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Assessment of Adoption of Improved Fish Pond Management Technologies among Fish Growers in Benue State, Nigeria

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Abstract

The study assessed adoption of improved fish pond management technologies among fish growers in Benue State, Nigeria. Stratified, purposive and simple random sampling techniques were used in selecting 221 respondents. Primary data were collected using structured questionnaire. Data collected were analysed using both descriptive such as frequency distribution tables and inferential statistics such as Kruskal Wallis H test and factor analysis. The results revealed that 88.7% of the respondents used concrete ponds in fish production. One of the major sources of information on improved fish pond management technologies was from friends/neighbour/relation 93.7%. Socio-economic characteristics of innovations and politico-cultural cum ecological constraints were faced by the fish growers. The results of Kruskal Wallis analysis indicated that there was no significant difference (P> 0.05) in adoption of improved fish pond management technologies among fish growers in the three agricultural zones. It was therefore recommended that more efforts should be made to ensure that improved fish pond management technologies are adopted by fish growers.

1. Introduction

Fish farming is the breeding and rearing of fish in ponds or any enclosure for direct harvest of the product Usman, (2014). Its production provides employment opportunities to millions of people and serves as a source of foreign exchange earnings to many countries. (Adewuyi et al., 2010). According to Adebayo, (2008), it is also an important source of rich protein and provides about 40% of the protein intake for nearly two third of the world's human population. Fish is a good source of vitamins (A, D, E and K) which makes it one of the protective foods for human beings. It is preferred for its lysine, methionine, iron, calcium, iodine, copper, magnesium and phosphorus content which are relatively in greater proportion than in many other foods.

The aquaculture sub sector contributes between 0.5% and 1% to Nigeria's domestic fish production as revealed by (Adewuyi *et al*., 2010). Adesina, (2014) observed that the country spends about N125 billion (N220/ US$1) every year on fish importation in order to meet its demand which is estimated at 2.7 million metric tonnes. The rapid increase in population in Nigeria, has led to increase in the demand for animal protein (which is essentially higher in quality than plant protein). The average protein intake in Nigeria which is about 19.38/output/day is low and far below FAO requirement of 65 g/output/day. Adewuyi, et al. (2010) further observed that the nutritional requirement is particularly crucial in a developing country like Nigeria where malnutrition and starvation are the major problems faced by millions of rural dwellers. The malnutrition and starvation are an indication of shortage of high quality protein food in the diet of Nigerians. Despite the increase in the major sources of animal protein such as livestock and poultry industries, the problem of protein deficiency

still continues unabated. The protein deficiency in diet is equally associated with the inability of fish farming industry to supply the required quantity and quantity of fish (Usman et al., 2016) The aim of fish culture principally is to produce quality fish food for human consumption. It is also to enhance culture based fishery by providing enough fingerlings for re-stocking open waters like ponds. Fish culture also provides additional income to farmers and their families, thereby alleviating poverty particularly among the rural populace (Alali, 2013).

Ponds are the most widely used structures for fish culture in Nigeria. A fish pond is an artificial structure used for the cultivation of fish. It is filled with fresh water, fairly shallow and usually non-flowing (Akankali *et al*., 2011). Good fish culture depends on pond construction and watershed management, removal of unwanted and overpopulated species of fish, liming and/or fertilization, fish species selection and stocking, harvest and record keeping as well as evaluation of pond balance and weed control (Aali, 2013). The size of fish pond varies between 0.02 and 0.20 ha for small-scale earthen ponds, 25-40m^2 for homestead concrete tanks and 3 ha and above for commercial farms (Keremah and Esquire, 2014). At present, most fish farmers operate small-scale farms ranging from homestead concrete ponds (25 – 40 square meters) to small earthen ponds (0.02 - 0.2 hectares) (Olaoye *et* al., 2013). The simplest and best way to manage a pond is to prepare bottom soil, fill the pond with water, stock it with the right fish in the right quantity, feed the fish and keep the water fertilized, keep the pond in good order and crop the pond by removing the fish. Therefore, adoption of improved management technologies will enhance successful culture and high yield of fish (Akankali et al., 2011).

The adoption of new technologies by fish farmers is very important for agricultural development. For quite sometimes, a lot of fishery technologies had been introduced by research institutes, federal and state ministries of agriculture and other related organizations concerned with fishery innovations, but the response of the farmers had been negligible. there is therefore need to investigate this scenario

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2. Materials and methods

This study was conducted in Benue State, Nigeria. The State is located in the middle belt region of Nigeria, which is the transition zone from the Northern and Southern ecologies. It lies between latitudes 6^0 30'N and 8^0 10'N and longitude 6^0 31'E and 10^0 E (Benue State Agricultural and Rural Development Authority) (BNARDA, 2005). The State shares boundaries with five other States: Nasarawa to the North, Taraba to the East, Cross River to the South East, Enugu (South West) and Kogi to the West. The Southern part of the State is also bounded with the Republic of Cameroon (BNARDA, 2005)

Benue State has a land mass of about 33,955Km^2 with 23 Local Governments Areas (LGAs). The State is geographically and agriculturally divided into three zones, Zone A (Kastina-Ala, Ukum, Ushongo, Vandeiikya, Logo, Kwande and Konshisha Local Government Areas), Zone B (Gboko, Tarka, Buruku, Gwer-West, Gwer-East, Guma and Makurdi Local Government Areas), Zone C (Ado, Agatu, Apa, Otukpo, Ohimini, Okpokwu, Ogbadibo, Obi and Oju Local Government Areas). The State has a total population of 4,219,244 and a projected total population of 5,505,156 people at 3% growth rate on yearly basis (National Population Commission) (NPC, 2006; BNARDA, 2005). About 80% of the State's population is directly involved in agriculture.

The State has favourable agro-climate ecologies for arable crops, tree crops and livestock production and enjoys two distinct seasons; raining season, beginning from April to October, and dry season, from November to March. Annual rainfall records vary from 1700mm in the Southern part to 1250mm in the Northern ecology with annual temperature variations of 30^0C and 38^0C (BNARDA,2005)

There are three prominent ethnic groups in the State namely; the Tiv, Idoma and Igede. Other smaller ethnic groups in the State are Etulo, Abakpa, Ofia and Jukun. Benue people are predominantly farmers but embark upon other ventures especially fishing activities which are mostly undertaken by the Etulo, Jukun and Agatu people. Map of the study area is shown in figure 1.

The population of the study consisted of all aquaculture fish growers in the three Agricultural zones of Benue State. Due to the enormity of this population, a sample size of 225 respondents was selected using stratified, purposive and simple random sampling techniques.

Figure 1. Map of Benue State showing the location of the study area.

Firstly, the State was stratified into three agricultural zones, A, B and C. Secondly; two Local Government Areas from each of the three zones were purposively selected because of the predominance of aquaculture fish growers there.

In zone A, Katsina-Ala and Kwande were selected. In zone B, Makurdi and Gboko were selected, while Otukpo and Oju were selected from zone C. Thirdly, using the data collected from BNARDA on fish growers from the selected Local Government Areas, a sampling frame was generated for each of the Local Government Areas and using a proportional allocation of 50% (0.5) across board, a total sample size of 225 respondents was selected.

Data for this study were collected from primary sources using structured questionnaire alongside interview techniques. Data collected were analyzed using descriptive statistics, factor analysis and Kruskal Wallis (H) test.

Model Used

(A) The Kruskal Wallis (H) test model.

The Kruskal Wallis (H) test that was used for testing hypothesis one (1) is stated below:

$$\chi^2_{k.w} = \frac{12}{N(N+1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(N+1)$$

χ^2 =Kruskal Wallis
N=Total No. of observations over all samples
ni= Sample size of samples i
R^2i= Square of the sum or rank for sample i
$\sum R_i^2/n_i$= the squares of sum or ranks divided by the corresponding sample size (n_i) in the samples as are summed across all samples.

(B) Factor Analysis Model. The model for constraints affecting adoption of improved fish pond management technologies is specified as follows:

Factor analysis model

$$F_1 = \alpha_1X_1 + \alpha_{12}X_2 + *** + \alpha_{1n}X_n$$
$$F_2 = \alpha_{21}X_1 + \alpha_{22}X_2 + *** + \alpha_{2n}X_n$$
$$* \qquad\qquad *$$
$$* \qquad\qquad *$$
$$* \qquad\qquad *$$
$$F_n = \alpha_{n1}X_1 + \alpha_{n2}X_2 + *** + \alpha_{nn}X_n$$

Where;

$F_1, F_2, * * * F_n$ = unobserved underlined factors affecting the adoption of improved fish pond management technologies

$\alpha_1, \alpha_2 * * * \alpha_n$ = Factor loadings or correlation coefficients

$X_1, X_2, * * * X_n$ = Observed variables/ factors affecting the adoption of improved fish pond management technologies

$F_n<X_n$= Necessary condition that must be met in factor analysis.

Constraints affecting adoption of improved technologies- were measured by asking the respondents to indicate with a tick the constraints affecting adoption of improved fish technologies using the key Strongly agree (SA=4), Agree (A=3), Disagree (D=2) and Strongly disagree (SD=1). The Likert-type scale was summated thus: 4+3+2+1/4 = 2.5. The cut-off point was set at 2.5 for the acceptance of mean.

3. Results and discussion

3.1 Common types of Fish Ponds used

The results in Table 4 showed that most (88.7%) of the respondents used concrete ponds in fish production. Only 21.3% of the respondents used earthen ponds in raising fish in the study area. The predominant use of concrete pond may be due to its convenience, ease in cleaning and management of the pond, ease of harvesting and draining. It is commonly believed by the farmers to be advantageous in the area of high profitability, absence of weed growth or bank erosion, good control of diseases and predators inter alia. It is considered to last longer than the earthen pond when properly built and maintained. This finding agrees with that of (Keremah and Esquire, 2014) who observed that most fish farmers in Nigeria operated small-scale farms ranging from homestead concrete ponds to small earthen ponds.

3.2 Improved Fish Pond Management Technologies adopted by fish growers

Table 2 revealed the percentage distribution of respondents according to their adoption of improved fish pond management technologies in the study area. Results of the analysis on improved fish pond management technologies revealed that respondents had low adoption in 9 improved fish

pond management technologies and high adoption in 1 of the technologies. This indicates that the respondents' adoption regarding improved fishery management technologies was generally low. The technologies that respondents had low and high adoption in include: Water re-circulatory system (1.4%) and integrated fish/poultry or rice farming (2.3%).

Furthermore, Use of secei disc to monitor turbidity (8.6%); Self formulation of feeds (9.5%); Dissolved oxygen monitoring (9.5%); pH testing and liming (11.3%); Induced spawning (hypophysation (13.1%); Polyculture/ appropriate socking density (14.0%); Mono-sex culture/ appropriate stocking rate (34.4%) and Recording keeping (68.8%) respectively. This implies that many of the respondents are in their knowledge, persuasion and decision stages of the adoption process respectively. The low adoption of improved fish pond management technologies could be attributed to paucity of technical information on improved aquaculture management among the fish farmers in the study area. The result of the finding is not surprising since majority of the farmers relied on their fellow Friends/neighbour/relations instead of extension agents as a source of information and advice.

3.3 Sources of Information on Improved Fish Pond Management Technologies

Sources of information available to fish growers are presented in Table 7. Farmers indicated that the major sources of information on improved fish pond management technologies were from friends/neighbour/relation and farmers' association (93.7%) each, followed by radio (71.9%); handset (67.4%); television (54.3%) and opinion leaders (45.7%).The result implies that majority of the farmers did not have access to extension services which is supposed to be a major source for disseminating information to respondents on improved technologies. This could be attributed to the fact that most Agricultural Extension Programmes in Nigeria are tilted towards food crop and livestock production. This finding is consistent with Ofuoku *etal*. (2008) and Okunlola *et al*. (2011) who reported that the most popular sources of information available to fish farmers in Nigeria was interaction with other fish farmers and from cooperative meetings.

3.4 Major Constraints Affecting Adoption of Improved Fish Pond Management Technologies

Table 4 reveals that there were three (3) major categories of constraints affecting adoption of improved fish pond management technologies in Benue State, namely: Socio-economic constraints (factor 1), Characteristics of innovations constraints (factor2) and Politico-cultural cum ecological constraints (factor3).

In factor 1, the socio-economic constraints affecting adoption of improved fish pond management technologies in Benue State were high cost of technologies (0.434), negative perception of the concept of fish farming (0.488), inadequate extension services (0.568), lack of access to information sources on improved technologies (0.397), high cost of fingerlings (0.715), high cost of feeds (0.620) and inadequate starting capital (0.741). The implication of these findings is that the high rate or spate of absolute or extreme poverty in Benue State has hindered majority of fish growers from adopting improved fish pond management technologies, considering the high cost of technologies and initial capital required.

In factor 2, the characteristics of innovations constraints affecting adoption of improved fish pond management technologies in Benue State were relative economic advantage (0.739), compatibility of innovations (0.852), triability of innovation (0.843), complexity of innovations (0.762) and observability of innovations (0.765). These imply that fish growers can readily adopt improved fish pond management technologies if they are more cost effective than the existing technologies, if they are very easy to understand and use, if the results or impact could be felt and if they can be tried on a small scale before adoption.

In factor 3, the politico-cultural cum ecological constraints affecting adoption of improved fish pond management technologies in Benue State were: inconsistent government policies (0.527), institutional framework (0.644), lack of incentives (0.698), shortage of trained labour (0.715), climate change (0.638) and land tenure associated constraints (0.580). these imply that frequent changes in government in Nigeria in general and Benue State in particular tend to affect policy implementation and that in turn affects fish growers in adopting improved fish pond management technologies. For instance, the Maputo Declaration of 2012 recommended that every developing country should set aside at least 10% of its Federal annual budget for the Agricultural sector, but only 6% in 2016 and 2.0% in 2017 were allocation to the agricultural sector. This amounts to violation of international protocols or agreements, hence poor annual budgetary allocation and disbursement to the agricultural sector. Besides, it implies that the present land tenure policy, the land use Act of 1978 needs to be reformed into legislated available and accessible to the landless.

More so, climate change, especially flooding has greatly impacted negatively on fish pond farmers in Nigeria in general and Benue State in particular.

As a result of unbridled flooding in 2012 and 2017, a lot of fish growers had experienced and recorded cases of collapse dykes and over flooding of fish ponds with its concomitant loss of fingerlings, frys or even matured fish.

Test of Hypothesis

Table 11 shows that there is no significant difference in the improved fish pond management technologies adopted among fish growers in the three (3) agricultural zones in Benue State (P> 0.05). Specifically, the Kruskal Wallis test (H) reveals that $\sum R_1$=164.5, $\sum R_2$= 169.5 and $\sum R_3$=101.0.

A closer look at table 12 shows that none of the fish growers adopted aquaponics in Benue State. It was also found that in zone C, water re-circulatory system was not adopted by fish growers. This indicates that adoption of improved fish pod management technologies among fish growers across the three agricultural zones in the study area was generally low. The null hypothesis which stated that there is no significant difference in the improved fish pond management technologies adopted among fish growers in the three (3) agricultural zones in Benue State is therefore, rejected. This implies that only very few fish growers have adopted improved fish pond management technologies in Benue State.

Table 1. Types of Ponds Used by Fish Growers

Variables	Frequencies*	Percentage
Types of Ponds		
Concrete	196	88.7
Earthen	47	21.3
Barrage	2	0.9
Plastic tanks	5	2.3
Wooden troughs	1	0.5
Cages	2	0.9

*Multiple responses, Source:Field Survey (2017)

Table 2: Improved Fish Pond Management Technologies Adopted By Fish Growers

Improved Fish Pond Management Technologies	Frequencies *	Percentage
Induced spawning (hypophysation)	29	13.1
Aquaponics		
Water re-circulatory system	3	1.4
Integrated fish/poultry or rice farming	5	2.3
pH testing and liming	25	11.3
Mono-sex culture/ appropriate stocking rate	76	34.4
Polyculture/ appropriate socking density	31	14.0
Dissolved oxygen monitoring	21	9.5
Self formulation of feeds	21	9.5
Use of secei disc to monitor turbidity	19	8.6
Recording keeping	152	68.8

* Multiple responses, Source:Field Survey (2017)

Table 3. Sources of Information on Improved Management Technologies

Sources of Information	Frequencies*	Percentage
Extension agents	49	22.2
Radio	159	71.9
Newspaper	65	29.4
Television	120	54.3
Opinion leaders	101	45.7
Friends/neighbour/relation	207	93.7
Extension bulletin	29	13.1
Handset	149	67.4
Internet	63	28.5
Farmer's association	207	93.7

* Multiple responses

Source:Field Survey (2017)

Table 4. Factor Analysis of Constraints Affecting Adoption of Improved Fish Pond Management Technologies

S/N	Variables	Factor 1	Factor 2	Factor 3
1	High cost of technologies (HCOT)	0.434*	-0.114	0.11
2	Negative perception of the concept of fish farming (NPCF)	0.488*	0.387 E02	0.091
3	Inadequate extension service (IAES)	0.568*	0.039	0.07
4	Lack of access to information sources on improved technologies (LOAIIT)	0.397*	-0.223	0.347E02
5	High cost of fingerling (HCFL)	0.569*	0.005	0.250
6	High cost of feeds (HCOF)	0.620*	0.139	-0.020
7	Inadequate starting capital (INASC)	0.741*	-0.043	-0.040
8	Relative economic advantage (REA)	0.029	0.739**	-0.043
9	Compatibility (COMPAT)	0.086	0.852**	-0.085
10	Triability (TRIB)	0.055	0.843**	0.002
11	Complexity (COMPLEX)	0.185	0.762**	0.074
12	Observability (OBS)	-0.005	0.765**	-0.062
13	Inconsistency in government policies (INIGP)	0.061	0.479EO2	0.527***
14	Institutional frame work (IFW)	0.241	0.180	0.644***
15	Lack of incentives (LOI)	0.139	0.090	0.698***
16	Shortage of trained labour (SOTL)	0.163	0.100	0.715***
17	Climate change (CLC)	0.178	-0.285	0.638***
18	Land tenure problem (LTP)	-0.215	0.083	0.580***

Source: Field Survey (2017), Method: Verimax with Kaiser Normallization
*- Factor 1: Socio- economic constraints
**- Factor 2: Characteristics of Innovation constraints
***- Factor3: Politico-cultural cum ecological constraints

Table 11. Kruskal Wallis (H) Test for Hypothesis Two

S/N	VARIABLES	ZONE A		ZONE B		ZONE C	
		Freq.	R1	Freq.	R2	Freq.	R3
1	Induced spawning (hypophysation	9	16.0	15	22.5	5	10.0
2	Aquaponics	0	-	0	-	0	-
3	Water re-circulatory system	1	2.0	2	4.5	0	-
4	Integrated fish/poultry or rice farming	1	2.0	3	6.5	1	2.0
5	pH testing and liming	5	10.0	17	25.0	3	6.5
6	Mono-sex culture/ appropriate stocking rate	46	27.0	16	24.0	14	21.0
7	Polyculture/ appropriate socking density	15	22.5	10	18.0	6	13.0
8	Dissolved oxygen monitoring	11	20.0	6	13.0	4	8.0
9	Self formulation of feeds	10	18.0	6	13.0	5	10.0
10	Use of secei disc to monitor turbidity	10	18.0	7	15.0	2	4.5
11	Recording keeping	60	29.0	52	28.0	40	26.0
	H-cal=30.2 H-tab=5.991		∑R1=164.5		∑R2=169.5		∑R3=101.0

Source: Field survey (2017)

4. Conclusions and recommendations

The study assesses adoption of improved fish pond management technologies among fish growers in Benue State, Nigeria. Evidence from the study indicated that adoption of improved fish pond management technologies was generally low, result also indicated that the major sources of information on improved fish pond management technologies were from friends/neighbour/relation and farmers' association. It was therefore concluded that Agricultural Development Project (ADPs) should carry out adequate public enlightenment campaigns on improved fish pond management technologies and Extension workers should ensure regular contacts with farmers to keep them abreast of available innovations on fish growers.

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