Trop. J. Anim. Sci. 1 (1): 75 - 83 (1999)
ISSN: 1119-4308

SUSTAINABLE FISH PRODUCTION: AN ECONOMIC ANALYSIS OF FISH FARMING IN BAUCHI STATE

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Target audience: Fish farmers, farm managers, agro-consultants, researchers, academicians.

ABSTRACT

This study was conducted in Bauchi State to analyse the economics of fish farming. Data were collected from 30 respondents in six Local Government Areas of the State using the simple random technique between January and March, 1996 using a well structured questionnaires. The collected data were analysed using the farm budgeting model and the cobb-Douglas production function analysis. The results obtained showed that the respondents were making an average net income of N80.00 per m^2 of fish pond and an average net income of N6,189.20 per respondent. Also that the coefficient of multiple determination or R^2 is 82.38 %. The F value is 26.50 and is found to be significant ($P<0.05$). The estimated coefficients (elasticities of production) are found to be positive but less than 1. The results also revealed the resources (fingerling, feed and labour) are being used below the economic optimal level. High cost of inputs, inadequate and untimely delivery of inputs, inadequate water during dry season and high cost of pond construction were some of the major constraints affecting fish farming in the area.

Key words : Economic Analysis and Fish Farming.

DESCRIPTION OF PROBLEM

Fish as a source of animal protein has played an important role in the nutritional budget of many nations. Fish production is becoming more and more an important source of valuable protein food. The world food crisis and the present demand for food are increasing the demand for fish and other aquatic organisms which can be directly consumed or coverted to food for eventual human consumption. More than half the world

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production depends on fish as a principal source of animal protein and in many countries people derive more than 50 percent of their daily animal protein requirements from fish (1). In Nigeria, 40 percent of animal protein intake comes from fish (2). Fish is second after rice in the diet of low income people of many developing countries (1).

Nigeria has ideal environmental and traditional characteristics for developing a high level of fish production that can meet the population's needs of between 1.2 million to 1.51 million metric tonnes by the year 2000 93). Recent estimates reveal that Nigeria has potential of about 1,010,000 hectares of perennial fresh water and 741,500 hectares of brackish water for aquaculture (4). Unfortunately, despite these potentials, Nigeria maintains a wide gap between production and demand of fish and fishery products. For instance, it was reported that Nigeria produces only 25 percent of the estimated annual yield of 1,145,450 metric tonnes of fish (3). This contribution is meagre considering the aquaculture potentials of the country. The reason for this is not far fetched. Sufficient information is not available for planning purposes with respect to the fishery industry. Government's concern about the fishery industry, is only of recent origin, even though the fishery industry, especially the artisanal fisheries has been a source of income and employment to milions of Nigerian, especially those in the riverine areas of the country (4).

Animal protein consumption in Nigeria is quite low, lower than per caput consumption in Europe and Asian countries (2). And indeed, lower than the WHO and FAO standards of 35.0 gm of animal protein per caput per day (5). The low animal protein supply in Nigeria also stemmed from the short fall in fish production owing to lack of Government commitment to the fishery sub-sector (4), use of crude fishing method by local fishermen, water hyacinth menance amongst other reasons (6). Given the above circumstances, it is important to improve protein supply in Nigeria. Fish farming is advocated because environmental conditions can be controlled and harvests can be predicted.

Bauchi State is selected for the study for it is endowed with potentials to guarantee abundant fish supply. With the gigantic Fubi dam, Balanga dam, Dadin-kowa dam, and the Gongola-Jama'are River Basin, perennial fish supply would be assured if investments are made in fish farming rather than capture. Hence there is a need for economic analysis of the enterprise.

OBJECTIVES OF THE STUDY

The study has the following specific objectives :

(i) To determine the socio-economic characteristics of fish farmers in the study area.
(ii) To determine the cost returns and profitability or otherwise of fish farming in the area.
(iii) To determine the elasticity of production.
(iv) To identify constrains that affect fish farming and suggest solutions to them.

MATERIALS AND METHODS

The study was conducted in Bauchi State. The list of all the fish farmers in the State was provided by the Bauchi State Agricultural Development Programme (BSADP). A total of 50 people engaged in fish farming, representing six local government areas of the State. They include Bauchi, Toro, Dass, Katagum, Gombe and Brilliri Local Government areas. A simple random sampling technique was used to select 30 respondents for the fishery unit of Bauchi State Agricultural Development Project between January and March, 1996. The collected data were analysed using the farm budgeting model to determine the profitability or otherwise of fish farming. The Cobb-Douglas production function model was also employed to determine the resource use efficiency. The model is given as :

$$Y = ax_1^{b1} x_2^{b2} x_3^{b3} u$$

where :

Y = Output of fish (kg/m^2)
a = Constant
X1 = quantity of fingerlings (kg/m^2)
X2 = quantity of feed (kg/m^2)
X3 = Human labour input ($man/hour/m^2$)
b1 b2, b3 = coefficients of x1, x2 and x3
U = Error term.

RESULTS AND DISCUSSIONS

Socio - Economic Characteristics of Respondents : Majority of the fish farmers fall between the age bracket of 30 - 39 years accounting for about 43% of the respondents, while the age bracket of 40 - 49 and 50 - 59 years represent 33 and 10 % respectively (Table 1). The implication of this is

that young people engage more in fish farming business than the older people and hence represent the highest percentage of fish farmers in the area.

The table also shows that 76 % of the respondents had tertiary education, while 10 and 5 % had secondary education or had no education, respectively. This shows that fish farming requires certain level of education in terms of management to ensure productivity. Fish farming is a recent innovation in the area, as such is yet to find its roots particularly among the less educated.

Table 1: Socio-economic Characteristics of the Respondents.

	Characteristic	Frequency	Percentage
1.	Age (Years)		
	30 -39	9	42.86
	40 -49	7	33.33
	50 -59	2	9.52
	60 -69	1	4.76
	Co-operative Societies.	2	9.53
	Total	21	100.00
2.	Level of Education (Category)		
	Never been to school	1	4.76
	Koranic/Arabic education	0	0
	Primary education	0	0
	Secondary education	2	9.52
	Tertiary education	16	76.19
	Co-operative societies	2	9.53
	Total:	21	100.00
3.	Household Size (Persons)		
	1 -3	8	38.10
	4 -5	8	38.10
	5 - 6	2	9.52
	7 - 8	10	4.76
	9 -10	0	0.00
	Above 10	0	0.00
	Co-operative society	2	9.53
	Total;	21	100.00
4.	Farm Size (M^2)		
	1 -40	12	57.14
	41 -80	4	19.05
	81 -120	0	0
	121 -160	1	4.76
	161 -200	1	4.76
	201 -240	1	4.76
	241 - 280	2	9.53
	Total:	21	100.00
5.	Experience In Fish Farming (Years)		
	1 - 5	17	80 -95
	6 - 10	4	19 - 05
	11 -15	0	0
	Total:	21	100.00

About 38 % of these respondents had household size of between 4-5 people, while 39% had household size of between 1-3 people, 10 and 5% had household size of between 6-7 and 8-9 people, respectively. The implication of large household size was that farm produce were consumed at home with little or nothing for the market.

Table 1 also reveals that the ponds of 241-280m^2, 42 - 74m^2, 1 - 40m^2 (can also be classified as large, medium and small) constitute 10, 57 and 25 % respectively. The size of the pond may play an important role in farm success, because it reflects availability of capital, access to credit and managerial ability. Further more 81% of the respondents had 1-5 years of experience, while 19 % had 6-10 years of experience.

Cost and Returns Analysis : Table 2 shows that the total cost of production incurred by the respondents was N123,492.21 giving an average cost of N5,880.58 per respondent or N76.00 per m2. The total cost comprise of the variable and fixed costs, from the table, variable costs represent 78 %, while fixed costs accounted for 22 % of the total cost of production. Additionally, feed cost represents 25.27 % while labour cost represents 18 % of the total cost of production. The table also reveals that the gross revenue of the respondents was N253,465. This gave an average gross revenue of

Table 2: Cost and Returns Analysis.

A:	Returns:	Amount (₦) All Respon dents.	Mean cost per Respon dent.	Mean Cost per M^2 of pond	Percentage contribution Total Costs
	Sale of carp	86,460	4,117.14	53.22	34.11
	Sale of Tilapia	58,475	2,784.52	35.99	22.07
	Sale of Clarias	108,530	5,168.09	66.80	42.82
	Total:	253,465	12,069.75	156.01	100.00
B:	Variable Cost				
	Cost of fingerlings	43,836	2,087.43	26.98	35.50
	Cost of feed	31,210	1,486.20	19.21	25.27
	Cost of labour	21,770	1,036.67	13.40	17.62
	Total:	96,816	4,610.30	59.59	78.39
C:	Fixed Costs				
	Depreciation of ponds	3,600.21	171.44	2.21	2.91
	Cost of water	15,450.00	735.71	9.51	12.52
	Depreciation of facilities	1,296.00	61.71	0.79	1.05
	Maintenance cost	6,330.00	301.42	3.89	5.13
	Total:	26,676.02	1,270.28	16.40	21.61
D:	Grand Total: (B+C)	123,492 =	5,880.58	76.00	100.00
E:	Net Income	Value:	Mean Income per respon-dent (=N=)	Mean income per M^2 of Pond (=N=)	
		129,972.80	6,189.20	80	

N12,069.92 per respondent or N156.01 per m^2. The average yield per m^2 was 2.3 kg. The net farm income (NFI) for the respondents was N129,972.80 giving an average net income of N6,189.20 per respondent of N80.00 per m^2. Thus it is profitable to produce fish in the study area.

Regression coefficients from Cobb-Douglas Production Function and Resource use efficiency analysis : The results of Cobb-Douglas Production Function are presented in Table 3. It shows that the coefficient of multiple determination R2 is 82.38 %. This reveals that 82.38 % of the total variation in the dependent variable is explained by variation in the explanatory variables included in the model. The F-ratio is 26.50 and is found to be significant at 5 % probability level, meaning that all the explanatory variables significantly explained the variation in the dependent variable. The table also shows that fingerlings and feed variables are significant at 5 % probability level, while labour is found to be significant at 10 % probability level. The estimated coefficient of fingerlings, feed and labour (X1, X2 and X3) respectively carry a positive sign which indicates that an increase in each of the variables would lead to an increase in the total physical product (TPP) by 0.29 %, 0.50 % and 0.03 %, respectively. Also the estimated coefficients (elasticities of production) are found to be positive but less than 1, indicating that diminishing returns are applied to each of the variable imputs and hence the farmers can be said to operate the stage II (rational stage) of production.

Table 3: Regression coefficients from Cobb-Douglas Production Function and Resource use efficiency Analysis;

A:	Variables	Regression Coefficient	T-values
	Constraint (a)	0.018	0.101
	Fingerlings (x_1)	0.291	3.225*
	Feed (x_2)	0.50	4.853*
	Labour (x_3)	0.036	0.366**

B:	Variable	Marginal value Product (=N=)	Acquisition cost Per Unit of input (=N=)
	Fingerlings	10.30	4.65
	Feed	38.42	8.60
	Labour	9.14	6.05

$R^2 = 82.38$ * F – value = 26.50

* Significant ($P < 0.05$)

** Significant ($P < 0.10$.)

The table also shows that fingerlings have a marginal value product of N10.30. This implies that if other inputs are held constant, increasing fingerlings input by 1 % would increase the total value product by N10.30. The average aquisition cost of fingerling input was N4.65 (less than the marginal value product). This means that the fingerling is being used below below the economic optimal level. Farmers can therefore increase

their profit by increasing their fingerling input. It also shows that feed input has a marginal value product of N38.42. If all other inputs are held constant, increasing feed input by 1 % would increase the total value product by N38.42. The unit cost of this input was N8.60 which is also less than the marginal value product. This implies that feed input is being used below the economic optimal level. Therefore increasing feed can lead to an increased efficiency. The marginal value product of labour input is N9.14 meaning that increasing it by 1 % would increase total value product by N9.14, if all other inputs are held constsnt. The average acquisition cost of labour in the study area was N6.05 (less than the marginal value product). This implies that labour input is being used below its economic optimal level. Thus farmers can increase their efficiency by increasing their labour input.

Constraints to fish farming : The constraints to fish farming in the area are numerous. It is clear from Table 4 that high cost of farm inputs is the most important problem reported by all the respondents. Another constraint that was largely experienced by the respondents was inadequate and untimely delivery of inputs. Except for cases where feeds were compounded locally, 47.61 % of the respondents reported that feeds as well

Table 4: Destribution of respondents according to problems encountered in producing fish

Nature of Problem	No. of respondent (s)	Percentage of total respondents
High cost of inputs	21	100
Inadequate and untimely delivery of inputs	10	47.61
Inadequate water during dry season	9	42.85
Eratic visits by Extension Agents	8	38.09
High cost of contruction of ponds etc	5	23.80

as fingerlings were difficult to procure. Inadequate water during the dry season was another problem that was observed by 42.85 % of respondents. Respondents who were not connected to the state water board had to buy and fill their ponds with water from the water supplies. Eratic visits by extention agents or ineffective extention system was another constraint.

CONCLUSION AND RECOMMENDATIONS

The fishery potentials of the study area are enormous and the economic analysis revealed that fish farming was profitable. However, the current situation indicates that the potentials were grossly underutilised. This is evident from the number of fish farmers in the area. Fish farmers should therefore be encouraged to produce more fish by alternating them from the constraints identified to be militating against their production. Thus this study recommends the following:

1. Establishment of state owned feedmill to produce fish feeds as well as other livestock feeds and to develop effective distribution channels, so as to guarantee ready availablilty of fish feed at low price.
2. Improve the activities of the fishery extension unit of the state ministry of Agriculture and BSADP to enhance regular visits of farmers.
3. Embark on public enlightenment campaign on the existence and technology of aquaculture, as well as establish state owned fish farms in each Local Government Area.
4. Provision of regular water supply and credit facilities. This measure will encourage the farmers to stay in the business.

Acknowledgement

Our thanks and appreciation go to all the staff of Bauchi State Agricultural Development Project, Fishery Unit, for making this research a success. Thanks also go to Abubakar Tafawa Balewa University for moral support.

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