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MANAGEMENT SYSTEM AND PRODUCTION OF AFRICAN CATFISH (*Clarias gariepinus*) IN EBONYI STATE, NIGERIA

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Abstract
This study analyzed the management system and constraints of African catfish production in Ebonyi State, Nigeria. The specific objectives were to describe the management systems adopted by African catfish producers in Ebonyi State, to determine the socio-economic determinants of African catfish production in the region, to determine the factors influencing the management of the African catfish and to examine the constraints to the production of African catfish in the study area. Four local government areas were purposely selected from each of which two communities were chosen and from which twenty African catfish producers were randomly selected to give a total of eighty respondents for the study. Descriptive statistical tools and ordinary least squares estimators were used to analyze the objectives. Most African catfish producers (44.40%) adopted the intensive African catfish management system, they preferred to keep their fish in home fish ponds, while few of them (17, 1%) practised the extensive African catfish management system in which they breed their catfish. fish in streams, rivers, lakes and ponds built outside their homes. Gender, number of workers and income of the African catfish were the socio-economic determinants of African catfish production. Cost of labour, the cost of drugs and the cost of fingerling were the cost factors influencing management and production. Lack of readily available skilled labour was the greatest constraint, while storage was the least constraint. It was recommended that catfish producers should improve their socio-economic characteristics such as experience, income from another profession, level of education and number of workers in order to improve their management system as well as their performance.

Keywords: African catfish management, African catfish production, Ebonyi State

Introduction

The management of natural resources all over the world is of paramount importance for the sustainability of natural resources in developing countries like Nigeria. Sarch, *et al*., (1997) identified and distinguished three main typologies of fisheries management systems, namely: Traditional systems - classified as management systems operated by the administration of traditional authorities; Mixed systems - involve the participation (intentionally or inadvertently) of both traditional and modern government administrations; Modern systems - include those operated by central government administrations where fisheries regulations are enforced by officers of fisheries departments. All three management systems are functioning in Nigeria (Ladu, *et. al*., 2000; Neiland *et. al.* 2002). By way of comparison, the type of mixed system is the most widespread (56%), followed by the traditional, with 33%, while the modern, representing only 11%. In terms of performance, traditional management systems, although in second place (33%) are the most effective, especially at the local community level (Bene *et. al*., 2003). The various management systems described above have also contributed to the sustainability of the fishing industry. While the mixed system is dominant, the traditional management system is ubiquitous and seems to work very effectively in regulating fishing activities for the benefit of both the main actors (fishermen, processors, etc.) and the resource itself (Ovie and Raji, 2006). Fish farming is the main form of aquaculture which involves the commercial farming of fish in tanks or pens, usually for food. It is also a system developed to complement an endangered species. Fishing occupies a unique position in the agricultural sector of the Nigerian economy. In terms of Gross Domestic Product (GDP), the fisheries sub-sector has

recorded the fastest growth rate of agriculture relative to GDP. The contribution of the fisheries sub-sector to GDP at current factor costs in 2010 increased from N 76.76 billion to N 162.61 billion in 2015 (CBN Report, 2015). Fish is an important source of protein for the large grouped population of Nigeria. It has been observed that 40% of the dietary animal protein intake of consumers in Nigeria is derived from fish (FDF, 1997), etc. For instance, in the rural areas of the country, over 60% of total protein intake in adults is obtained from fish and fishery products (Adekoya, 2004). According to Adekoya (2004), fish and fishery products constitute over 60% of total protein intake in adults, especially in rural areas. Nigerians are heavy consumers of fish with an estimated demand of 1.4 million metric tonnes. However, there is a demand-supply gap of at least 0.7 million metric tonnes nationally, with imports making up for the shortfall at a cost of nearly US $ 0.5 billion per year. National fish production of around 500,000 metric tonnes is provided by artisanal fishermen (85%), despite overfishing in many water bodies across the country (Adekoya, 2004). According to Shimang, (2005) Nigeria which occupies 923,768km^2 of land with a continental shelf of 47,934 km^2 and coastal lenght of 853km also has rivers, floodplains, lakes and natural and man-made reservoirs. The inland water body has been estimated to be around 12.5 million hectares of inland water capable of producing 512,000 metric tonnes of fish per year (Ita, 1984; and Shimang, 2005). Ebonyi State has a fair share of the vast fishery resources. These include rivers, dams and ponds where many fishing activities take place. Despite these considerably high potentials, local fish production has failed to meet the country's domestic demand (FAO, 2016; Ogunniyi, 2009). The fish industry remains the most pristine investment in Nigeria compared to importing frozen fish into the domestic market (Ndu, 2006). One sure way to substantially resolve the gap between supply and demand is to engage in large scale on-farm / small-scale fish production. However, the sources of this effort must be anchored on the analysis of fish production (FDF, 2008).

The catfish of the claridae family is the most commonly cultivated fish in Ebonyi state. The cultivated fish species are *Clarias gariepinus, Tilapia spp and heterobranchus spp.* Catfish is widely cultivated due to its strong preference, good marketability, rapid growth rate, good feed conversion rate, high disease resistance, low mortality rate and can survive in running and stagnant water can have a marked value size two to three times that of tilapia. They are able to transform their feed into flesh about twice as efficiently as chicken and five times as efficiently as beef cattle. The feed conversion rates of fish are higher than those of other common commercial animal protein sources because fish can utilize feed not used by most land animals. Again, aquaculture products can compete favourably in terms of price with chicken (Ogunniyi, 2009). Catfish production has the capacity to provide employment for young Nigerian team members if properly managed (Emmanuel *et al*., 2014). Despite the popularity of African catfish and its great market potential in Ebonyi State, the level of production is still not sufficient for consumers in the State, and this is due to several factors negatively influencing its production productivity. Insufficient supply of local fish farmers due to use of poor quality fry, insufficient information on catfish production, high feed cost, the small size of farms, inefficient use resources, poor infrastructure, lack of credit, lack of extension agents, lack of veterinarians (fisheries specialists) and lack of fish production equipment and low capital investment were put forward by the literature for the constant decline (Inoni, 2007). There is less emphasis on good management, especially of fisheries and other aquatic resources in Ebonyi State. This is due to the lack of awareness and information among rural people who are closer to these natural resources. However, the government recognizes some problems with existing production systems such as standing water pond systems; flow-through systems; and recirculation systems that fail to deliver the expected performance due to inadequate design of ponds and reservoirs to fit a production plan. In addition, some catfish producers do not adhere to the efficient use of feed, as they do not recognize the concept of QFEM (a qualitative measure of feed efficiency) and are unable to adapt to the rate of feed to maximize its effectiveness. Likewise, water quality management was often poor, with no monitoring of biomass, ammonia content among others. Producers do not monitor key production indicators such as population growth and size distribution (NBF, 2013). Consumers who have a strong taste for catfish cannot easily get to where they can buy catfish, and even if they end up gaining access to such places, the prices are high and that is a real problem for these consumers. In general, therefore, fisheries management systems in Nigeria can be described as variable and hampered by poor financial support for policy implementation (Nze and Onwumere, 2017). The sustainability of the fishing industry has also been affected by exogenous factors such as increasing human population, deforestation, poverty and demand for food. All of these factors have combined to put undue pressure on natural resources and therefore threaten the sustainability of fisheries. Neiland *et al.* (2002) identified four key issues facing fisheries management and sustainability that have general application and relevance to Nigerian inland fisheries in general. These are mainly environmental changes, exogenous factors, fisheries management and fisheries policy and implementation. The general objective of the study was to analyze the management system and production of African catfish production in Ebonyi State, Nigeria.

Methodology

This study was based on primary data, obtained from a cross-sectional survey of African catfish breeding farms in the Ebonyi South agricultural area in Ebonyi State. The study area is one of three areas that make up the state in the rainforest zone of southeastern Nigeria, the others being Ebonyi North and Ebonyi Central. The study area, the Ebonyi South Agricultural Zone, comprises five local governments, namely: Ivo, Afikpo North, Afikpo

South, Ohaozara and Onicha. The required information was obtained through personal structural questionnaires administered to a target sample of eighty (80) catfish producers. The farms were selected using a two-step sampling process. In the first stage, four (4) L.G.A. areas, namely Ivo, Afikpo South, Onicha and Ohaozara, were selected due to the intensity of the catfish industry in these areas. During the second stage, twenty (20) African catfish farms were selected in each of the four Local Government Areas according to their population. Descriptive statistical tools were and ordinary least squares estimators (Gujarati and Porter, 2009).

Model specification:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7 \text{ and } X_8)$
Where Y = Total Output of Catfish (kg)
X_1 = Experience (years)
X_2 = Age (years)
X_3 = Gender (male = 1, female =0)
X_4 = Education level (years)
X_5 = Income from other occupations (N)
X_6 = Number of workers (number)
X_7 = Income from catfish (N)
X_8 = Pond size (m^2)

$Y = f(X_1, X_2, X_3, X_4, \text{ and } X_5)$
Where Y = Catfish Management (Total Revenue from Fish (N)
X_1= Labor Cost (N)
X_2 = Feed Cost (N)
X_3= Depreciated charges (N)
X_4= Cost of drugs (N)
X_5= Cost of fingerlings (N)

Results and Discussion

Management system adopted by respondents in the study area

The catfish management system adopted by respondents in the study area is presented in Table 1. According to the table, the majority of respondents (44.4%) adopted the intensive catfish farming system. These catfish producers preferred to keep their fish in ponds at home. They preferred to provide food and medicine for intensive fishing, keeping them away from thieves, predators and monitoring production on a daily basis. Few of them (17.1%) practiced the extensive catfish management system of raising their fish in streams, rivers, lakes and ponds built outside their homes. This may be due to the fact that most of the fish farmers in the study area were engaged in some activity to earn additional income to help them increase their income which may not be sufficient to meet their needs. This consolidates with Filli *et al*. (2016) and Nze and Onwumere, (2017). However, 38.5% adopted both intensive and extensive systems.

Determinants of Output of Catfish Production

Multiple regression analysis of four functional forms was performed to determine the socio-economic determinants of catfish production as shown in Table 2. The semi-log functional form was chosen as the main equation. The coefficient of multiple determinations (R^2) was 0.519, implying that 51.9% of the product variations in catfish production were explained by the variables of the estimated model. The f ratio was statistically significant at 1%, indicating the goodness of fit of the model. Significant variables included sex, number of workers, and catfish income. Gender was statistically significant at the 10.0% risk level with a negative sign. This meant that the more male sex was involved in catfish production, the lower the yield. This is not in line with expectations a priori because it was expected that a greater number of men would give more yield given their strength and the energy provisions necessary for production. The implication could be that the male in the study area did not view catfish production as a primary source of livelihood and, as such, spent minimal time and energy on production. This is in accordance with the conclusions of Filli *et al*. (2016) who stated that fish farming should complement the main occupation of fish farmers where fish farming is not the main occupation. The coefficient for the number of workers was significant at 1.0% and positively related to output. This implied that as the number of workers increased, the production of catfish increased. This may be due to the fact that the increase in the number of workers must have helped to carry out the production activities, thus increasing the quantity produced. This is in line with a priori expectations and is in line with the conclusions of Ogunniyi (2009). Income was significant at 10.0% and positively related to catfish production. This meant that the higher the income of the catfish, the higher its production, which is in line with a priori expectations.

Cost Factors Influencing African Catfish Management in the Study Area

The cost factors influencing the management of African catfish in the study area are shown in Table 3. According to the table, the variables that were significant included the cost of labour, the cost of drugs and the cost of the fingerlings. The labour cost coefficient was significant at 5.0% and positively related to catfish management. This meant that as the cost of labour increased, it also led to an increase in the level of management of the catfish. This may be due to the expansion of production which required more labour to cope with the expansion of production. According to Filli *et al*. (2016), labour is employed on the basis of quantity in terms of numbers and quality in terms of skills required for increased efficiency and optimal performance. The cost of drugs was statistically significant at 1.0% with a positive sign, meaning that the increase in the cost of drugs led to a higher level of management. The fingerlings cost coefficient (11.305) was statistically significant at a 1.0% risk level with a positive relationship to catfish management, meaning that as the management level improved, the cost of fingerlings was also increasing. A high level of management will result in high-quality fry with a high price.

Constraints Militating against African Catfish Production in the Study Area

Factors affecting fish production are presented in Table

4, indicating that the most important constraints encountered in fish production were capital, power supply, water supply and diseases and pests, as indicated by 88, 75%, 72.50, 72.50 and 62.50% of the respondents, respectively. Poor power supply results in high cost of water supply. Regarding marketing, the farmers indicated that they were faced with the problem of the lack of an organized fish marketing system, which led all the farmers to sell their live fish on the farmers' farm gate. Fish production was positively affected by efficient delivery of fingerlings / juveniles resulting in high mortality rate and feed for fish farmers. In addition, the fish was sold alive and therefore storage / preservation were not a problem.

Conclusion

In conclusion, it can be deduced that most of the catfish producers in Ebonyi State, Nigeria (44.40%) adopted the intensive catfish management system, they preferred to keep their fish in home ponds, while few of them (17.1%), practiced the extensive catfish management system. Gender, number of workers and income of the catfish were the socio-economic determinants of catfish production. The cost of labour, drugs and fingerlings were the cost factors influencing management and production. The lack of readily available skilled labour was the greatest constraint, while the lack of an organized market was the least constraint. It was recommended that catfish producers improve their socio-economic characteristics such as experience, age, income, education level and number of workers in order to improve their management system as well as their performance.

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Table 1: Catfish Management System in the Study area

Management System	Percentage
Extensive Farming System	17.10
Intensive and Extensive Farming System	38.50
Intensive Farming System	44.40

Source: Computed from survey data, 2021

Table 2: Multiple Regression Result on Socio-economic Determinants of output of Catfish Production

Variables	Linear	Exponential	+Semi-log	Double-log
Constant	925115.711	11.659	1.069E6	10.587
	(2.862)***	(15.493) ***	(4.170)***	(6.776)***
Experience	-76981.589	-0.114	-14402.523	-0.263
(X_1)	(-1.862)*	(-1.478)	(-1.417)	(-1.046)
Age	-2767.841	0.012	-6524.242	0.182
(X_2)	(-0.594)	(0.173)	(-0.061)	(0.519)
Gender	-10023.587	-0.142	-52634.515	-0.089
(X_3)	(-0.786)	(0.637)	(-1.565)*	(-1.302)
Education level	-14676.448	-0.012	-5614.117	0.113
(X_4)	(-1.629)*	(-0.649)	(-0.181)	(0.675)
Income from other Occupation(X_5)	-0.134	-3.848E-7	-41766.779	0.038
	(-0.778)	(-1.031)	(-0.241)	(0.089
Number of workers	44751.335	0.138	240669.689	0.631
(X_6)	(2.024)**	(2.984)***	(3.303)***	(3.436)***
Income from catfish	18556.84	0.232	234550.842	0.651
(X7)	(0.167)	(0.903)	(1.770)*	(1.825)*
Pond size	9558.964	0.014	26324.937	0.064
(X_8)	(0.121)	(0.437)	(0.798)	(0.709)
R^2	0.384	0.269	0.519	0.532
R^{-2}	0.156	0.172	0.414	0.464
F-ratio	12.882***	13.130***	14.781***	2.951***

Source: Computed from survey data, 2021

Key: *** =1.0 percent, ** =5.0 percent and *=10.0 percent level of significance

+ = lead equation

Table 3: Multiple Regression Result on Cost Factors Influencing Catfish Management in the Study Area

Explanatory Variables	Linear	Exponential	+Semi-log	Double-log
Constant	2.387E6	11.673	-2.064E7	9.158
(b_0)	(6.802)***	(114.834)***	(-5.614)***	(9.827)***
Labor cost	8.364	8.951E-7	71171.879	0.243
(X_1)	(2.610)**	(0.678)	(2.802)***	(2.641)**
Feed cost	-0.440	2.276E-8	50347.562	0.027
(X_2)	(-0.332)	(0.053)	(0.816)	(0.027)
Depreciation charges	-253.660	-5.888E-5	121524.573	-0.142
(X_3)	(-0.717)	(-0.373)	(0.231)	(-0.870)
Cost of drugs	73.757	9.530E-2	212304.213	0.092
(X_4)	(2.980)***	(0.774)	(0.678)	(0.781)
Cost of fingerlings	11.821	7.725E-6	11.305	0.271
(X_5)	(3.123)***	(2.310)**	(3.733)***	(1.110)
R^2	0.823	0.514	0.663	0.567
R^{-2}	0.766	0.473	0.624	0.553
F-ratio	49.248***	11.417***	17.214***	12.552***

Source: Computed from survey data, 2021.
Key: *** =1percent, ** =5percent and *=10percent level of significance
+ = lead equation

Table 4: Constraints encountered in fish production (N = 80)

Constraints	Number of respondents with problems	Percent of respondents
Skilled labor	74	92.5
Supply of fingerlings/ juveniles	4	5.00
Availability of feed	4	5.00
Water supply	58	72.50
Capital/finance	71	88.75
Disease and pest	50	62.50
Lack of organized market	48	60.00
Transportation	4	5.00
Storage	2	2.50
Power supply	58	72.50

Source: Computed from survey data, 2021