

COSTS AND RETURN ANALYSIS OF FISH FARMING IN CALABAR METROPOLIS, CROSS RIVER STATE NIGERIA

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ABSTRACT

The study examines 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 brackets 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 show that average total cost (TC) of ₦525,000 was incurred and total revenue (TR) of ₦650,000 was realized giving a returning gross margin (GM) of ₦425,000 with a Net farm income (NFI) of ₦125,000 per cycle. This is an indication that fish farming is profitable in the study area using a minimum of 1000 fingerlings for a start. From the results, feeds cost, production systems, education level and stocking density were important factors that influence fish output. Constraints perceived by most of the farmers include: high cost of fish feeds, lack of awareness and skilled personnel were identified *ab initio* that hindered fish production in the area. The study, therefore, recommended that the development of nutritive research institute for the development of fish feeds is a *sine qua none* for enhanced productivity in the fishery subsector in Nigeria.

KEYWORDS: Fish farming, fingerlings, returns, revenue, total cost

INTRODUCTION

Fish farming is one of the fastest-growing animal based food production sector, particularly in the developing countries (Green facts, 2004). In Africa, the fish sector provides income for over 10 million people engaged in fish production, processing and trade (New Partnership for African Development, 2005). Fish has also become a leading export commodity for Africa with an annual export value of \$2.7 billion (U.S.). Fish is one of the cheapest sources of animal protein and accounts for 22% of the protein in sub-Sahara Africa and 40% of animal protein consumption in Nigeria (FDF, 2009). In 2013, fishery sector accounted for about 4% of the GDP and also contributed to 42% in agricultures to national GDP (FDF, 2013). In Nigeria, fish demand as estimated by Ruma (2008) was 2.1 million metric tons at 11.5kg per capita consumption and going by 2013 estimates, fish demand stands at 2.66million MT while local supply is 0.76million MT with a per caput consumption of 15.46kg. The statistics for fish supply provided by the Federal Department of Fisheries (FDF) revealed that the average domestic annual fish supply has never met the demand. Nevertheless, such yearly occurring deficits have been

offset through enormous imports by various governments. The negative effects of these imports on the nation's foreign reserve have been variously acknowledged (FAO, 2002; FAO, 2006). However, it's obvious that fish supply from marine and freshwater capture fisheries cannot meet the growing global demand for aquatic production. This together with national efforts aimed at generating foreign currency and higher standard of living have focused the attention of many countries on the development and strengthening aquaculture (Rana *et al.*, 1997). Irrespective of the increase in fish production, the nutritional requirement from the average protein intake in developing countries is still relatively unattained. Hence, this paper attempts to: describe the socio-economic characteristics of the fish farmers, identify the types and nature of fish farming practices in the area, examine the costs and returns relationship of fish farming and investigate the variables that are likely to influence fish output. The remainders of the paper were organized as follows. The theoretical basis on which the paper is anchored was discussed followed by methodological and analytical frameworks. Next is the results and discussion of findings followed by conclusion and policy recommendations.

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Some theoretical issues

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:

$$Q = F(X_1, X_2) \dots\dots\dots (1)$$

From equ(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 :

$$Q = F(X_1, X_2^0) \dots\dots\dots (2)$$

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:

$$C = r_1x_1 + r_2x_2 + b \dots\dots\dots (3)$$

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:

$$C^0 = r_1x_1 + r_2x_2 + b \dots\dots\dots (4)$$

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

$$x_1 = \frac{c^0 - b}{r_1} - \frac{r_2}{r_1} \cdot x_2 \dots\dots\dots (5)$$

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:

$$\pi = PQ - \Phi(Q) - b \dots\dots\dots (6)$$

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

$$\frac{\partial \pi}{\partial Q} = P - \Phi'(Q) = 0 \dots\dots\dots (7)$$

And moving the MC to the right becomes:

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

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).

METHODOLOGY

Description of the study area

The study was conducted in Calabar metropolis, Cross River State (CRS), Nigeria. The area is situated in the Southern geopolitical zone of the state which comprises of Calabar Municipality and Calabar South. Calabar Metropolis lies between latitudes $N04^{\circ} 56' 00''$ and $N05^{\circ} 40' 0''$ North of the Equator and longitudes $E08^{\circ} 18' 40''$ and $E08^{\circ} 24' 0''$ of the Meridian. The town is flanked on its eastern and western borders by two large perennial streams viz: the Great Kwa River and the Calabar River respectively. It has an area of 406km^2 and a population of 371,022 (NPC, 2006). The metropolis has two clear identifiable seasons; the rainy or wet

season that last from April to October and dry season from November to March (Antigha, 2014). Calabar averages just less than 3,000mm of precipitate annually. Temperature is relatively constant throughout the course of the year, with average high temperatures usually ranging from 25 to 28 degrees Celsius. The major occupation of the people is farming (fish farms inclusive) and major crops cultivated include cassava, yams, rice, plantain, banana, cocoyam, maize, cocoa, rubber, and groundnut while major livestock are poultry, pigs, sheep and cattle (Agbor, 2007). Understandably, fish farms flourish in the area because of the favourable environmental features and adaptable to the business in spite of rigidities in terms of cost of feeds and funds from financial institutions.

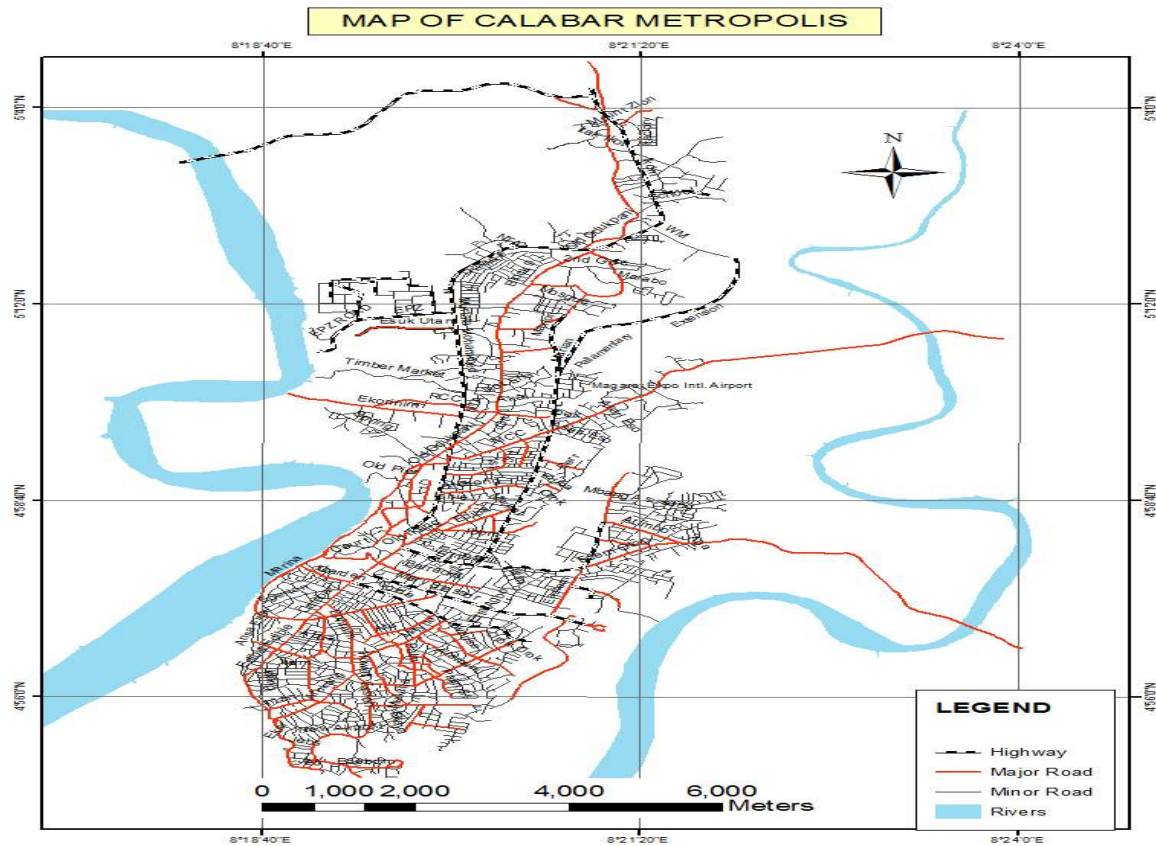


Fig. 1: Map Showing the Study Area

Source: Geographic Information System (GIS) Laboratory, Department of Geography and Environmental Science, University of Calabar.

Sampling procedure and sampling size

A two-stage sampling procedure was employed in selecting respondents for this study. In the first stage, 20 fish farmers from each of the two Local Government Areas (LGAs - Calabar municipality and Calabar south) was purposively selected, giving a total of 40 fish farmers, based on the availability of large number of fish farms. In the second stage, 15 fish farmers were randomly selected from the two LGAs giving a total of 30 fish farmers, representative of the LGAs, which were used for the study. Thus, a total of 30 farmers were used for analysis.

Sources of data and method of collection

Data for the analysis was obtained through primary sources. Primary data were elicited through the use of questionnaire which was supplemented with oral discussion. The questionnaire was designed based on

the study objectives and divided into two main sections. Section one elicit information on the personal characteristics of the respondents, while section two elicit responses to address the research questions and objectives.

Analytical technique

Descriptive, inferential and budgetary technique was used to analyze the data. Descriptive statistic such as tables, frequency and percentages was used to examine objectives 1 and 2. Objective 3 was analyzed using budgetary techniques analysis such as gross margin. This will enable the estimation of the total costs cum total revenue accrued to the enterprise within a specific production period. The difference between revenue (returns) and Total Variable Cost (TVC) makes up the Gross Margin (GM).

$$GM = TR - TVC \dots\dots\dots (9)$$

where:

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

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

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

$$Y = b_0 + b_1 \text{Log}X_1 + b_2 \text{Log}X_2 + b_3 \text{Log}X_3 + b_4 \text{Log}X_4 + b_5 \text{Log}X_5 + b_6 \text{Log}X_6 + b_7 \text{Log}X_7 + U \dots\dots\dots (11)$$

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

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

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)($b_4 < 0$)
- LB = Labour (Mandays)(indeterminate)
- CF = Cost of feed ($b_6 > 0$)
- PS= Production system ($b_7 > 0$)
- U = Error term

Note that b_1 to b_7 parenthesis are *a priori* expectations

RESULTS AND DISCUSSION

Table 1 shows the distribution of fish farmers with respect to their socio-economic characteristic. The results revealed that male (70%) are actively engaged in fish farming than the female (30%). This result can be justified by the assertion of Brummett, *et al.* (2010) that fisheries activities are mostly dominated by men. Majority (33.3%) of the fish farmers fall within the age bracket of 40 –49 years, 26.7 percent fall within 30 –39 years, 23.3% fall within 50-59 of age while 16.7% fell within the age range of 60 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). This indicates that very few old people are involved in fish farming. This result is in line with the findings of Oluwawumi *et.al.* (2010). it was also discovered that majority of the farmers were married (60%) while very few were widowed and separated. These results show that marriage confer some level of responsibility and commitment on individual who are on it (Fakoya, 2000; Oladoja *et. al.*, 2008). Most fish farmers had a small household size 2-4(40%) due to the migration of some members of the household. All of the respondents were highly educated

as all of them had attended tertiary education (100%). 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, majority of the fish farmers were civil servants (50%), while others where trading (6.7%), business owners (2%),teaching (3.3%) and only 10.0% engage in fish farming. This finding corroborates with what Ideba *et al.* (2013) and Adewuyi *et al.* (2010) alluded that 100% and 79% respectively of fish farmers were not on full time basis. The study also revealed that 56.7% of the sampled respondents were the most experienced in fish farming community. This result is consistent with what Olaoye *et. al.* (2013) opined that respondents with the highest number of years of experience perhaps have good skills and better approaches to fish farming business. The study also posits that the respondents with 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 1: Socio-economic characteristics of fish farmers in the study area

Variable	Frequency	Percentage
Gender		
Male	21	70
Female	9	30
	30	100
Age(years)		
30-39	8	26.7
40-49	10	33.3
50-59	7	23.3
60 and above	5	16.7
	30	100
Marital Status		
Single	10	33.3
Married	18	60.0
Divorced	1	3.3
Widow(er)	1	3.1
	30	100
Household size		
>2	8	26.7
2-4	12	40.0
5-7	6	20.0
8 and above	4	13.3
	30	100
Education level		
No formal education	0	0
Primary Education	0	0
Secondary Education	0	0
NCE/OND	5	16.7
University	25	83.3
	30	100
Primary Occupation		
Civil Servants	18	60.0
Trading	2	6.7
Fish Farming	3	10.0
Business	2	6.7
Teaching	1	3.3
Others	4	13.3
	30	100
Years of Experience		
<1	3	10.0
1-3	5	16.7
4-6	5	16.7
7 and above	17	56.7
	30	100

Source: Field Survey (2017)

Table 2 indicates the socio-economic characteristics of fish farmers in the area of study. The survey shows that all the respondents in the study area used intensive system of farming. This is because the prime motive of farmers is to make profit. This is in line with the findings of Olaoye *et.al.* (2013). The collapsible pond also known as mobile pond (46.7%) and concrete ponds (43.3%) were mostly preferred by the fish farmers. This was because concrete pond has the advantage of lasting over ten years and is not affected by climatic changes (i.e. not drying up during the dry season when the water table is low). This result, however, disagrees with the findings of Ideba *et al.* (2013) who stated that earthen pond/production system was mostly preferred in fish

farming (aquaculture). The number of operational ponds per individual farmer was mostly on small size less than 5 ponds (53.4%), 33.3% of the farmers had between 5-10 ponds while just 13.3% had above 10 ponds. Sources and quantity of water availability are one of the most important factors to be considered when selecting a site for aquaculture practice. Most (86.7%) of the respondents had borehole as their major source of water, 10% depend on deep well, while 3.3% depend on stream as source of water for the enterprise. Based on the types of fish stocked, majority (43.3%) of the fish farmers stocked *Clarias* (Catfish), a fast maturing species of catfish, followed by poly-culture (*Clarias and Tilapia*)(30%), 20% stocked *Heterobranchus* with a few

6.7% *tilapia* (Lady fish). This result was in line with Olayode *et al.* (2013) and Emmanuel *et al.* (2014). 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. Majority (86.7%) of the farmers stocked between 41- 60 fish per pond followed by 13.3% of the farmers who stock between 20-40 fish per pond. The results also indicated

that most fish feeds used by the farmers are formulated (70%) which is very expensive to purchase. However, only 30% of the farmers used locally-made feeds. This locally-made feeds contain substandard nutrient value owing to paucity of active ingredients in such feeds. Thus, such feeds may contribute to high mortality and morbidity rates in most fish farmers in the area (Ideba *et al.*, 2013).

Table 2: Surveyed results of fish farmers in the study area

Variable	Frequency	Percentage
Type of Farm		
Intensive	30	100
Extensive	-	-
Total	30	100
Types of pond		
Earthen	2	6.7
Concrete	13	43.3
Collapsible	14	46.7
All of the above	1	3.3
Total	30	100
Number of pond/production system		
<5	16	53.4
5-10	10	33.3
10 and above	4	13.3
Total	30	100
Sources of water		
Well	3	10
Stream	1	3.3
Borehole	26	86.7
Total	30	100
Type of fish stocked		
Cat fish/Clarias	13	43.3
Poly-culture (<i>Clarias and Tilapia</i>)	9	30
<i>Tilapia</i>	2	6.7
<i>Heterobranchus</i>	6	20
Total	30	100
Stocking density per pond		
<2000	4	13.3
2000-3000	26	86.7
Total	30	100
Source of feeds		
Local feeds	9	30
Formulated feeds	21	70
Total	30	100

Source: Field Survey Data (2017)

Table 3 gives estimates of cost and returns analysis made from fish farming using cost (fixed and variable costs) and fish yield data generated by each of the sampled fish farmers per season. The cost and returns analysis in **Table 3** revealed that the fixed cost accounted for the largest proportion (57.14%) of the total cost of fish farming in the study area. This indicates that

large amount of money spend by fish farmers in the study area was majorly for the construction of the pond. The cost of feed (34.29%) from fingerlings to market weight accounted for the largest proportion of the operating cost. This finding is in agreement with Adewunmi *et al.* (2005). From the survey, a total cost (TC) of ₦525,000 was incurred by a respondent per

fishing cycle while total revenue (TR) of ₦650,000 was realized with a returning gross margin (GM) of ₦425,000 and a net farm income (NFI) of ₦125,000. This indicates that fish farming in the study area was profitable (see for

instance, Ideba *et al.*, 2013; Olayoye *et al.*, 2013; Ashaolu *et al.*, 2006) whose results revealed that the business is profitable according to the level of investment and variable cost minimization.

Table 3: Estimate of cost and returns of fish farming based on 1000 fingerlings in the study area

Items	Amount(₦)	Total Cost (%)
A. VARIABLE COST		
** Feeds	180,000	34.29
Labour	15,000	2.86
*Fingerling	30,000	5.71
TOTAL VARIABLE COST	225,000	
B. FIXED COST		
** Cost of constructing the pond	300,000	57.14
TOTAL FIXED COST	300,000	
TOTAL COST (A+B)	525,000	
TOTAL REVENUE	650,000	
GROSS MARGIN	425,000	
NET FARM INCOME	125,000	

Notes: *=per stocking cycle/period for 1000 fingerlings; cost of feed per 15kg =N5800; cost of fingerling=N30.00; sales per kilo=N650.00; **=Inclusive of labour, cement, chippings etc ; ++ =N180 per feed to market weight.

Source: Field Survey Data (2017);

A multiple regression analysis was done in four functional forms (linear, semi-log, double log and exponential forms). Based on the statistical significance of 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 chosen also because it has the highest R² value (0.99) and F-ratio (311.28) (Table 4). Stocking density had a positive relationship with output and was significant at 1% thereby conforming to the *a priori* expectation. This

result also agrees with the findings of Adewuyi, *et al.* (2010) and Nwosu and Onyeneke (2013). Production system was significant at 1% and had a positive relationship with output, meaning that the more efficient the production system used, the greater the output. The cost of feed used was significant at 1% and had a positive relationship with output. Education had a negative relationship with output and was significant at 5%. This means that one can go into fish farming without formal education.

Table 4: Summary results showing factors that influence fish output in the area

Variable	Linear	Double-log	Semi log*	Exponential
Age	-0.582 (0.462)	0.152 (0.140)	0.123 (0.165)	-0.110 (0.135)
Education	-0.020 (0.293)	-0.161 (0.121)	-0.271** (0.142)	-0.024** (0.086)
Farm	0.661 (0.561)	-0.028 (0.117)	-0.131 (0.138)	0.185 (0.164)
Experience	0.003 (0.007)	-0.025 (-0.051)	2.050*** (0.070)	-0.001 (0.002)
Labour	0.000 (0.0)	-0.008 (0.012)	0.013 (0.014)	-3.163E-005 (0.000)
Feed cost	7.231E-006 (0.000)	-0.052 (0.085)	0.600*** (0.100)	-5.576E-005 (0.000)
Production System	3.839 (0.319)	2.042*** (0.074)	8.399*** (0.087)	0.911 (0.093)
Constant	-2.423 (2.124)	0.713 (0.078)	-4.596 (1.033)	-0.195 (0.620)
R ²	0.930	0.988	0.999	0.904
Adjusted R ²	0.907	0.985	0.999	0.873
F-Ratio	41.61***	265.31***	311.28***	29.427***
S.E	1.286	0.131	0.154	0.376
DW	1.68	2.03	1.855	1.64

Notes: ***=significant at 1% level; ** = significant at 10% level; DW= Durbin Watson. Values in parenthesis at standard are errors; + = Lead equation

Table 5 shows the constraints faced by fish farmers. Majority (43.33%) of the respondents interviewed complained of high cost of feed. This was in line with Ike *et al.* (2003) who reported that high cost and unavailability of fish feed concentrate make fish farming unproductive. Lack of fund was complained by 16.66% of the farmers. Fund is vital in purchasing

productive inputs and in payment of hired labour. About 23.33% of the respondent complained of lack of awareness and skilled personnel (see **Table 5**). This was largely responsible for the failed attempts to resuscitate the aquaculture business in the early 90s by the then Federal Military Government of Nigeria.

Table 5: Some constraints encountered in fish farming enterprise in the area

Constraints	No. of respondent	Percentage
lack of awareness and skilled personnel	7	23.33
Lack of funds	5	16.67
Predation	2	6.67
Water quality/availability	3	10.00
High cost of feed	13	43.33
Total	30	100

Source: Field Survey Data (2017)

CONCLUSION AND POLICY RECOMMENDATIONS

Stocking density, production system, feed cost and education were found to significantly influence fish output in the study area. The total revenue realized from total cost of production of ₦525,000, was ₦650,000, making a net farm income of ₦125,000. It was, therefore, concluded that fish farming in the area was highly profitable as revenue generated adequately covered the operating expenses and a reasonable floating capital left. A vast majority of the fish farmers indicated that, they were faced with problems of high cost of feeds, lack of awareness and skilled personnel, water quality/availability and lack of capital. Based on the findings, the following policy recommendations were made:

- I. Extension services in the state should be updated via regular organization and workshops for the benefit of fish farmers in the area;
- II. Nutrition feed research institute should be established to help reduce the cost of feeds and enhance the capacity of fish farmers nationwide;
- III. Local nutritive feeds should be made readily available in the markets as this will help in the long run to reduce the demand and cost of foreign feeds.
- IV. Government and financial institutions should encourage fish farmers by making loans readily available to them at zero or reduced interest rates. This policy will encourage fish farmers to expand their enterprises and capacity for enhanced productivity of the commodity.

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