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Differentials in Adoption of Improved Fisheries Technologies among Fish Farmers in Nigeria

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Abstract
The study was carried out in Benue, Nassarawa and Kogi States of Nigeria to assess the adoption of improved fisheries technologies. Fish farmers were the respondents for the study and selected using multistage sampling techniques which involved stratified, purposive and simple random sampling techniques. A total of three hundred and twenty five (325) respondents were used for the study. Structured questionnaire was employed to collect the required data while descriptive and inferential statistics were used for the data analysis. The results of the analysis revealed that majority (66.46 %) of the respondents were males. The mean age of respondents was 48 years and majority of them were married (85.85 %). Most of the respondents had formal education (98.77%), while their mean household size was five persons. They had average income from fish farming of ₦208,884 per production cycle while their mean fish stock was 321 fishes. The common sources of information were from extension agents and cooperative association. Results also revealed the existence of very high adoption level of improved fisheries technologies across th5e States except for technologies such as fish sex reversal (39.38%) and induced fish breeding (49.85%). High cost of technologies (0.4867*), inadequate access to extension services (0.6327*), complexity of technologies (0.5742**) among others were identified as significant constraints associated with improved fisheries technologies adoption. Logistic regression shows that household size was negative and fish was positive and had significant relationship with adoption at 10%. This study therefore recommends that extension agents make available good, high yielding and improved breed of fish stock with prolific value to ensure full adoption technologies among fish farmers.

Keywords: Improved, Fishery, Technologies, Adoption and Fish farmers

Introduction

Fish is the most important animal protein in Nigeria. About 50% of the total animal protein intake of the country is acknowledged to be from this source, mostly because of its low cost, nutritional value and health benefits (Federal Department of Fisheries, 2009). It is a good source of high quality protein and contains other essential nutrients such as lipids, vitamins and minerals which are essential for nursing mothers and growing children (Tsado, Adeniji, Ojo, Adebayo and Abdulazzeez, 2012). The nation's fish supply comes from import, artisanal, river and local production which all make up the fishery industry. The fishery industry includes activity concerned with culturing, harvesting, processing, preserving, storing, transporting, marketing and selling fish of fish products. It encompasses recreational, subsistence and commercial fishing and the harvesting, processing and marketing aspects of the sectors (Food and Agriculture Organization, 2008). In Nigeria, the industry is broadly divided into two major sub-sectors which are artisanal and aquaculture fishery however aquaculture has become the most promising of the industry (Alarape and Solole, 2009). Aquaculture or farming in water is generally the practice of growing aquatic organisms such as fish, molluscs, crustaceans and plant in ponds and tanks at household level, small scale or commercial level (FAO, 2021). It involves raising important fast growing fish species in tanks, ponds or ocean enclosures mostly for food (Salau, Lawee, Luka and Bello, 2014). The common fish species used in fish farming are carp, salmon, tilapia, and catfish (FAO, 2016) while species such as catfish, tilapia and carp are most popular in Nigeria due to their characteristics fast growth rate, disease resistance, high feed conversion efficiency, high stocking density and aerial respiration (Adewolu, Ogunsanmi and Yunusa, 2008). This aspect of fishery has significantly contributed in enabling households and the nation achieve protein security, increase households' income, bring about poverty alleviation in addition to providing

consistent supply of fish to the populace and lowering the pressure of supplies from natural sources and dependence on import (Apata, 2012).

Nigeria has over 14 million hectares of inland water surface, out of which about 1.75 million are available and suitable for aquaculture (FAO, 2006b). The nations aquaculture is predominantly an extensive land based system practiced at subsistence levels in fresh waters with most operations carried out on small-scale farms ranging from homestead concrete ponds to small earthen ponds and in recent days tanks made from plastics and tarpaulins (Anyawu and Akeredolu, 2005; Olaoye, Ashley-Dejo, Fakoya, Ikeweinwe, Alegbeleye, Ashaolu and Adelaja, 2013). However, with the nations' human population projected at 200 million there is constant pressure on local fish production hence the need to steam up production using improved technologies in other to lower the dependence on imported fish (Apata, 2012). Some of the improved fisheries technologies that have been developed by fisheries research institutions which include; profitable homestead fish pond management, controlled production of tilapia, control of common diseases of fish, appropriate species combination and stocking density, development of fast growing species, development of quality feeds for fast and healthy growth, suitable manuring and fertilization procedures, improved smoking kilns, longer shelf-life of smoked fish, good fishing methods, information on pond-site selection, pond construction, pond installation, pond preparation, stocking of pond, transportation of fingerlings, feeding, pond maintenance, harvesting of fish, and fish preservation (Bolorunduro, 2003). The crucial link to improve fish production by the resource poor farmers is therefore effective transfer of these improved fish farming innovations to them for their adoption.

According to Ekong (2002) and Bhandari (2018), adoption of new technology is described as innovation-decision process where an individual goes through the time of first knowledge of the innovation to the decision stage of adoption or rejection and, to confirmation of that decision". The adoption-rejection decision of a farmer towards an innovation (technology) depends to a large extent on the degree of risk involved relative to the existing practices. A number of determinants could influence adoption-rejection decision; most importantly are the characteristics of the innovation and the socioeconomic characteristics of the farmer. In addition to these, are the extent of availability of the technologies being disseminated, extension methods provided and extent of resources available to farmers (Wetengere, 2008; Wetengere, 2010). The packaging of a technology, the extent of awareness creation by extension agencies using various extension delivery strategies, the friendliness in adaptation and perceived benefit (s) all play significant roles in the adoption of technologies (Bolorunduro and Adeseshinwa, 2007).

National Agricultural Extension and Research Liaison Services (2005) noted that adoption of fisheries technologies has been relatively low when compared to other agricultural technologies in Nigeria. The reasons for this have been blamed on some developments which include; high cost of inputs, difficult technical features of some of the technologies and insufficient awareness creation among others (Bolorunduro *et al.*, 2005). According to Oladimeji (2015), Benue, Kogi and Nassarawa States in North-Central Nigeria have great fisheries potential because they are blessed with water bodies (River Benue and River Niger shared by all the states) that can be harnessed for fish farming. In spite of this great potential, fish farming in Nigeria especially in these states is still poorly developed. Ahmed (2015) reported that up till 2015, there was a national fish demand of about 2.1 million metric tonnes per annum and a domestic production estimated at about 800,000 metric tonnes. Despite the potential market and growing awareness of fish farming there is obvious limitation of knowledge of many improved technologies that would have helped boost output and increase practitioners' revenue from their production (Odediran and Ojebiyi, 2017). Several studies have been carried out on adoption of improved fisheries technologies in different regions of the nation (Okunlola *et al*., 2011; Apata 2012; Salau *et al*., 2014; Onuegbu, 2015), however, most of these studies focused on adoption level of improved fisheries technologies, not doing much on the determinants of adoption. Furthermore, most of these studies hardly study more than one state of the federation or make efforts to identify constraints of adoption of improved fisheries technologies. Hence, this study became imperative to provide answers that will fill this missing gap.

Methodology

The study was conducted across Benue, Nassarawa and Kogi States of Nigeria. The study adopted cross sectional survey design for data collection in 2019. The sample population consisted of all fish farmers who adopted improved fisheries technologies as documented by the State ADPs. A sample size of three hundred and thirty seven (337) respondents was selected using multistage sampling technique which involved stratified, purposive and simple random sampling techniques but only three hundred and twenty five (325) were returned valid. Firstly, three states were purposively selected namely Benue, Nassarawa and Kogi States among others States which are known for large scale fish production because of their intensity in fish production. Secondly, each of these states was zoned as follows; Benue State (Northern, Eastern and Central zones), Kogi State (Central, Kogi East and Kogi West) and Nassarawa State (Southern, Central and Western zones). Thirdly, one Local Government Area (LGA) each was purposively selected from each of the zones based on their high involvement in fishery activities compared to others. Fourthly, communities improved fisheries technologies were introduced were purposively selected and lastly, three hundred and thirty seven (337) adopters where randomly identified within the communities and interviewed. Data was collected

from primary source with the aid of well-structured questionnaire and personal interview. Descriptive statistics such as frequencies, percentages and means and inferential statistics such as Factor analysis and Logistic regression were used for the data analysis.

Results and Discussion

The result of Table 1 showed that majority (85.23%) of the fish farmers within these States were within the age category of 41-60 years. This is an indication that only a few youths were involved in aquaculture (fishery) in the study area. Majority (66.46%) of the farmers were male than female (43.64%) indicating dominance of male farmers in the profession. More married persons were involved in the venture (85.85%) which could be attributed to need for an extra income to meet family needs and the advantage of utilizing family labour to carryout activities required. Majority (89.47%) of the fish farmers had post-secondary education which could be attributed to a deliberate choice of taking up aquaculture in the mist of low employment opportunities in the country after years of formal education. Also majority (55.07%) of the fish farmers had a large household size from 5 persons. This implies availability of labour for the producing, increased saving of cash which is a good source of earning extra income to meet the needs of the family. The study found mean income earning of N208,884 per production cycle; this amount shows that the venture is taken up mostly as a part-time business but if given full attention would bring in higher returns per year. All (100%) the fish farmers were found to belong to associations indicating that their membership attracted some form of benefits; possibly access to credit facilities and information that is of advantage to their production. The mean fish stock of 320.49 fingerlings shows most of these production are not necessarily commercial in nature but minor home productions whose potentials are not being stretched. The study found a mean fish farming experience of 11.79 years implying long stay and high experience for them to have expanded their production capacity beyond their current average. All (100%) fish farmers have access to extension contact showing that their production is recognized by their various State Agricultural Development Project (ADPs), hence efforts made to provide them with extension advisory services.

The findings is in conformity with that reported by Okunlola *et al*. (2011) in terms of age of fish farmers, Akangbe *et al*., (2015) in terms of sex, Ike and Onuegbu (2015) in terms of marital status and Apata (2012) in terms of household size. This implies that the age, sex, marital status and household size of those involved in fish farming across Nigeria falls within same description hence this characteristics can be targeted to study their influence on improved fishery technologies adoption in Nigeria. The findings however contradicted Bolorunduro and Adeseshinwa (2007) who reported high illiteracy among fish farmers in Lagos and Rivers states Nigeria although is possible that fishermen may have been were interviewed instead of fish farmers because aquaculture generally require besides skills some level of technical understanding. This result was also at variance with that of Salau *et al*. (2014) who reported far higher mean income of over N1,000,000 from fish farming. Lastly, the finding also contradicted Akangbe *et al*. (2015) who reported mean fish stock of 4,000 far higher than mean of 320.49 which show commercial fish farming ventures in the location their study was conducted. The clarity provided shows these attributes could still be used to investigate how they influence improved fishery technologies adoption in Nigeria.

The result of Table 2 shows all the improved fisheries technologies. The finding showed many of the listed technologies had high level of adoption across all the States. The result finding could be attributed to the extension contact these fish farmers had enabling them to understand the innovations and make positive adoption decisions. However, there was low level in the adoption of induced fish breeding (49.85%) and sex reversal in fish (39.38%) which are innovations that require skills and technical knowledge. This may be due to the complexity of the innovation making it difficult to understand hence the low adoption level. This result generally agrees with report of Apata (2012) and Salau *et al*. (2014) on high adoption of improved fisheries technologies across Nigeria which is generally high indicating that as farmer gain more contacts extension agents even the complex technologies would be understood.

The result of Table 3 showed sources of information commonly used by farmers. The result reveal that extension agents and fish farmers association (100% each), family and friends (63.38%) and bulletins (55.08%) were common used sources of information among fish farmers utilized to gain knowledge on improved fisheries technologies across the States. The low use of electronic media and private consultants could be possibly due to channels used by ADPs to pass information about fishery innovation and the unwillingness of the farmers to pay private consultants for information. This finding is consistent with report of Ogunremi *et al*. (2013) and Akangbe *et al*. (2015) that extension agents, fellow farmers and cooperative societies were the major sources of information about innovation among the fish farmers.

The result of Table 4 showed the constraints associated with adoption of improved fisheries technologies. The resulted finding reveal that high cost of technologies (0.4867), lack of technical support in adoption process (0.5307), illiteracy of the farmers (0.5569), inadequate access to sources of information on improved fisheries technologies (0.6417), small farm size (0.4704), inadequate access to extension services (0.6327), inadequate timing (0.4794), inadequate inputs (0.5837), inadequate credit facilities (0.3988), inadequate sources of information (0.4157), high cost of land (0.3337) and land tenure system (0.5997) were identified as social constraints militating against adoption of improved

fisheries technologies among fish farmers. Also, the result revealed that complexity of innovation (0.5742), compatibility of innovation (0.5297), and no clear relative advantage of innovation (0.4170), handling difficulty (0.5302) and water scarcity (0.3507) were identified as innovation constraints militating against adoption of improved fisheries technologies. The implication of this finding is that the ADPs is not giving all fish farmers equal access to information about improved fisheries technologies that would enable them process and make informed decisions about adoption. This finding is in line with report of Ibrahim, Girei and Tari (2016) that unrestricted access to extension services can be resolved through Information and Communication Technology (ICT). ICT channels has the power to increase farmers' knowledge about innovations enabling them to further make inquiries, get clarity and make timely adoption decisions. Also, the complexity of innovation identified is consistent with the position of Okunlola *et al*. (2011) that good access to extension agents bring about practical demonstration of innovation application which eventually brings about its understanding.

The result of Table 5 showed the influence of socio-economic characteristic of the fish farmers on the adoption of improved fisheries technologies. The result reveals that household size had a negative and significant influence at 10%. These factors were found to exert influence on the adoption of improved fisheries technologies in Benue, Nasarawa and Kogi States. Specifically, the negative coefficient of household size implies that a unit increase in household size will decrease adoption of improved fisheries technologies. Collaborating these findings, Singas and Manus (2014) similarly reported negative relationship between family size and adoption of pond fish farming innovation among fish farmers. Akudugu, Guo and Dadzie (2012) in their study on adoption of modern agricultural production technology by farm households reported that Farm size had a positive and significant relationship with the probability of adoption of modern agricultural production technologies and this is in tandem with the findings of this study. Furthermore, the coefficient of fish stock also had a positive significant influence at 10%. This implies that a unit increase in fish stock will probably increase adoption in the study area. It can therefore be deduced that only household size and fish stock of fish farmers are factors that have significant effect on adoption of improved fish technologies among fish farmers in the study area.

Conclusion

The adoption of fisheries innovation to improve livelihood of the fish farmers in Nigeria has no doubt boost the fish production capacity and put the country on the path of fish and protein sufficiency. The research established that fish farmers in the study area have high awareness and have widely adopted available improved fisheries technologies. Also, the various States ADPs are fully involved in providing fish farmers with information about the innovations as well as extension advisory services together with other incentives. Some social and innovation constraints were identified to be militating against fish farmer's adoption of these improved fisheries technology. Lastly, household size and fish stock were identified as factors influencing adoption of improved fisheries technologies in the study area. This study therefore recommends that ADPs utilize electronic channels of passing information about improved fisheries technologies so as to make access to such knowledge easier for fish farmers thereby removing the restriction associated with physical extension methods. There is also need to give fish farmers (with large household size) special attention, incentive and encouragement to enable them adopt improved fisheries technologies that will lead to them increasing their fish stock and overall production. Lastly, there is need for extension agents to make available good, high yielding and improved breed of fish stock with prolific value to ensure full adoption technologies among fish farmers.

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References

Adewolu, M. A., Ogunsanmi, A. O. and Yunusa, A. (2008). Studies on Growth Performanceand Feed Utilization of two Clariid Catfish and their Hybrid Reared Under Different Culture Systems. *European Journal of Science Research*, 23(2): 252-260.

Ahmed (2015). Bridging the fish demand-supply gap in Nigeria. *Published May*, *14th* , *2015.*

Akangbe, J. A., Ajiboye, G. E. and Komolafe, S. E. (2015). Effects of improved fish production technology on the output of fish farmers in Ilorin, Kwara State, *Nigeria. Ruhuna Journal of Science*, 6:50-62.

Akudugu, M. A., Guo, E. and Dadzie, S. (2012). Adoption of Modern Agricultural Production Technolgies by Farm Households in Ghana: What factors influence their decisions? *Journal of Biology*, *Agriculture and Healthcare.*2(3).

Alarape, A. A. and Sololu, A. O. (2009). Fisheries and Wildlife. *NOUN Course guide (BIO 220*.https://nou.edu.ng/coursewarecontent/BIO%20220%MAIN%20BODY%202.pdf

Anyawu, O. and Akeredolu, B. (2005). Urban aquaculture in Nigeria. *World Aquacuture Society. Annual report. www.was.org/meetings/abstractdata*. Retrieved on October, 2, 2006.

Apata, O. M. (2012). Awareness and Adoption of fish production technologies in South Western Nigeria. *Journal of Emerging Trends in Engineering and Applied Sciences* (JETEAS), 3(5): 819-822.

Bhandari, U. (2018). Research Review on Adoption Process. *Researchgate*. DOI:10.13140/RG.2.2.19255.21920

Bolorunduro, P. I. (2003). Improved fisheries technologies and approaches for this dissemination. A case study of Niger state. Proceedings of the 16th annual conference of the Fisheries Society of Nigeria, November 4-9, 2001, Maiduguri, Nigeria, Pp74-79.

Bolorunduro, P. I., Adeseshinwa, A.O.K. and Ayanda, J.O.(2005). Adoption of improved fish preservation technologies in Northwestern Nigeria. *Tropicultural*, 23: 117-123.

Bolorunduro, P. I. and Adeseshinwa, A. O. K. (2007). Adoption levels of improved fisheries Technologies and impacts of extension services on Fisher-folks in two maritime states in Nigeria. *Asian Journal of Information Technology*, 6 (1): 58-64.

Ekong, E. E. (2002). An Introduction to Rural Sociology. *Jumak Publisher*, *Nigeria*.

Federal Department of Fisheries (2009). Nigeria National Aquaculture Strategy. Assisted by FAO. Formally approved by Government. 18p.

Food and Agriculture Organization (2006). Fisheries management in the Federal Republic of Nigeria.

Food and Agriculture Organization (2008). Fisheries section: Glossary; Fishing industry. Retrieved on 28th May, 2016.

Food and Agriculture Organization (2016). The State of the world's fisheries and aquaculture. Rome, Italy, United Nations. 77pp. Retrieved 2017-3-15.

Food and Agriculture Organization (2021). Fisheries and Aquaculture. https://fao.org/fishery/aquaculture/es

Ibrahim, S. U., Girei, A. and Tari, B. (2016). Analysis of the Constraints to the Adoption of Improved Fish Farming Technologies by Farmers in Yola North and South LGA of Adamawa State, Nigeria. *https//:10.9734/AJAEES/2016/20729*

Ike, N. and Onuegbu, R. (2015). Adoption of aquaculture technology by fish farmers in Imo State, Nigeria. *The Journal of Technology Studies.* 33(1): *57-64.* DOI: 10.21061/jots.v33i1.a.8

NAERLS (2005). Water quality management in fish culture. *Extension Bulletin*, *Amedu Bello University Zaria.* 98(3):14.

Odediran, O. F. and Ojebiyi, W. G. (2017). Awareness and Adoption of Improved fish Processing Technologies among fish Processors in Lagos State, Nigeria. *Research Journal of Agriculture and Environmental Management*, 6(3). http:www.apexjournal.org

Okunlola, J. O., Oludare, A. O. and Akinwalerem B. O. (2011). Adoption of new technologies by fish farmers in Akure, Ondo State, Nigeria. *Journal of Agricultural Technology*, 7 (6): 1539-1548.

Olaoye, O. J., Ashley-Dejo, S. S., Fakoya, E. O., Ikeweinwe, N. B., Alegbeleye, W. O. and Ashaolu, F. (2013). Assessment of Socio-economic Analysis of fish farming in Oyo state, Nigeria. *Global Journals Science (GJSFR)* 13 (7). https://globaljournals.org/GJSFR_Volume13/7-Assessment-of-Socio-Economic-Analysis.pdf

Onuegbu, C. (2015). Determinants of Value Addition Initiatives Use by Fish Farmers in Kwara and Kogi States North-Central, Nigeria. *Research gate publication*. https://researchgate.net/publication/299642028

Ogunremi, J. (2013). Fish Production Practices and Use aquaculture technologies among fish farmers in Oyo State, Nigeria. *JEBE*. https://www.semanticscholar.org/paper/fish-production-practice-and-use-of-aquaculture-in-ogunremi/784a71e8a9f63472cb58a60adbb6138949ab368c

Oladimeji, Y. (2015). Estimation of Efficiency Differentials in Artisanal Fishery: Implication for Poverty Reduction in Selected States in North Central, Nigeria. *Nigerian Journal of Basic and Applied Science*, 23(2). DOI:10.4314/njbas.v23i2.6

Salau, E. S., Lawee, A. Y., Luka, G. E. and Bello, D. (2014). Adoption of Improved Fisheries Technologies by Fish Farmers in Southern Agricultural Zone of Nasasrawa State, Nigeria. *Journal of Agricural Extension and Rural Development*.6(11), P.342. Available at http://www.academicjournals.org/JAERD. Accessed 15th September, 2019

Singas, S. and Manus, P. (2014). Factors influencing Adption of pond fish farming innovations in Potsy of Morobe Province, Papau New Guinea. *Universal Journal of Agricultural Research*, 2 (6):19-197.

Tsado, J. H., Adeniji , O. B., Ojo, M. A., Adebayo, C. O. and Abdulazzeez, R. (2012). Perception of women knowledge on the nutritive value of fish in kaduna north local government area of Kaduna State, Nigeria. *Journal of Agriculture and Social Research*, 12(1): 162-169.

Wetengere, K. (2008). Determinants of Adoption of a Recommended Package of Fish Farming Technology: The Case of Selected Villages in Eastern Tanzania, © Maxwell Scientific Organization, Tanzania.

Wetengere, K. (2010). Determinants of Adoption of a Recommended Package sof Fish Farming Technology: The case of Selected Villages in Eastern Tanzania. *Advanced Journal of Food Science and Technology*, 2 (1): 55-62.

Table 1: Distribution of Respondents Based on Socioeconomic Characteristics

Variables	Frequency	Percentages (%)	Mean
Age			
21-30	2	0.62	**48.46**
31-40	46	14,15	
41-50	129	39.69	
51-60	136	41.85	
Above 60	12	3.69	
Sex			
Male	216	66.46	
Female	109	33.54	
Marital status			
Single	23	7.08	
Married	279	85.85	
Divorced	2	0.61	
Widow/widower	21	6.46	
Level of Education (years)			**14.40**
Non formal	4	1.23	
Primary	3	0.92	
Secondary	24	7.38	
Post Secondary	282	86.77	
University	7	2.16	
Post Graduate	5	1.54	
Household size (No.)			**4.95**
Below 2 persons	3	092	
2-4 persons	143	44.01	
5-7 persons	137	42.15	
Above 7 persons	42	12.92	
Average Fish Income (000)			**208,884**
Below N50,000	0	0.0	
N51-100,000	24	7.38	
N101-150,000	35	10.72	
N151-200,000	87	26.77	
N201-250,000	86	26.46	
N251-300,000	77	23.69	
N301-350,000	8	2.46	
N351-400,000	5	1.54	
N401-450,000	2	0.62	
Above N450,000	1	0.31	
Membership of Organization			
Yes	325	100.0	
No	0	0.00	
Number of Fish stock (No.)			**320.49**
Below 100	0	0.00	
100-200	50	15.38	
201-300	146	44.92	
301-400	106	32.62	
Above 400	23	7.08	
Farm Experience (years)			**11.79**
Below 5	0	0.00	
5-10	122	37.54	
11-15	175	53.85	
Above 15	28	8.61	
Extension Contact			
Yes	325	100.0	
No	0	0.00	

Source: Field Survey, 2019

Table 2: Distribution of Respondents Based on Improved Fisheries Technologies Adopted (n=325)

*Fisheries Technologies Adopted	Benue State (n = 69)		Nasarawa State (n = 94)		Kogi State (n = 162)		Pooled (n=325)	
	F	%	F	%	F	%	F	%
Fertilization and liming of ponds	69	100.00	94	100.00	162	100.00	325	100.00
Prevention and control of fish diseases	69	100.00	94	100.00	162	100.00	325	100.00
Techniques of hatchery and fingerlings production	41	59.42	57	60.64	71	43.83	169	52.00
Use of modern smoking kilns	59	85.51	89	94.68	158	97.53	306	94.15
Optimum stocking rate	68	98.55	87	92.55	161	99.38	316	97.23
Standard feeding regimes	69	100.00	88	93.62	160	98.77	317	97.54
Use of aerated containers for transporting fingerlings to reduce stress and mortality	68	98.55	85	90.43	144	88.89	297	91.38
Induced fish breeding	37	53.62	55	58.51	70	43.21	162	49.85
Sex reversal in fish	0	0.00	57	60.64	71	43.83	128	39.38
Water testing kit for oxygen, acidity and fertility	68	98.55	94	100.00	162	100.00	324	99.69
Cropping (harvesting) of pond	69	100.00	83	88.30	162	100.00	314	96.62
Provision of Inlet and outlet devices in ponds	69	100.00	84	89.36	162	100.00	315	96.92
Techniques of improving water quality in fish culture	69	100.00	92	97.87	162	100.00	323	99.38
Improved breeds of fingerlings	69	100.00	88	93.62	161	99.38	318	97.85
Frequent change of water	69	100.00	88	93.62	162	100.00	319	98.15
Regular sampling/ sorting of fish	69	100.00	91	96.81	162	100.00	322	99.08
Improved techniques in pond construction and maintenance	68	98.55	91	96.81	162	100.00	321	98.77
Fish preservation and storage techniques	65	94.20	91	96.81	162	100.00	318	97.85
Construction of modern fishing gears	56	81.16	92	97.87	162	100.00	310	95.38
Soil testing before site selection	69	100.00	93	98.94	113	69.75	275	84.62
Daily sanitation and record keeping	69	100.00	93	98.94	162	100.00	324	99.69
Floating feeds	69	100.00	94	100.00	162	100.00	325	100.00

Source: Field survey, 2019. *Multiple responses

Table 3: Distribution of Respondents Based on Information Sources Commonly Used (n=325)

* Information Sources Mostly Used	Benue State (n = 69)		Nasarawa State (n = 94)		Kogi State (n = 162)		Pooled (n=325)	
	F	%	F	%	F	%	F	%
Radio	16	23.19	50	53.19	41	25.31	107	32.92
Television	8	11.59	36	38.30	21	12.96	65	20.00
Newspapers	4	5.80	22	23.40	14	8.64	40	12.31
Bulletins	50	72.46	73	77.66	56	34.57	179	55.08
Internet	7	10.14	10	10.64	18	11.11	35	10.77
Extension agents	69	100.00	94	100.00	162	100.00	325	100.00
Private consultants	11	15.94	7	7.45	14	8.64	32	9.85
Neighbors/ Relations/ Friends	31	44.93	66	70.21	109	67.28	206	63.38
Fish farmers association	69	100.00	94	100.00	162	100.00	325	100.00

Source: Field Survey, 2019. *Multiple responses

Table 4: Constraints Associated with Adoption of Improved Fisheries Technologies in the Study Area

S/N	Constraints	*Factor 1	**Factor 2
1	High cost of technologies	0.4867*	-0.1650
2	Lack of technical support in adoption Process	0.5307*	-0.2097
3	Complexity	0.3886	0.5742**
4	Compatibility	0.3661	0.5297**
5	Illiteracy of the farmer	0.5569*	-0.0982
6	Inadequate access to sources of information on improved fisheries technologies	0.6417*	-0.1186
7	No clear relative advantage	0.3560	0.4170**
8	Handling difficulty	0.2502	0.5302**
9	Small Farm size	0.4704*	-0.0120
10	Inadequate access to extension services	0.6327*	-0.1121
11	Inadequate timing	0.4794*	-0.1547
12	Inadequate inputs	0.5837*	-0.1151
13	Water scarcity	0.0176	0.3507**
14	Inadequate credit facilities	0.3988*	-0.0783
15	Inadequate sources of information	0.4157*	-0.0931
16	High cost of land	0.3337*	-0.0656
17	High labour requirement	0.4707*	-0.1045
18	Land tenure	0.5007*	-0.0919

Source: Field Survey, 2019. *Factor 1: Socio - economic constraints, **Factor 2: Innovation's constraints

Table 5: Binary Logistic Regression of the Influence of Socio – economic Characteristics on the Rate of Adoption of Improved Fisheries Technologies in Benue, Nasarawa and Kogi States

Socio-economic characteristics	Coefficient	Std. Err.	Z	P > /z/	[95% Conf.	Interval
Age	-.0180102	.0200168	-0.90	0.368	-.0572424	.021222
Sex	.0360478	.2860447	0.13	0.900	-.5245895	.5966851
Marital Status	-3085296	.3157668	-0.98	0.329	-.9274212	.310362
Educational Level	.0084456	.056959	0.15	0.882	-.103192	.1200832
House hold Size	-.1156851	.0599472*	-1.93	0.054	-.2331793	.0018092
Credit	1.199621	1.276808	0.94	0.347	-1.302876	3.702118
Stock of fish	.00271	.0017273*	1.57	0.117	-.0006754	.0060955
Farming Experience	.0563045	.0421468	1.34	0.182	-.0263016	.1389107
Extension Visits	-.0896057	.1559243	-0.57	0.566	-.3952117	.2160004
Constant	-.2454837	1.762012	-0.14	0.889	-3.698964	3.207997

Source: Computer Print Out from Field Data, 2019. *Statistically significant at 10% level of significance