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PROFITABILITY ANALYSIS OF CATFISH FARMING IN SULEJA LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA

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ABSTRACT

The problem of profitability and scale of production of catfish has not been properly addressed. This study was conducted in Suleja Local Government Area of Niger State to assess the profitability of catfish production. Forty (40) catfish farmers were selected from the study area using simple random sampling techniques. Structured questionnaire was used to collect data from the respondents. The analytical tools used include, descriptive statistics, net farm income analysis and profitability ratios and multiple regression functions. The result of the analysis showed that the average total cost per kilogram of fish was ₦321.23k and the average total revenue per kg of fish was ₦501.31. This gives a net farm income of ₦180.08k per kilogram of fish farmed. The study also showed that the sum total of elasticity of variables was less than one (0.994), this indicates that catfish farming in the study area is in stage II, which is the rational stage of production. Double-log functional model was chosen as lead equation. The value of R^2 was 0.998. The number of ponds (X_1) and number of fingerlings (X_3) were significant at 1%, while labour(X_5) was significant at 5% levels of significance. The F- ratio of 2964.370 was significant at P (< 0.01). This implies that all the explanatory variables taken together have significance on the dependent variable (Y), the output. Due to expensive nature of flow-through and re-circulatory ponds, earthen ponds were mostly preferred by majority (92.5%) of the fish farmers in the study area. The major problems faced by catfish farmers include; water, high cost of feed and capital.

Key Words: cat fish, net farm income, profitability ratio

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INTRODUCTION

Recent knowledge shows that the world's natural stocks of fish and shell fish, though renewable have finite production level which cannot be exceeded even under the best management regimes. For most of our lakes, rivers and oceans, the maximum sustainable fishing limit has been exceeded (FAO, 2001). Aquaculture or fish farming is the rearing of aquatic organism under controlled or semi-controlled conditions for economic and social benefits. In a broad sense, it include the rearing of tropical, shrimps, minnows, gold fish, the culture of sport fishes for stocking into farm ponds, streams, reservoirs and the growth of aquatic plants such as algae (Ayodele and Fragene, 2003). Fishing like any other hunting activities has been a major source of food for human race and has put an end to the unsavory outbreak of anemia and other nutritional diseases. Statistics indicate that Nigeria is the largest African aquaculture producer, with production output over 15,489 tonnes per annum which constitute about 4% of the nation's agricultural G.D.P (FAO, 2005). A survey conducted by Abba (2012), showed that Nigeria produces 1.7m metric tonnes of fish annually. Environmental threats pose great danger to fish production from a natural body of water, the scenario which calls for prudent management of fish stock and point to the need to augment fish production in the country through aquaculture. Lack of information on profitability of fish farming could be one reason among other constraints why aquaculture has not really set its stand in the country. African catfish (*clarias gariepinus*) has been reared for almost 20 years in Africa with mixed success (Janssen and De Graaf, 1996). It is agreed that African catfish is one of the most suitable species for aquaculture in Africa (Ricther, 1979). African catfish has some advantages which include;

i. High growth rate
ii. Resistance to handling stress
iii. Sociological and physiological qualities coupled with its high economic value
iv. Low bone content
v. Fine flavor and high growth rate make the fish highly recommendable for fishing in Nigeria.

The profitability of aquaculture as a business has not been demonstrated adequately as compared to other industries like crop production in the country. Tilapia is the main farmed species. Commercial production of this species has been hampered by small harvest resulting from excessive production and stunting. Hence, there is need for alternative culture approach (Lovshin *et al.*, 1990). One idea would be to grow a ferocious feeders and fast growing fish, a description that correctly fits the African catfish (*clarias gariepinus).*

According to FAO (2006), 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. On the other hand, Emokaro *et al*., (2010) and Business World (2011) asserted that engaging in catfish farming in Nigeria is a goldmine that can guarantee 100% return on investment with 90 days payback period. Despite this fact Ezike and Adedeji (2010) revealed that the performance of catfish is still uneconomical. Given the importance of fish in our socio-economic life, the level of resource use must be improved upon. However, little is known about the choice of the level of input that will ensure maximum output through input elasticity, return to scale and marginal physical product (resource use efficiency), and since little is known about the technical efficiency, the fish output cannot be enhanced for optimum production. With respect to these problems, the following research questions arise which the study seeks to find answer to.

i. What are the socio-economic characteristics of catfish farmers?
ii. What are the inputs used by catfish farmers?
iii. What are the cost and profitability of catfish farming in the study area?
iv. What is the elasticity of production and resource use efficiency?
v. What are the problems encountered by catfish farmers?

This study thus sets out to analyze the profitability of catfish farming in Suleja Local Government Area, Niger State. The specific objectives are to,

i. identify the socio-economic characteristics of catfish farmers in the study area
ii. examine the inputs used by the farmers
iii. determine the profitability of catfish farming
iv. determine the resource use efficiency in catfish farming, and
v. identify the problems in catfish farming in the study area and make recommendations

Methodology

Simple Random sampling techniques were used to select forty (40) respondents in Suleja Local Government Area of Niger State. The primary data was collected via a structured questionnaire and personal interviews with respondents. The questionnaires elicited information on the socio-economic characteristics of farmers, determinants of cost and return, resource use efficiency, problems, solutions and recommendations. Information collected also included the source of capital, equipments, land acquisition, source of feed, fertilizer, fingerling cost and quantity, source of labour and cost, feed cost, total revenue and major constraints in catfish farming.

The dependent variable (Y) is the total output of catfish in kilogramme at the end of farming year, while the independent variables include the following;

i. Size of the pond (m^2)
ii. Fingerlings (No.)
iii. Fertilizer (kg)
iv. Fuel (litres)
v. Age of farmers (years)
vi. Cost of feed (₦)
vii. Years of experience in catfish farming (No.)

Data analysis

Data collected were analysed using descriptive analysis to achieve objectives (i) and (v): - Frequency distribution, percentage, cumulative percentage and mean were used to analyse the socio-economic characteristics of catfish farmers and input used in its production. Net farm income analysis was used to achieve objectives (ii) and (iii), this measures the return to unpaid family labour, operator's land, labour, capital and management. It is represented as;

Net Farm Income = Gross Receipts – Total Cost of Production
Where; Gross Receipts = Total output x Price per unit of produce, and
Total Cost of Production = Operating Costs + Fixed Costs

Profitability Ratio Analysis

Gross Ratio (GR) = TC / TR
Where TC = Total Cost
TR = Total Revenue

Expense Structure Ratio (ESR) = FC / VC
Where FC = Fixed Cost
VC = Variable Cost

Rate of Return (ROR) = NR/TC
Where NR = Net Return
TC = Total Cost

Cost Analysis:

Total cost is the money incurred; it is the sum of fixed and variable cost given by the equation;

TC = TVC + TFC

Where TC = total cost, TVC = total variable cost, and TFC = total fixed cost.

Variable cost is the cost incurred during production. Fixed cost is incurred in a production firm whether there is production or not. It is the cost incurred on fixed items e.g. – land, buildings, implements etc.

Fixed cost only exists in the short run but they are all variable in the long run. This provides an assessment of the profitability of a given project. Revenue is the money generated from the sales of goods at a given price. Total revenue is the quantity of product multiplied by the market price.

TR = PQ
Where; TR=Total Revenue
P = Price
Q = Quantity of the product
The Total revenue (TR) – Total cost (TC) is the production profit.
Gross margin = TR – TVC
Gross margin (GM) – Total fixed cost (TFC) = Farm profit

Multiple Regression Analysis: - this was used to examine the relationship between dependent and independent variables. The production function recommended for fish farmers in this study area is implicitly presented as;

$Q = f(X_1, X_2, X_3, X_4, X_5, X_6, \ldots\ldots, e)$
Where Q = Output in kg
X_1 = No. of ponds

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X_2 = pond size in square meter (m^2)
X_3 = fingerlings in numbers
X_4 = quantity of feed in kilogram (kg)
X_5 = labour (man days)
X_6 = quantity of fuel litres
e = error term (assumed to have a zero mean)

The linear, semi-log, double-log and exponential production functions (whose functional forms are specified in equations 1 – 4)were evaluated using ordinary least square method.
Linear form: - $Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + e$ …………………………………..…….(1)
Semi log form: - $Y = \log b_0 + b_1\log x_1 + b_2\log x_2 + b_3\log x_3 + b_4\log x_4 + b_5\log x_5 + b_6\log x_6 + e$ ……………..(2)
Double- log form: $-\log Y = + \log b_0 + b_1\log x_1 + b_2\log x_2 + b_3\log x_3 + b_4\log x_4 + b_5\log x_5 + b_6\log x_6 + e$…….(3)
Exponential form**: -** $\mathrm{In}\ Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + e$ ……………………………(4)

Where;

Y = dependent variable or output
b_0 = constant term
$b_{1-}b_6$ = coefficient of the independent variable $x_1 – x_6$
$x_1 – x_6$ = independent variable used to derive output Y
e = error term

If the sum of b's is equal to one, it implies constant return to scale, if it is less than one, it implies decreasing return to scale and if it is greater than one, increase return to scale. It is expected that increase in the quantity of explanatory variable will cause an increase in the production of catfish, every other thing being held constant (objective iv). Therefore the economic efficiency level of fixed resources used was determined by finding the ratio of marginal value product (MVP) and price of each input, i.e.,

Output price x MPP = MVP
MPP x Xp = MVP
MVP > Xp => under utilization
MVP < Xp => over utilization
MVP = Xp => Efficient

RESULTS AND DISCUSSIONS

Socio-economic characteristics of catfish farmers

The Socio-economic characteristics of catfish farmers considered in this study include age, gender, and level of education, farming experience, and source of capital.

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The analysis in table 1 shows that 75.0% are within the age bracket of 31 – 50 years, while only 5.0% are above 60 years. This indicates that majority of the catfish farmers are in their productive age. This findings is in agreement with the findings of Olowosegun *et al*. (2004) . The gender of the respondents indicates the prevalence of catfish farming among the male as female respondents make up 20.0% and the remaining 80.0% covers the male respondents. This finding is also in consonance with that of Brummett *et al.* (2010) in which they found that fish farming activities are mostly dominated by men. The education attainment of the respondents shows that 40.0% attained Higher School Certificate (HSC) level while 32.5% had Secondary education. 10.0% attained primary school and 7.5% had both first degree and Ordinary National Diploma (OND) respectively. 2.5% had no formal education. Analysis also shows 70.0% of the respondents have between 1-5 years of experience, 25.0% have 6-10 years of experience and 5.0% have above 10 years of experience in catfish farming indicating that the venture is just taking effect in the study area. Catfish farmers in the study area may not have had access to credit and loan as 92.5% sourced their capital from personal savings, 5.0% from family inheritance and 2.5% from co-operative societies. The finding is consistent with that of Issa *et al*. 2014 in which they found out that majority of catfish farmers in Kaduna state source of capital was from personal savings.

Results show that 92.5% of the respondents (majority) make use of earthen ponds and the remaining 7.5% used re-circulatory. This finding is at variant with that of Issa *et al*., (2010) in which they found out that majority of sampled cat fish farmers in Kaduna state used concrete ponds of an average 200 m^2. This indicates that earthen pond is cheap to construct and maintain than re-circulatory and flow-through. The analysis shows that majority of catfish farmers of about 70.0% in the study area owns between 1 – 2 ponds, 20.0% own between 3 – 4 ponds while the remaining 10.0% owns 5 ponds and above. The mean number of pond is 2.3

The analysis also shows that 35.0% of the respondents have pond size of between 20.01 - 40.0 meter squared, 22.5% between 40.01 – 60.0 meter squared, 17.5% have pond size of between 60.01 – 80.0 and above 80.0 square meters respectively. Only 7.5% of the respondents have less than 20 square meter pond size. Findings also shows that 62.5% of the respondents stocked between 1001 – 2000 numbers of fingerlings, 17.5% stocked between 2001 – 3000, 12.5% stocked less than 1000 numbers of fingerlings and 7.5% stocked above 3000 number of fingerlings, the mean number of stocking was 1851.25. It was also observed that 67.5% of the farmers used between 101 – 200 kg of feeds, 25.0% between 201 – 300 kg of feed, 5.0% used above 300kg while 2.5% used less than 100 kg of feed. The mean quantity of feed used is 179.20 kg, and from the table, it shows that the highest quantity of feed used is within the range of 101 – 200 kg. The analysis also indicates that 47.5% of catfish farmers in the study area used 101 – 200 litres of fuel, 32.5% used 201 – 300 litres, 7.5% used less than 100 litres and above 400 litres respectively while 5.0% used 301 – 400 litres of fuel during production. The mean quantity of fuel used by the respondents in the study area is 238.75 litres which implies that majority used 201 – 300 litres of fuel. The general implication of statistics above shows that majority of the farmers in the study area are small scale farmers.

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Costs, Net farm income analysis and Profitability ratios

This is the analysis of costs, which are the expenditures involved in the production system, the revenue generated after marketing of catfish and the profitability ratios so as to examine the profitability and the efficiency of the farmers. The total cost and revenue are expressed in terms of their average, that is, average cost and revenue respectively. The total costs of production are categorized into two; they are fixed cost and variable cost.

The fixed costs are expenditures that do not vary as output changes. The depreciated values were obtained using straight line method, while variable costs are expenditures incurred during the production process and this varies with the level of output.

From table 3 above, the average variable cost of catfish farming in the study area was ₦ 233,188.13 in which fingerlings accounted for 39.93% and labour accounted for 34.68%, feed accounted for 15.17% while water accounted for 7.54% respectively. This means that fingerlings, labour, feed and water are essential inputs in catfish farming. The fixed cost covers rent and pond construction, tax and implements like; net, scale, pumping machine, shovel. The average fixed cost was ₦ 52,783.22 in which rent and pond construction accounted for 86.73% and implements accounted for 11.36%. The Average Total Cost, Revenue, Gross Margin and Net farm Income of catfish farming in the study area were further divided by the total output in kilogram to obtain per kilogram costs shown in the table above.

The gross ratio (GR) was found to be 0.64; this implies that from every ₦1.00 returns to the enterprise, ₦64.00k is being spent. The expense structure ratio (ESR) was found to be 0.23, which implies that about 23% of the total cost of farming is made up of fixed cost component. This make the business worthwhile since increase in the production with variable cost will increase the total revenue leaving the fixed cost unchanged. The rate of returns in catfish farming in the study area is 0.56 which is 56%. This shows that for every ₦1.00 invested, 56 kobo is gained by the respondent. This result is at variant with that of Issa et al., (2014) in which they found out that cat fish farmers using earthen pond in Kaduna state had a rate of return of 73.4% per production cycle. It shows that catfish farming in the study area is still profitable.

Regression results

In determining the profitability, output was regressed on the input used for the farming of catfish. The inputs used in the farming are; number of ponds, pond size, and number of fingerlings stocked, quantity of feed, labour and quantity of fuel.

Though four functional forms (double-log, semi-log, exponential and linear regressions) were used, the double-log regression was used as lead equation. The choice of this function is on its conformation to a priori expectation in terms of signs and magnitude of the coefficient of the number of significant variables, the magnitude of R-square and the coefficient of multiple determinations (R-Square) (Olayemi and Olayide, 1981). The value of the coefficient of

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determination (R square) indicated that about 99.8 of variations in output in the study area was explained by the explanatory variables with the remaining unexplained and this was attributed to the random nature of the variables.

The adjusted R of 0.998 obtained indicates that the explanatory variables explained about 99.8% of the adjusted variability in catfish farming in the study area.

Four of the estimated coefficients of number of ponds (X_1), number of fingerlings (X_3), feed (X_4) and quantity of fuel (X_6) have positive signs indicating that an increase in any of these variables would increase the level of output in catfish farming in the study area. The coefficient of pond size X_2, and labour X_5 have negative signs indicating that increasing these variables would decrease the level of revenue of respondents in the study area. This finding is not consistent with the findings of Adewuyi *et al*., (2010).

The number of ponds and number of fingerlings were significant at 1% level of significance, while labour was significant at 5% level of significance and pond size, feed and quantity of fuel were not significant. The F ratio is 2964.370 and was significant at P (< 0.01) percent to the output of catfish farmed. This implies that all the explanatory variables taken together have significance on the dependent variable (Y), the output. Therefore, there is significant relationship between output and various inputs used in catfish farming in the study area.

The sum of elasticity of production of the variables in table 5 above was less than one, which is 0.994 and this indicates a decreasing return to scale (stage II of production). This suggests that catfish farming in the study area have a decreasing positive return to scale. This is the rational stage of production because at this stage, the Average Physical Product (APP) is decreasing but positive, and though the Marginal Physical Product (MPP) is declining, yet it is within the limit of the resources available and this is the factor that helps to determine the exact point or where to produce. It gives the optimum point which represents the point of full and efficient utilization of resources to obtain a given output. The implication is that the more the input used, the higher will be the value of fish even at a decreasing rate. This finding is consistent with that of Olagunju *et al*. (2007) and Adewuyi *et al*. (2010) in their study of economic viability of cat fish farming in Oyo and Ogun state respectively.

Marginal value productivity and resource use efficiency

This is the yard stick for measuring the efficiency of resource used in a farming activity. Table 6 below shows the marginal values and efficiency index of number of ponds, number of fingerlings stocked and labour used in the farming area.

Positive marginal value productivity implies that output could be raised by adding more of the resources comparing the magnitude of MVP with the input cost of the resources in order to determine the worthwhile of increasing the level of the particular resources, while the negative implies a reduction of output with increase in that input.

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From the table, the ratio of MVP to input (MFC) is more than one for the significant variable of number of pond (X_1), indicating under utilization of this resource, while the ratios for the significant variables of the number of fingerlings (X_3) and labour (X_5) is less than one respectively and this indicates over utilization of these resources for catfish farming in the study area and must be reduced in order to increase output.

The over utilization of the inputs mentioned above can be attributed to low capital base, high cost and lack of adequate knowledge on catfish farming and appropriate stocking density and time consuming nature and labour intensity in the production of catfish in the study area.

Major problems of catfish farming

A number of constraints were identified with catfish farming in the study area. The major ones include fingerlings, water, capital, feed, marketing and diseases.

Table 7 indicates that constraints such as water, high cost of feed and lack of capital are the major constraints encountered by the respondents and this accounts for the major percentage of the entire constraints from the multiple response and needs urgent attention from the government and the co-operative society in order to enhance catfish farming in the study area, while the remaining constraints such as high cost of fingerlings, poor marketing channel and disease makes up the remaining percentage of the multiple response.

Conclusion and Recommendations

There is increasing demand for fish consumption in the country; this research work has come a long way to show that the venture is profitable in the study area. It is a highly profitable venture with good net return. The sum of elasticity of production of the variables is less than one (0.994), which indicates a decreasing return to scale (stage II of production). This suggests that catfish farming in the study area has an increasing negative return to scale. It is an acceptable production stage. The major problems identified are water scarcity, high cost of feed and lack of capital. Based on these findings the following recommendations are made:

1. Cat fish farmers need to locate their production site/ponds close to sources of constant and clean water which is the major production input.
2. Cooperative associations of catfish farmers in the study need to build the capacity of their members in the areas of local production of feeds, access to improved methods and technologies of catfish farming.
3. Encouragement in the form of provision of subsidized inputs such as fertilizer, lime, feed, fingerlings and drugs for fish treatment should be made available to the present catfish farmers at the right and appropriate time by government agencies, non-governmental organizations and input providers so that they can enhance their production and profitability of the venture.

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APPENDIX

Table 1: Socio-economic characteristic of catfish farmers

Variables	Frequencies	Percentages
Age		
31-40	17	42.5
41-50	13	32.5
51-60	8	20.0
>60	2	5.0
Gender		
Female	8	20.0
Male	32	80.0
Education		
No formal education	1	2.5
Primary	4	10.0
Secondary	13	32.5
HSC	16	40.0
OND	3	7.5
B.Sc	3	7.5
Fish farming experience		
1-5	28	70.0
6-10	10	25.0
>11	2	5.5
Source of capital		
Personal savings	37	92.5
Family inheritance	2	5.0
Co-operative society	1	2.5

Source; Field survey, 2012

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Table 2: Distribution of inputs used by respondents

Variables	Frequency	Percentage
Type of pond		
Earthen	37	92.5
Flow through	0	0.0
Re-circulatory	3	7.5
Number of Pond		
1-2	28	70.0
3-4	8	20.0
5-6	3	7.5
>6	1	2.5
Size of pond		
1 - 20 m	3	7.5
20.01 – 40.0 m	14	35.0
40.01 – 60.0 m	9	22.5
60.01 – 80.0 m	7	17.5
> 80.0	7	17.5
Number of fingerlings		
1 - 1000	5	12.5
1001 – 2000	25	62.5
2001 – 3000	7	17.5
> 3000	3	7.5
Quantity of feeds		
1 - 100 kg	1	2.5
101 – 200 kg	27	67.5
201 – 300 kg	10	25.0
> 300 kg	2	5.0
Quantity of fuel		
1 – 100 litres	3	7.5
101 – 200 litres	19	47.5
201 – 300 litres	13	32.5
301 – 400 litres	2	5.0
>400 litres	3	7.5

Source; Field survey, 2012

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Table 3: Estimated Costs, Net farm income analysis and profitability ratios per 100m^2

Inputs	mean cost (₦)	Percentage (%)
Variable Costs		
Feed/Supplement	35,365.00	15.17
Fertilizer	167.50	0.07
Fingerlings	93,112.50	39.93
Fuel/Water	17,583.13	7.54
Labour	80,860.00	34.68
Lime	275.00	0.12
Packaging/Storage	1,937.50	0.83
Pesticide	975.00	0.42
Transportation	2,912.50	1.25
Total Variable Cost (TVC)	**233,188.13**	**100**
Fixed Costs		
Rent/Pond construction	45,775.00	86.73
Implement	5,995.72	11.36
Tax	1,012.50	1.92
Total Fixed Cost (TFC)	**52,783.22**	**100**
		Cost ₦/kg
Total Cost (TC) = (TVC + TFC)	285,971.35	321.23
Total Revenue (TR)	446,287.50	501.31
Gross margin (GM) = (TR – TVC)	213,099.37	239.37
Net farm income (NFI) = (TR – TFC)	160,316.15	180.08
	Ratios	
Gross ratio (GR) (TC/TR)	0.64	
Expense structure ratio (ESR) (FC/VC)	0.23	
Rate of Return (ROR) (NR/TC)	0.56	

Source; Field survey, 2012

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Table 4: Estimated double log production function (lead equation)

Variables	Regression coefficient	Standard error	T-Values
Constant	-0.673	0.123	-5.481 ***
No. of ponds X_1	0.026	0.008	3.425 ***
Pond size X_2	-0.011	0.009	-1.214 NS
Fingerlings X_3	1.001	0.022	45.968 ***
Feed X_4	0.001	0.013	0.067 NS
Labour X_5	-0.008	0.004	-2.216 **
Fuel X_6	0.002	0.009	0.199 NS
R^2	0.998		
R-Adjusted	0.998		
F Ratio	2964.370***		

Source: Field survey, 2012
NS Not Significant
*** Significant at 1%
** Significant at 5%

Table 5: Elasticity of production and return to scale

Independent Variables	Elasticity of production
No. of ponds (X_1)	0.038
Pond size (X_2)	-0.021
Fingerlings (X_3)	0.993
Feeds (X_4)	0.001
Labour (X_5)	-0.019
Fuel (X_6)	0.002
Return to scale	**0.994**

Source: Field survey, 2012

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Table 6: Marginal value productivity and resource use efficiency

Variables	MPP	MFC	MVP	Efficiency index
No. of ponds (X_1)	9.934	6193.55	61526.73	9.9340
No. of fingerlings(X_3)	0.481	50.30	24.19	0.4809
Labour (X_5)	-0.006	67.67	-0.41	-0.0069

Source: Field survey, 2012

Table 7: Major problems faced by catfish farmers in the study area

Constraints	Frequency*	Percentage
Fingerlings problem	7	17.5
Water problem	31	77.5
Lack of capital	14	35.0
High cost of feed	21	52.5
Marketing problem	5	12.5
Problem of disease	7	17.5
TOTAL	85*	

Source; Field survey, 2012 * multiple responses allowed