265,000	37.2
Pumping machine	45,000	6.3
Total fixed cost(TFC)	310,000	43.5
Total cost(TVC+TFC)	712,000	100
3.Total Revenue(TR)	1,190,000	
4.Net farm income(TR-TC)	478,000	
5. Profitability ratios:		
i. Benefit cost ratio (BCR)	0.67	
ii. Percentage Profit Margin		40.2

Source: field survey (2018)

Table 1 revealed that the net farm income of catfish production in the study area was ₦478,000/ production cycle, suggesting that catfish production is a relatively profitable venture with prospects for improved economic potentials. The average output of catfish per production cycle was 850kg per average fish pond; average price per kg is ₦1400.00; consequently estimated total revenue accruable from the sales of the harvested catfish was ₦1,190,000. The estimated total cost of catfish production was ₦712,000; total variable and fixed costs constituted 56.5% and 43.5% of the total production cost respectively. This result suggests that a significant proportion of the total revenue (gross farm income) was expended on production cost. The pond construction 37.2% and catfish feeds 36.5% constituted the most significant components of production cost. The estimated percentage profit margin was 40.2%, which suggests the percentage net margin accruable to the farmer from the estimated gross margin. The benefit-cost ratio was 0.67, which is indicative that for every naira (₦1) invested in catfish production ₦0.67 can be accruable in return. These ratios are indicative of the profitability index of catfish production in the study area. This corroborates with the findings of [14] who also reported that fish production was a viable venture. [15], also reported that catfish farming is a profitable venture in Rivers State, Nigeria.

Total Factor Productivity Analysis

***Table 2**. Distribution Based on Total Factor Productivity of the Catfish Farmers*

Productivity index	Frequency	%
Sub-optima (<1.00)	41	68.3
Optima (1.00-1.09)	12	20.0
Super-optima (>1.10)	7	11.7

Source: Field survey (2018)

The summary statistics of the total factor productivity result in Table 2 revealed that most (68.3%) of catfish farmers were sub-optimally productive as their TFP indices were below the optimal scale, which indicated sub-optimal input mix allocation in the production process; 20% were found to be optimally productive as indicated by their TFP indices and 11.7% were super-optimally productive as their TFP indices were above the optimal scale. The low productivity could be attributed to sub-efficient input mix and cost of production inputs, which yielded low output in respective fish farms in the study area. This corroborates with the findings of [12] who also reported similar results in their study on Agricultural Productivity Profiles.

Constraints Associated with Catfish Production

Table 3. *Constraints Confronting Catfish Production among Smallholders*

Constraints	Frequency	%
1. High cost of feed	57	95.0
2. Inadequate capital	48	80.0
3. High cost of pond construction	44	73.3
4. Poor market linkages	42	70.0
5. Poor access to modern	39	65.0
technologies	31	51.7
6. High labour cost	28	46.7
7. Fish mortality	23	38.3
8. Water pollutants	18	30.0
9. Scarcity of seeds (Fingerlings)	15	25.0
10. Inadequate extension contact		

Source: Field survey (2018); * = multiple responses recorded

Table 3 revealed the most prevalent constraints of catfish production in the study area were; high cost of feeds (95%), the result corroborates with [15] who reported that high cost of feeds is a major constraint to catfish farming in Nigeria. Inadequate capital (80%), the result corroborates with [17] who also reported that inadequate capital was a major production constraint; also [17] identified inadequate finance as a serious problem in catfish production. High cost of pond construction (73.3%); the respondents revealed that catfish farming requires a huge initial capital outlay especially for pond construction, this results corroborates with [15] and [17]. Poor market linkages (70%), poor access to modern technologies (65%), high labour cost (51.7%), fish mortality (46.7%), water pollutants (38.3%), Seed (fingerling) scarcity (30%) and inadequate extension contact (25%) are also critical constraints of catfish production in the area. This corroborates with the findings of [17] who also reported a similar result in their study on catfish production.

CONCLUSION

This study analyzed catfish productivity among smallholders in in Ekeremor, Bayelsa State, Nigeria. The results revealed that catfish production was relatively profitable in the study area; with possibilities for further increase in output and farm income. Furthermore, the result revealed that most of the catfish farmers were sub-optimally productive as their TFP indices were below the optimal scale; attributable to sub-efficient input mix and high cost of production inputs. All the constraints identified by the farmers were economically important and significantly affected catfish production in the study area; hence effort should be made to minimize the constraints faced by the farmers. Based on the findings of this study, the following recommendations are made to improve farm output, boost profitability and catfish productivity in the study area: Research funding to explore alternative feed sources and adoption of modern practices and technology that automates production; mitigates fish mortality, minimizes labour costs and optimizes productivity. Provision of financial and credit information to farmers to avail them opportunities to capital required to expand their scale of production. Policy formulation to subsidize feed

cost, pond construction materials and equipment. Improved market linkages to increase farm profitability. Improve farmer's access to and supply of adequate water, modern production inputs, technological innovations (fingerlings, feeds, pond fertilizers, etc.) to ensure sustainable production. Catfish farmers should form cooperatives that will enable them pool their resources together to boost their level of productivity and increase their economies of scale. Provision of incentives and interventions by improving farmer's access to extension services.

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