Adaptation of New Technologies by Fish Farmers in South East, Nigeria

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Abstract— *Adaptation of new technologies like intensive system of fish culture, processing of fish using modified drum ovum as well as other new technologies were studied in the South East Nigeria. Data collection for this study came from primary and secondary data. The primary data was generated through field survey using well-structured questionnaires as a major research instrument. The secondary data on the other hand were obtained through relevant literature ranging from textbooks, journals, articles, periodicals, seminar papers and proceedings. The result evinced that fish farmers in the entire south east used mainly intensive system of farming and less of extensive system of farming. Modified drum ovum is the most popular processing method preferred by all the fish farmers in the entire five south east states of Nigeria while choker kiln is the least. This can be attributed to its availability and affordability. The study recommends government support towards fish farming activities in the entire five South Eastern States of Nigeria. The farmers are encouraged to form cooperative societies or groups to gain easy access to credit facilities, they should also as a matter of urgency reorganize their various state Agricultural Development Programmes and recruit young fishery graduate that can be deployed in their state local government areas as well as providing financial assistance to these fish farmers through loans, subsidies in the form of feed, fish fingerlings, processing units etc. and organized special trainings in on-farm feed formulation, hatchery, fish processing, marketing, fish pond management and maintenance.*

Keywords— Adaptation, New Technology, primary and secondary data, fish farmers and south east.

I. INTRODUCTION

The government research institutions and the universities have made effort in developing improved strategies and technologies so as to increase production to meet the demand of the country and even export. These technologies are new improved ideas, methods, practices, innovations and inputs which supersede the ones previously in use. It also provides the means of achieving a sustainable increase in fish farm productivity and consequently leading to an improved living standard of the people as stated by Ifejika and Ayanda (2014). But according to Bolorundu (2016) the level of adoption of these technologies by the fish farmers is very low. This is due to the combination of various constraints among which are faulty aquaculture policies, institutional framework and unfavourable socio-economic environment.

The adoption of new strategies and technologies by fish farmers is very important for aquaculture. For quite sometimes, a lot of fishery technologies had been introduced by research institutes, state and federal Ministries of Agriculture and other related organizations concerned with fishery innovations, but the response of the farmers had been negligible. It has been noted that people do not just adopt a technology because it is available to them. In their submission, Berdgue and Eswbar (2017) stated that even when the technologies are available and appropriate, some constraints tends to exert influence on their decision to adopt or not. For instance, agricultural development project and farming skill acquisition centres in the state has for long been assisting fish farmers on how to develop fish farming and to increase production so as to meet the increasing demand of animal protein using the modern recommended fish farming technologies. To this effect, various training programmes were conducted toward achieving these objectives but less attention is given to assessing their level of adoption and problems faced in production. Thus it becomes necessary to study the effect of socio-economic and new technologies on fish farmers in South Eastern, Nigeria.

In achieving this, the study intends to answer the following questions:

1. What is the effect of socio-economic characteristics of fish farmers on aquaculture productivity within the five South Eastern states of Nigeria?
2. In what ways do the use of new technologies influence sustainability of fish farmers within the five States of South Eastern, Nigeria?
3. In what ways can aquaculture be improved and promoted within the five States of South Eastern, Nigeria?
4. What are those major constraints faced by fish farmers in improving aquaculture productivity within the five States of South Eastern, Nigeria?
5. What are the potential of governmental support towards aquaculture improvement and productivity within the five States of South Eastern, Nigeria?

Technologies are increasingly being developed in a global market, for farm level application with an impact on the sustainability beyond the farm. Adoption and use of technology for sustainable fish farming systems is a multi-disciplinary approach taking into account a wide range of objective geared towards sustainable aquaculture.

According to FAO (2017) over the last five years the system and technology used in aquaculture has developed rapidly. Similarly, research by (El-Gayar, 2011) showed that recent advances in information technology have had profound impact on all walks of life and aquaculture is no exception. He continues to state that the growing importance of aquaculture as an alternative source for food protein has further emphasised the need to adapt and develop advanced IT for the better management of aquaculture facilities as well as the regional planning for aquaculture development. According to Wetengere, (2010) improving farm production through integrated modern technologies into the existing farming systems is essential for the enhancement of household food and income security. His study recommended that technology developers should strive to improve the profitability of fish farming through the reduction of the risk of losing fish, shortening culture cycle to target market size fish, use of low cost inputs and/or integrating fish farming with the existing farming systems and access to urban market. According to Olatunji and Ogunremi (2016) findings on awareness of fish farming technologies by fish farmers they found out that lack of awareness, lack of knowledge of effects of recommended technology or negative attitude to the innovation may be responsible for non-adoption among farmers.

A research by Jacobi (2013) indicates that one of the reasons for slow aquaculture development in developing countries has been; use of traditional fish and water husbandry, political, social and economic constrains that restrict investment and delay expansion and lack of information on fish farming technology (FAO, 2017). In his study Henri *et al.* (2011) contend that adopt ion of fish farming technology is more likely to be adopted by the younger farmers. However, Jacobi (2013) case study shows that it is difficult for some countries to obtain knowledge on pond design and construction, hatchery equipment and other farm inputs such as aerators, cages and hatching incubators.

In regards to the use of technology Rajan (2013) research found out that feed management, selection and management of seed are some of the important technological components in fish farming. In his study, Onzere (2013) found that communities still used traditional methods of fish farming, harvesting and preservation. In her research Kagiri (2016) stated that lack of technology is among constrains fish farmers face in developing countries, it has led to reduced output as well losses since the fish harvested cannot be stored for long period that would enable fish farmers market their produce at a later date or even transport to a different location for sale. Wetenegere (2010) states that fish farming have very high potential which can be fully utilized if only technology was adopted. According to Singas and Manus (2014) farmers adopt fish farming technologies if they are assured that fish farming is a profitable venture. In his study Wetenegere (2010) implies that importance of the recommended technology related to existing practices must be clearly demonstrated to farmers. To ensure that the small scale farmers get the desired benefit, low cost technologies appropriate to the farmers needs to be extended widely.

In conclusion technology adoption and use is quite broad and is affected by development, dissemination and application of the technologies at farm level especially farm capital and other inputs. It's also affected by extension, advice and information which form the basis of farmer knowledge as well as technologies and practices in the overall agro-food sector that have an impact at the farm level. Fish farmers have always looked at new aquaculture technology as a way of reducing cost of production a clear indication that demand driven adoption and use of technology. Fish farmers invest in sustainable technology and farm practice if they expect the investment to be profitable, have the right education, information and motivation.

The study therefore sort to establish the influence on the use of new technologies on sustainability of fish farmers in these study areas.

II. MATERIALS AND METHODS

2.1 Study Area

South-East of Nigeria is one of the six geopolitical zones in Nigeria. The region consists of the following states: Abia, Anambra, Ebonyi, Enugu and Imo. South East geopolitical zone is 99.9% of population of Igbo people.

2.2 Experimental Design

General survey of the five states that make up South East of Nigeria namely; Abia, Anambra, Ebonyi, Enugu and Imo states were visited through the assistance of the staffs of the various ministries of Agriculture and National Resources. Also, those from Agricultural Development Program in these five states. During this period that lasted for over one month, identification, location and visitation of all known existing fish farmers were traced and counted in the order to ascertain the exert number of fish farmers that were interviewed and issued with questionnaire. It was also from these trips that these following agricultural zones were identified and mapped out. It was also during this period that the five states were divided according to their agricultural zones where the fish farmers' circles and blocks were identified and mapped out and subsequently visited.

Subsequently identified fish farmers were counted according to their circles, blocks, agricultural zones as well as their respective States from where they were interviewed and issued with questionnaire. This general survey carried out laid to identification of the following circles, blocks and agricultural zones

2.3 Sampling Size and Technique

The population sample comprise of three hundred and twenty(320) fish farmers that were randomly selected within the following circles, blocks and the agricultural zones of the five states. The Lists of Circles, Blocks and Agricultural Zones among the Five States of South East are presented in Table 1.

TABLE 1
LISTS OF CIRCLES, BLOCKS AND AGRICULTURAL ZONES AMONG THE FIVE STATES OF SOUTH EAST

Sr. No.	State	Agricultural zone	Fish block	Fish circle
1	Abia	Aba	15	30
		Ohafia	9	20
		Umuahia	10	21
		Total	**34**	**71**
2	Anambra	Aguta	13	25
		Anambra	12	25
		Awka	9	18
		Onitsha	15	39
		Total	**49**	**102**
3	**Ebonyi**	Ebonyi central	7	20
		Ebonyi North	8	20
		Ebonyi South	12	29
		Total	**27**	**69**
4	**Enugu**	Enugu East	15	31
		Enugu North	11	21
		Enugu West	8	18
		Total	**34**	**70**
5	**Imo**	Okaigwe	7	12
		Orlu	17	38
		Owerri	13	22
		Total	**37**	**72**

Source: Field survey (2019)

Using Taro Yamani formula, Yamani Taro (1967) the following number of respondents were identified.

$$n = \frac{N}{1+N(e)^2}$$

Where n = Sample size

N = population size

e = 0.05 based on research condition

2.4 Method of Data Collection

In this study, questionnaires, interviews, field observation, visits to fish farms where photographs were taken which was used during data collection. However, questionnaire was the major tool used for gathering necessary data from fish farmers (respondents). The questionnaire was structured in such a way that it provided answers to the research questions.

2.5 Questionnaire

A self-administered questionnaire was adopted to collect primary data for the study. The questionnaire was divided into five sections namely, Section A: which looked at bio-data and socio-economic factors affecting fish farmers, Section B: Considered those new technologies that tend to influence the sustainability of fish farm business, Section C: Considered some constraints that tend to affect fish farm productivity while Section D: looked at the potential of government support towards fish farm improvement and profitability. Section E: Tried to proffer solutions and suggestions towards the fish farm improvements and promotion.

2.6 Oral Interview

Interview is a systematic way of talking and listening to people. It is a conversation between a respondent (fish farmer) and the researcher based o he topic in question in order to gather facts, opinions, ideas and knowledge. The purpose of oral interview in the study was to get adequate information that may be vital for the success of this study through verbal interview between researcher and respondent fish farmers within the selected sample area.

2.7 Field Observations

The Field observation involved in the visitation of these zones of the five states that make up the South East as well as take some photographs on the type of fish pond they use in rearing their fish and other aquatic organisms.

2.8 Source of Data Collection

Data collection for this study came from primary and secondary data. The primary data was generated through field survey using well-structured questionnaires as a major research instrument. The secondary data on the other hand were obtained through relevant literature ranging from textbooks, journals, articles, periodicals, seminar papers, proceeding, and internet etc.

2.9 Viability of the instrument

Copies of the questionnaires were given to experts in Agricultural Economics, Fisheries Economics and Statistics and Computer Science in Nnamdi Azikiwe University for Validation.

2.10 Data Analysis

Analytical tools that was adopted in this study were descriptive statistics (frequency, percentage, mean), inferential statistics and SPSS version 2020 was used to analyse research questions, research hypothesis and objectives of the study. Multiple Regression and Z statistics was adopted to test the hypothesis of the study. The computation was done using SPSS 22 package).

III. RESULTS

The rate at which various farming systems and processing technology are used in Abia state is presented in Table 2.

TABLE 2
TYPE OF FARMING SYSTEMS AND PROCESSING TECHNOLOGY USED IN ABIA STATE.

		Frequency	Percent	Valid Percent	Cumulative Percent
	Intensive	41	67.2	68.3	68.3
	Semi intensive	17	27.9	28.3	96.7
	Extensive	2	3.3	3.3	100
	Total	60	98.4	100	
Missing	System	1	1.6		
Total		61	100		

The result revealed that farmers in Abia state used mostly intensive system of fish farming (67.2%), semi intensive (27.9%) with extensive system having the least (3.3%). Fish farmer's in Abia state processed their fish using more of modified drum ovum (36.1%), Altona (29.5%), solar tent (16.7%) ad chokor kiln having the least (13.3%).

The rate at which various farming systems and processing technology are used in Anambra state is presented in Table 3.

TABLE 3
TYPES OF FARMING SYSTEMS AND PROCESSING TECHNOLOGY USED IN ANAMBRA STATE.

	Frequency	Percent	Valid Percent	Cumulative Percent
Intensive	59	73.8	73.8	73.8
Semi intensive	17	21.3	21.3	95
Extensive	4	5	5	100
Total	80	100	100	

Fish farmers in Anambra state used more of intensive system of fish farming (73.8%) than semi intensive (21.3%) with extensive system having (5.0%). They also prefer to process their fish using modified drum ovum (33.8%) followed by Altona (33.8%), while choker kiln and solar tent had (16.3%) respectively.

The frequency at which various farming systems and processing technology are used in Ebonyi state is presented in Table 4.

TABLE 4
TYPES OF FARMING SYSTEMS AND PROCESSING TECHNOLOGY USED IN EBONYI STATE.

	Frequency	Percent	Valid Percent	Cumulative Percent
Intensive	40	66.7	66.7	66.7
Semi intensive	17	28.3	28.3	95
Extensive	3	5	5	100
Total	60	100	100	

Fish farmers from Ebonyi state used intensive system of farming more (66.7%) that semi-intensive system of farming (28.3%) and extensive (5.0%). They also process their fish using modified drum ovum (35.0%), altona (31.7%), solar tent (18.3%) and chokor Kiln (15.0%).

The percentage at which various farming systems and processing technology are used in Abia state is presented in Table 5.

TABLE 5
TYPES OF FARMING SYSTEMS AND PROCESSING TECHNOLOGY USED IN ENUGU STATE.

	Frequency	Percent	Valid Percent	Cumulative Percent
Intensive	39	65	65	65
Semi intensive	18	30	30	95
Extensive	3	5	5	100
Total	60	100	100	

Fish farmers from Enugu state used intensive system of farming more than semi intensive (30.0%) and extensive (5.0%). They also prefer to process their fish using modified drum ovum (36.7%) and altona (35.0%), choker kiln (15.0%) and solar tent (13.3%).

The rate at which various farming systems and processing technology are used in Imo state is presented in Table 6.

TABLE 6
TYPES OF FARMING SYSTEMS AND PROCESSING TECHNOLOGY USED IN IMO STATE.

	Frequency	Valid Percent	Valid Percent	Cumulative Percent
Intensive	39	65	65	65
Semi intensive	19	31.7	31.7	96.7
Extensive	2	3.3	3.3	100
Total	60	100	100	

The table showed that majority of fish farmers in Imo state used intensive system of farming (65.5%) more than semi-intensive (31.7%) and extensive (3.3%). They also process their fish using modified drum ovum and altona (36.7%) respectively choker kiln and solar tent (13.3%) respectively.

The summary of farming system and processing methods in all the states is given in Table 7 and Table 8, respectively.

TABLE 7
SUMMARY OF FARMING SYSTEM IN ALL THE STATES

Current technology	Abia state	Anambra state	Ebonyi state	Enugu state	Imo state
Intensive	41	40	40	39	39
Semi intensive	17	17	17	18	19
Extensive	2	3	3	3	2
Total	60	60	60	60	60

Fish farmers in the entire south east used mainly intensive system of farming and less of extensive system of farming.

TABLE 8
SUMMARY OF PROCESSING TECHNOLOGY IN ALL THE STATES.

Processing technology	Abia state	Anambra state	Ebonyi state	Enugu state	Imo state
Modified drum ovum	22	27	21	22	22
Choker kiln	8	13	9	9	8
Altona	18	27	19	21	22
Solar tent	12	13	11	8	8
Total	60	80	60	60	60

Modified drum ovum as the most popular processing method preferred by all the fish farmers in the entire five south east states of Nigeria while choker kiln is the least.

Results of the multiple comparisons among farming systems and among processing methods in south east, Nigeria are shown in Tables 9 and 10.

TABLE 9
MULTIPLE COMPARISONS AMONG FARMING SYSTEMS IN SOUTH EAST, NIGERIA

(I) Current technology	(J) Current technology	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intensive	Semi intensive	22.20000*	0.4899	0	21.1326	23.2674
	Extensive	37.20000*	0.4899	0	36.1326	38.2674
Semi intensive	Intensive	-22.20000*	0.4899	0	-23.267	-21.133
	Extensive	15.00000*	0.4899	0	13.9326	16.0674
Extensive	Intensive	-37.20000*	0.4899	0	-38.267	-36.133
	Semi intensive	-15.00000*	0.4899	0	-16.067	-13.933

TABLE 10
MULTIPLE COMPARISONS AMONG PROCESSING TECHNOLOGIES IN SOUTH EAST, NIGERIA

(I) Processing technology	(J) Processing technology	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Modified drum ovum	Choker kiln	13.4000*	1.00664	0	11.2067	15.5933
	Altona	1.4	1.00664	0.19	-0.7933	3.5933
	Solar tent	12.4000*	1.00664	0	10.2067	14.5933
Choker kiln	Modified drum ovum	-13.4000*	1.00664	0	-15.593	-11.207
	Altona	-12.0000*	1.00664	0	-14.193	-9.8067
	Solar tent	-1	1.00664	0.34	-3.1933	1.1933
Altona	Modified drum ovum	-1.4	1.00664	0.19	-3.5933	0.7933
	Choker kiln	12.0000*	1.00664	0	9.8067	14.1933
	Solar tent	11.0000*	1.00664	0	8.8067	13.1933
Solar tent	Modified drum ovum	-12.4000*	1.00664	0	-14.593	-10.207
	Choker kiln	1	1.00664	0.34	-1.1933	3.1933
	Altona	-11.0000*	1.00664	0	-13.193	-8.8067

Multiple comparisons among farming systems revealed no significant differences between intensive systems of fish farming ($P < 0.05$) when compared with semi-intensive and extensive systems. There was also no significant difference when extensive systems were compared with intensive and semi intensive.

Multiple comparisons among processing technologies showed that there were significant difference between modified drum ovum and altona ($P < 0.05$) while there were no significant difference ($p < 0.05$) between modified drum ovum and choker kiln and solar tent. There were no significant difference ($P > 0.05$) between and choker kiln and solar tent. There was also no significant difference ($p > 0.05$) kiln while there were no significant difference ($P > 0.05$) when compared with modified drum ovum and atona.

The influence on the use of new technologies on the sustainability of fish farmers in south east Nigeria was also examined during the study period. Most fish farmers in South East Nigeria used intensive system of farming and less extensive system. The difference in the culture systems are that the input fingerlings and out (harvest) are high in intensive system as their higher number of input and output when tend to improve upon the result from the farm (Chioma and Adebayo, 2012; Abioma *et al* 2012). It was also observed that majority of the fish farmers in south east used modified drum ovum as the most popular fish processing method. This can be attributed to its availability and affordability. When intensive system of fish farming were compared with other systems, there was no significant different ($p<0.05$) among them. However, when modified drum was compared with other types of processing there were significant difference ($p>0.05$).

Result of respondents on ways fish farming can be improved and promoted within the south east showed that fish farmers in south eastern Nigeria have not received adequate extension services 96.0 percent while only a weaker 1.4 percent received.

Salau *et al*. (2014) also reported below level of extension services to fish farmers in Nasarawa State Nigeria.

There were no significant constraints faced by fish farmers in south east, Nigeria.

Data from respondents showed that fish farmers in south east were faced with numerous constraints that tend to reject the smooth running of fisheries enterprises in south east, Nigeria. Among the major constraints were marketing constraints was noticed to be among their major challenge as most fish farmers after struggling to produce their fish the market where they can sell at a competitive price.

There were closely followed by environmental, production, infrastructural, financial, production as well as institutional respectively.

IV. CONCLUSION

Result from respondents showed that the entire government of southeast do not support towards aquaculture improvement as there is no government support noticed during this study. There were no extension services from government, no loan

facilities, no training, etc. Most of the fish farmers are just car but their fish farming activities through self-help and family support.

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