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Determinants and Resource-Use Efficiency of Catfish Production in Kumbotso Local Government Area of Kano State, Nigeria

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Abstract: The study was carried out to determine the efficiency of resource use for catfish production in Kumbotso Local Government Area, Kano State, Nigeria. From the study area, Guringawa, Kumbotso, Panshekara, Mariri and Danmaliki wards were purposively selected due to high concentration. A list collected from the Department of Agriculture consists of 95 Catfish producers and 65% of them were randomly selected using balloting, making a total of 62 respondents. Data collected from catfish producers were analyzed using regression analysis of the production function model. Results of the study revealed that; catfish producers had a mean age of 34, mean household size of 6 individuals, mean years of education of 7 and mean years of experience of 4. The study also revealed that there is significant relationship between the inputs used for production of catfish and the output. Feed and pond size were found to have significant effect at 1%, fingerlings at 5% and labour at 10%. While fuel, lime and antibiotics were not significant. The result also revealed that labour and lime were over-utilized, while feed, pond, fingerlings, fuel and antibiotics were under-utilized. Cost of feeds was the major constraint to catfish production in the area. The study recommended that catfish producers should adjust the use of production inputs so as to achieve efficiency which will increase their output as well as income which will in turn improve their standard of living. Fish farmers should also be trained by government and NGOs in feed formulation techniques to make feed by themselves.

Keywords: Determinants, Resource-Use Efficiency, Catfish, Production

1. Introduction

Fish farming is the art and science of controlled rearing of fish in ponds, farms and in some instances natural water bodies from hatchlings (freshly hatched fishes) to mature size. It therefore, involves the controlled feeding, fertilization, stocking combination, reproduction and harvesting of fish [3]. Fish farming may have started more than 50years ago with the establishment of small experimental station at Onikan, Lagos State and an industrial farm about 20ha at Panyan, Plateau State by the Federal Government of Nigeria [13]. Presently fish culture has spread to all states in the country. Fish culture has been established as the best alternative to bridge the widening gap between the demand for and supply of food fish in the country [19]. The Food and Agriculture Organization recommends that an individual should take 35g/caput/day of animal protein for sustainable growth and development [16].

Earlier, the animal protein consumption in Nigeria was less than 8 g per person per day, which was far below the FAO minimum recommendation [9]. The major animal protein sources in the country include cattle, goats, sheep, poultry and fish. Out of these sources, fish and fish products provide more than 60% of the total protein intake in adults especially in the rural areas [2] Therefore, the importance of the fish industry to the sustainability of animal protein supply in the country cannot be over- emphasized.

There has been a historic decline in the supply of fish in Nigeria. This is due to the decline in the country's major source of food fish, the artisanal fisheries [18]. The shortfall is reported to be bridged by the importation of 680,000 metric tons annually consuming about N50 billion in foreign exchange [11]. Adediran (2002) and Ugwumba (2005) have buttressed the importance of catfish production in boosting fish production and moving the country towards self-sufficiency in fish production [1, 17]. He also noted that this prompted the Federal Government of Nigeria to package the Presidential Initiative on fisheries and aquaculture development in 2003 to provide financial and technical assistance to government programs and projects encouraging fish production [18].

In Nigeria despite all efforts of past agricultural policies to fight food insecurity, there is worsening nutritional deficiency, which is manifesting in widespread hunger and malnutrition due to the inability of the county's food production rate of 2.5% to meet the food demand rate of 3.5% in the face of the ever rising population rate of 2.83% [12]. There are indications that the development of efficiency of fish farming in Nigeria can be a bridge towards solving this problem of nutritional imbalance and low income especially among farmers in the country [5, 12]. Despite these challenges, still catfish production in Nigeria is profitable [6, 14, 15] and improvement in the efficiency of production can improve the profit margin, thereby increasing the income of the catfish farmers. This would eventually move them away from poverty. Hence the need for this study to assess the level of resource-use efficiency of catfish farmers and constraints bedeviling the venture.

2. Methodology

The study was carried out in Kumbotso local government area, It's headquarter is located in Kumbotso town. It has an area of 158km^2 and a population of 295,979 as at 2006 census [8]. The Local Government is bordered by Gwale from the north, Madobi from the west, Kano Municipal and Tarauni from the east, Dawakin Kudu and Kura from the south.

Purposive sampling technique was employed to select five (5) wards out of the existing 11 wards in the study area based on the intensity and concentration of catfish farming. These five wards are: Guringawa, Kumbotso, Mariri, Panshekara and Danmaliki. A list of catfish farmers was collected from the Department of Agriculture of the Local Government, containing a total of ninety five (95) was used as a sampling frame. From each of the five (5) wards, 65% of the total population of catfish producers was randomly selected using balloting, to come up with a sample size of 62 respondents. Data were collected with the aid of questionnaire and analyzed using descriptive statistics, range, mean and regression of the production function model.

The production function is expressed as a function of the explanatory variables showing the relationship between dependent variable (Y) and independent variables (X_n). Linear, semi-log and double-log functional forms were tested and the one that gave the best fit was double log function and was therefore selected. The choice of the best functional form was based on both statistical and econometric criteria. The implicit form of the model is expressed as follows:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, e) \quad (1)$$

Where:
Y = dependent variable (Output),
$X_1, X_2, \ldots\ldots X_7$ = independent variables,
e = error term,
Explicit Double log function:

$$\log Y = \alpha + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \beta_4 \log X_4 + \beta_5 \log X_5 + \beta_6 \log X_6 + \beta_7 \log X_7 + e \quad (2)$$

Where:
Y = Output of catfish production (Kg),
α= constant,
$\beta_1 - \beta_7$= Regression co-efficients,
X_1 = Labour (man/day),
X_2 = Feed (Kg),
X_3 = Pond size (m^3),
X_4= Fingerlings (units),
X_5 =Fuel (litre),
X_6 = lime (Kg),
X_7 = Antibiotics (litre),
e = Error term.

In order to ascertain whether resources were efficiently utilized, the Marginal Value Product (MVP) of labour, feed, pond, fingerlings, fuel, lime and antibiotics were computed and then compared with their input prices. Since these variables were expressed in physical quantities in the function estimated, the MVPs of those variables were compared with their unit prices to determine the degree of efficiency in their usage. That is:

$$MVPxi = MPPxi.Py \quad (3)$$

Where:
MVPxi = Marginal Value Product of ith input,
Py = farm gate price of catfish,
MPPxi = Marginal Physical Product of the ith input,
dy = change in quantity of output dxi = change in quantity of ith input.

The marginal value product (MVP) was divided by the cost of one unit of the input (marginal factor cost) to make influence on resource use efficiency. In order to make the

relative efficiency of resource use the following ratio was computed:

$$r = \frac{MVP}{MFC} \quad (4)$$

Where:
r = efficiency ratio,
MVP = Marginal Value Product,
MFC = P_{xi} = Marginal Factor Cost.
If:
r = 1 resource is efficiently used (MVP = MFC),
r > 1 resource is under-utilized (MVP > MFC),
r < 1 resources is over-utilized (MVP < MFC).

3. Results and Discussion

The socio economic variables identified include age, household size, level of education and years of experience. These variables are presented in Table 1. Younger and middle aged individuals are known to be active and innovative [3]. The result of the study in Table 1 revealed that catfish producers had minimum and maximum ages of 21 and 70 years respectively with a mean of 34 years. This implies that most of the respondents fall within the active age are strong and capable of making good production decision and have potentials for greater productivity. They are also expected to be in a position to effectively utilize resources available to them [10]. Household size refers to a group of people related or not related staying together under the same roof in the same house and share the same food and think for themselves as a unit [4]. The household size is important in analyzing home consumption rate, home expenditure and in supply of labour in production and management. The results in Table 1 revealed that the household size of catfish producers ranged from 1 to 20 with a mean of 6 which is beyond the national average of 5 reported by National Bureau of Statistics [7]. High number of household could be due to the high rate of polygamy marriage in the study area, and having large household size is considered a source of pride and a source of family labour that will reduce the cost being spent for hired labour.

Years of experience are collection of events and activities in a particular instance of personality encountering or undergoing something. The years of experience serve as a basis for making more precise production decisions and taking appropriate actions, the more the years of experience the more precise the decision making. The result in Table 1 revealed that catfish producers had a minimum of 1 year of experience and a maximum of 15 years with an average of 4 years. This implies that majority of catfish producers have not been in production for quite long period of time.

Educational status of catfish producers affects their level of responsiveness to new innovation or adoption of new innovation. The higher the educational statuses the higher the chances of adopting innovations which will in turn positively affect production. The result in Table 1 revealed that the formal education attainment of catfish producers ranged from 0 to 16 with a mean of 7. This signifies that most of the catfish producers are educated and are therefore expected to adopt new technologies easily.

Table 1. *Age, Household size, years of education, and years of experience.*

Variables	Minimum	Maximum	Mean
Age	21	70	34.23
Household Size	1	20	6.29
Years of Education	0	16	7
Years of Experience	1	15	4.23

4. Determinants of Catfish Production

Production function model was used to determine the relationship between the output (dependent variable) and inputs (independent variables) such as labour, feed, Land, fingerlings, fuel, lime and anti-biotic. The choice of the functional form that is Cobb Douglas was determined after comparing all the functional forms using different statistical criteria. Table 2 presents the estimated regression result of catfish production.

Table 2 shows the result of multiple regression analysis; R^2 was found to be 0.926, which means that about 93% of the total variation in the dependent variable was explained by independent variables included in the model. The remaining 7% was due to error or random disturbance. Also R^2 adjusted was found to be 0.917 which confirms the fitness of the model. F-statistics was found to be 97.196 and significant at 1% which measures the joint significance of all explanatory variables in the model. The T-values indicated the fitness of individual variables.

The coefficients of exogenous variables in the model represent elastic ties, which indicate the change in yield relative to change in input. The results revealed that the coefficient of labour has a positive value of 1.937 and was found to be significant at 1% which implies that an increase in labour by 1 manday will lead to an increase in the quantity of catfish produced by 1.937kg. Feed has a positive significance of 0.637 which means an increase in feed by 1Kg will increase the output by 0.637Kg. It was also revealed that pond size has a positive value of 0.252 which signifies an increase in pond size by $1m^3$ will increase the output by 0.252Kg; this simply means giving fish more space will ease movement, thereby improving digestion and gives room to more feed consumption which will lead to increase in output. Coefficient of fingerlings was also found to be positively significant at 5% and has a value of 0.205. Which means an increase in fingerlings by one will lead to an increase in the quantity of output by 0.205Kg.

Results of the study also revealed that the coefficient of fuel has positive coefficient of 0.136 and it was not significant, meaning that an increase in fuel by 1 litre to provide water will increase the output by 0.136Kg. It was found that lime has a negative coefficient of -0.055 and was not significant, revealing that an increase in lime by 1Kg will lead to decrease in output by 0.055Kg, sometimes causing skin damage. Furthermore, it was found that the coefficient

of antibiotics was positive with a value of 0.044 and not significant. Which means an increase in the quantity of antibiotics by 1 litre will lead to an increase in yield by 0.044Kg.

Table 2. *Estimates of Cobb-Douglas Regression Result for Catfish Production.*

Variables	Coefficient	Standard error	t-value	Significance level
Constant	-0.980	0.324	-3.025	0.004**
Labour (man/day)	- 1.937	0.078	-24.833	0.000***
Feed (kg)	0.637	0.082	7.768	0.000***
Pond size (m^3)	0.252	0.066	3.818	0.000***
Fingerlings (unit)	0.205	0.064	3.203	0.002**
Fuel (litre)	0.136	0.084	1.619	0.110^{ns}
Lime (kg)	-0.055	0.061	-0.902	0.368^{ns}
Antibiotic (litre)	0.044	0.054	0.815	0.423^{ns}
$R^2 = 0.926$				
R^2 adjusted = 0.917				0.000***
F–statistics =97.196				

***P<0.01 Significant at 1%
**P<0.1 Significant at 5%.

5. Resource-Use Efficiency of Catfish Production

Coefficient of each of the variables as obtained from production function analysis was used in the computation of marginal value product of that variable. The ratio of marginal value product (MVP) to marginal factor cost (MFC) gives 'r' which is the efficiency ratio. Table 3 presents the result of resource use efficiency. Based on the results obtained, it was found that labour and lime were over-utilized, while feed, land, fingerlings, fuel and anti-biotics were under-utilized. The result of this research indicated that the catfish producers in the area of study do not achieve absolute efficiency because they do not achieve optimal utilization of the resources they use.

Table 3. *Resource Use Efficiency of Catfish Production.*

Variables	Coefficient	MVP	MFC	R	Decision
Labour (man/day)	-1.937	-15,896	200	-79.48	Over-utilization
Feed (Kg)	0.637	768.71	500	1.54	Under-utilization
Pond size (m^3)	0.252	4,329.50	3000	1.44	Under-utilization
Fingerlings (units)	0.205	2,147	20	107.35	Under-utilization
Fuel (litre)	0.136	39,118.74	145	269.78	Under-utilization
Lime (Kg)	-0.055	-11,087.58	50	-221.75	Over-utilization
Antibiotic (litre)	0.044	4,941.891	850	5.81	Under-utilization

6. Constraints to Catfish Production

The constraints associated with catfish production are presented in Table 4. It is obvious that the most glaring constraint of catfish farmers in the area of study were high cost of feed (90.3%), followed by high cost of pond (56.5%), inadequate quality fingerlings (43.5%), insufficient capital/finance (32.3%), high cost of labour (30.7%) mortality of fish (24.2%), diseases (19.4%), and finally high cost of transportation (11.3%). High cost of feed was found to be the predominant constraint faced by farmers in the study area which is as a result of low production of fish feed in the country that can't satisfy farmers need and therefore has to be imported from other countries. All problems identified affect catfish production negatively leading to low productivity.

Table 4. *Constraints associated with Catfish Production.*

Constraint	Frequency	Percentage (%)	Ranking
High cost of feed	56	90.3	1
High cost of pond	35	56.5	2
Inadequate quality fingerlings	27	43.5	3
Insufficient capital/finance	20	32.3	4
High cost of labour	19	30.7	5
Fish Mortality	15	24.2	6
Diseases	12	19.4	7
High cost of transportation	7	11.3	8

7. Conclusion and Recommendations

The study was carried out to analyze the efficiency of resources used for catfish production in Kumbotso Local Government Area, Kano State, Nigeria. The study showed that the producers fall within the active age capable of undertaking all activities needed to produce catfish, with a large household size which provides the production activity with the labour necessary for catfish production thereby reducing the use of hired labour, low level of education and low years of experience. It also indicated that none of the resources used for catfish production in the study area was efficiently utilized. Feed, pond size, fingerlings, fuel and antibiotics were found to be under-utilized which is due to the high cost of production inputs and lack of financial support which will help catfish producers in achieving production efficiency. Furthermore, the study also revealed that labour and lime were over-utilized. Major constraint to catfish production in the study area was found to be high cost of feeds. The study recommended that catfish producers should adjust the use of some production inputs so as to achieve efficiency, also government and other financial institutions should help with some financial assistance in form of subsidies or loan to catfish producers so that they can afford to use the inputs efficiently. Catfish producers should seek knowledge of catfish production by trying to attend seminars organized by catfish producers associations. Also, fish farmers should also be trained by government and NGOs in feed formulation techniques to make feed by themselves.

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