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Adoption of Aquaculture Technologies among Fish Farmers in Oluyole Local Government Area, Oyo State

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Abstract**—** *This study examined the level of adoption of aquaculture technology among fish farmers in Oluyole Local Government area of Oyo State, Nigeria. To improve aquaculture practice in Nigeria, a technology package was developed and disseminated to fish farmers in the Local Government. This package included twelve practices that the fish farmers were supposed to adopt. One hundred and ten respondents were randomly selected from the registered fish farmers in the Local Government. Data were collected through use of well structured questionnaire. Descriptive statistics such as percentage and frequency distribution were used while Chi-square and PPMC were used to analysis the hypotheses. The results showed that level of adoption of the technology was low. Less than half of the respondents adopted the technology. After the liming of pond, which was fully adopted by 55.9%, pond outlet and inlet fully adopted by 50.0% and Feed technology fully adopted by 50.0% which were usually not to specification. The farmers found it difficult to adopt the other recommendations, (e.g., Use the chilled holding for preservation fully adopted by 16.6%, hatchery technique fully adopted by 40.4% Water quality test before fully adopted by 40.1%). It was discovered that the farmers did not have adequate funds to maintain their small ponds and to purchase the necessary feed and other necessities for aquaculture technology adoption. To increase the level of adoption of aquaculture technologies in the study area, it is necessary to change farmers' perception from subsistence to commercial and sustainable farming practice; to assist the farmers with credit facilities and to intensify activities of the extension agents.*

Keywords**— Adoption, Aquaculture, Technologies, Fish, Farmers.**

I. INTRODUCTION

Fish farming is expanding rapidly throughout the world and has a high potential for the provision of valuable protein in less developed countries. World aquaculture production attained an all-time high level in 2006, at 47.3 million tonnes excluding aquatic plants and non-food products (FAO 2008).

According to National Information Centre (NIC) (2007), aquaculture plays an important role in many developing economies. In Nigeria, aquaculture is gaining increasing importance for employment creation and income generation, particularly in the socio-economic weaker communities of fishermen, which represents the poorest section of the society in many developing countries (NIC, 2007). The average annual demand for fish in Nigeria by 2006 was estimated to be 2.66 million metric tonnes, (FDF, 2007).

According to FAO (2005) aquaculture system is not operating in a sustainable and efficient manner over the years, however effort have been made to develop new and suitable techniques which have been introduced into the industry.

The major problem has been the inadequacy of appropriate technologies (Gupta *et al.*, 2004 and UNDP, 2004). Aquaculture technologies have been developed disseminated to fish farmers across the nation. However, the system and technologies used in aquaculture have developed rapidly in the last fifty years (FAO, 2012). They vary from simple facilities to high technology systems. The crucial point is for

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the farmers to be able to afford and adopt the technologies extended to them. According to Daniel *et al.*, (2005), people do not just adopt technologies because of its availability but even when the technologies are available and appropriate, there are some personal and socio-economic or cultural factors that determine the decision to adopt or not.

This study was however carried out to assess the level of adoption of aquaculture technologies among fish farmers in the study area with the specific goals of ascertaining the sources of information on aquaculture technologies, determining the available aquaculture technologies and their level of adoption as well as the constraints faced in adopting them in the study area.

II. METHODOLOGY

This study was carried out in Oluyole Local Government area of Oyo State. The study area is in the northern eastern part of the state and it has an area of 629km^2 and a population of 202,725 at the 2006 census (National Population Census (NPC) 2006). The study area is situated within the tropical rainforest region, agricultural and other petty trading are the predominant occupation in the study area. The climates in the study are tropical type with two distinct rainfall patterns. The rainy season which marks the agricultural production season is normally between the month of April and October.

Although Oluyole local government area was randomly selected among the 33 local government in Oyo State, purposive sampling was used to select three villages in Oluyole Local Government based on the fact that fish farming activities is predominant in the area. They are the largest villages that are practicing aquaculture in Oluyole LGA. Also, Random sampling techniques was used to select 50% of the fish farmers in each village base on the total number of registered fish famers i.e. Ayegun, 42, Jaloke 28, Mosfala 40. This gave a total number of 110 fish farmers selected in the study area.

Distribution of respondents

Community selected	No. of registered fish farmers in each community	No of fish farmers selected in each community
Ayegun	83	42
Jaloke	56	28
Mosfala	80	40
Total	219	110

Primary data were collected from fish farmers usung a well structured questionnaire. Both descriptive and inferential statistical tools were used to analyze the data collected. Descriptive Statistic such as frequency and percentage were used, while Chi-square and Pearson Product Moment Correlation (PPMC).

Chi-square model used

$$X^2 = \frac{\Sigma(0-E)^2}{E}$$

X^2= The Chi-Square
Σ = The Summation of the Value
0 = The Observed Value
E = The Theoretical or Expected Value

Pearson product moment correlation model

$$P = \frac{\sum (x)(y)}{\sqrt{\sum x^2 \sum y^2}}$$

P = Pearson product moment correlation
$\sum$ = Summation of the frequency
$x = X - x$
$Y = Y - y$
X = mean of the frequency
Y = mean of the frequency

III. RESULTS AND DISCUSSION

Table 1. Socio Economic Characteristics of the Respondents

Variable	Frequency (n=102)	Percentage
Gender		
Male	82	80.4
Female	20	19.6
Marital status		
Single	35	34.3
Married	62	60.8
Divorced	2	2.0
Widowed	3	2.9
Age		
21-30years	22	21.6
31-40yeas	34	33.3
41-50years	29	28.4
51-60 years	14	13.7
Above 60 years	3	2.9
Educational status		
Informal education	20	19.6
Adult education	19	18.6
Primary education	2	2.0
Secondary education	21	20.6

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Tertiary education	40	39.2

Table 1 shows the gender distribution indicating that majority (80.4%) of the respondents were male while 19.6% were female which implies that males were engaged more in aquaculture simply because farming demands a lot of energy and skills especially in the area of construction of the pond, hatching and feeding. This aligned with the report of Birner, (2006) who reported that men engage in agriculture more than women.

The result also shows that most (60.8%) of the respondents were married while 34.3% were single. This implies that most of married people need to cater for their household, so fish farming serves as one of attractive livelihood activities in the study area. The result further revealed that more than fifty percent of the respondents were in age ranged from 21-40 years. This is in agreement with the findings of Okunmadewa *et al.*, (2000) and Afolabi (2007) that most of these fish farmer were in their active and productive ages who can easily adopt new innovations that could enhance aquaculture.

Moreover, 39.2% of the respondents attended tertiary institution, 20.6% were with secondary school certificate, 19.6% were with no formal education, and 18.6% were with adult education while 2.0% had only primary education. The implication is that the ability to read the write could enhance them to easily adopt new innovation and expose them to market information which could lead to more efficient fish farming activities. This is in agreement with the report of Azeez (2013) that, most of the fish farmers have tertiary education and Akinwole *et al.*, (2014) that reported that 82% of their respondents farm managers have tertiary education (OND and above.

Table 2: Respondents involvement in aquaculture

Variable	Frequency (n=102)	Percentage
Secondary Occupation		
Civil servant	38	37.3
Security	13	12.7
Trading	25	24.5
Crop farmer	23	22.5
Business	2	2.0
Engineering	1	1.0
Type of Pond		
Concrete pond	38	37.3
Earthen pond	5	4.9
Plastic or vat	29	28.4
Re-circulatory	8	7.8
Earthen and plastic	2	2.0
Concrete and earthen	15	14.0
Concrete, earthen and plastic	5	4.9
Years of Experience		
1-5yrs	55	53.9
6-10yrs	32	31.4
11-15yrs	8	7.8
Above 15yrs	7	6.9
Mode of Production		
Large scale	26	25.5
Medium scale	50	49.0
Small scale	26	25.5
Income per annum		
Less than 100,000	23	22.5
100,00-200,000	44	3.1
Above 2000,000	35	34.3

According to table 2, majority (37.3%) of the respondents were civil servants while 24.5% were involved in trading as 22.5% involved in crop farming, only 2.0% were involved in business while as secondary means of livelihood. This implies that fish farming could be done with another job with little or no distraction. However this contradict the findings of Kainga *et al.*, (2016) that reported majority of the fish farmers to be farmers in other areas other than fishing.

The table also revealed the type of pond the respondents are using in carrying out their aquaculture activities. Most (37.3%) of the respondent use concrete pond, about 28.4% use plastic or vat, 7.8% re-circulatory while only 4.9% use earthen pond. This is does not agree with the submission of Akinwole *et al.*, (2014) who reported that most of their respondent used earthen ponds.

The result from the table shows that the majority (53.9%) of the fish farmers has 1-5 years of experience while 31.4% has 6-10 years' experience. Only 7.8% with 11-15 years but less than seven percent has above 15 years of experience. This is in contrast to the findings of Kainga *et al.*, (2016) that reported majority of the fish farmers with between 5- 10 years of experience in the business.

The table also shows that 49.0% were operate medium scale fish farming while both large and small scale production were 25.5% of the respondents. On income generation the table shows that 43.1% of the respondents make ₦100,000-₦200,000 gross income per annum, followed by 34.3% with above ₦200,000 per annum while 22.5% make less than

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₦100,000 gross income per annum. This is unlike the report from Ibarapa area of the state where Akinwole *et al.,* (2014) reported that most of the fish farmers are into large scale production.

Table 3: Source of Information on Aquaculture Technology

S/N	Statement	Never	Rarely	Occasionally	Regularly
1	Family member	20(19.6)	23(22.5)	16(15.7)	48(42.2)
2	Friends/neighbor	13(12.7)	32(31.4)	20(19.6)	37(36.3)
3	Extension agents	31(30.4)	16(15.7)	26(25.5)	29(28.4)
4	Radio	20 (19.6)	33(32.4)	27(26.5)	22(21.6)
5	Fisheries association	19(18.6)	26(25.5)	28(27.5)	29(28.4)
6	Handbill/posters	31(30.4)	30(29.4)	22(21.6)	19(18.6)
7	Seminal	35(34.3)	27(26.5)	27(26.5)	13(12.7)
8	Newspaper	42(41.2)	32(33.3)	20(19.6)	8(7.8)
9	Television	37(36.3)	34(33.3)	20(19.6)	11(10.8)
10	Cooperative society	31(30.4)	34(33.3)	27(26.5)	10(9.8)
11	Internet	51(50.0)	19(18.6)	22(21.6)	10(9.8)
12	Research Institute	49(48.0)	25(24.5)	17(16.7)	11(10.8)

Percentage (%) in parenthesis

Table 3 shows the source of information on aquaculture technology among the respondents. The results shows that 42.2% and 36.4% regularly get information on aquaculture technology from their friends family member while only 28.4% regularly get information from extension agents.

Furthermore, not fewer than 71.6% rarely get information on aquaculture technology from the fisheries association.

The respondents never heard information from handbill or poster were 30.4%, 29.4% rarely heard, 21.6% occasionally heard while 18.6% regularly heard information. Also, 34.3% of the respondents never heard information through seminar or workshop. While rarely and occasionally information had 26.5% likewise 12.7% of the respondents regularly heard information 41.2% of the respondent never heard information from the news paper, 31.4% rarely heard, 19.6% occasionally heard, while 7.8 regularly heard information from the newspaper. Television as source of information was never heard by 36.3% of the respondents, 33.3% rarely heard, 19.6% occasionally heard, while 10.8% regularly hard information from the television. Furthermore, 26.5% regularly get information from the cooperative society, 33.3% rarely, 26.5% occasionally. Some respondents obtain information from internet and research institute. This is in line with the findings of Ifejika *et al.,* (2009) on influence of information sources on aquaculture technologies adoption among fish farmers.

Table 4: Available Aquaculture Technology among the respondents in the Study Area.

Aquaculture Technology	Yes	No
Install water inlet and outlet device	82(80.4)	20(19.6)
Fertilizer application techniques	70(68.6)	32(31.4)
Hatching /breeding of the fish	57(55.9)	45(44.1)
Water quality test before stocking	65(63.7)	37(37.3)
Smoking kiln for preservation techniques	63(61.8)	39)38.2)
Feed Technology	45(44.1)	57(55.9)
Re-circulatory system aquaculture (RAS)	44(43.1)	58(56.9)

Percentage (%) in parenthesis

Table 4 shows that majority (80.4%) of the respondents considered install water inlet and outlet devices as aquaculture technology, while a good portion (68.6%) of the respondents considered fertilizer application techniques as aquaculture technology. The table further revealed that the only (55.9%) of the respondents considered hatchery and

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breeding of fish as aquaculture technology, while the most (63.7%) of the respondents considered water quality test before stalking as aquaculture technology. This is also supported by Roger (2003). 44.1% and 43.1% of the respondents reported feed technology and re-circulatory system aquaculture respectively as their own aquaculture technologies. This falls in line with the reports of FAO, (2003).

Table 5: Level of Adoption of Aquaculture Technology in the study area

Technology	Not adopted	Partially adopted	Fully adopted
Soil testing before pond construction	37(36.3)	23(22.5)	42(41.2)
Fertilizer application	25(24.5)	26(27.5)	49(48.0)
Water quality test before	36(35.4)	25(24.5)	40(40.1)
Stocking the pond base on the specification by the ADP	24(23.5)	38(37.3)	40(39.2)
Feed Technology	22(21.6)	29(28.4)	51(50.0)

Percentage (%) in parenthesis

Table 5 above shows that majority (41.2) of the respondents had fully adopted the aquaculture technology on soil testing before construction while 22.5% had partially adopted the technology with 36.3% non adopters. Also, not fewer than 41.2% had fully adopted fertilizer application techniques, while 27.1% and 24.5% are partial and non adopter respectively. More so, about 40.1% respondents had fully adopted the water quality test before stocking, this agrees with Kainga *et al.*, (2016) that the adoption of water quality maintenance (pH testing) by fish farmers was high, while fewer (35.4%) not adopted the water quality test before stocking.

Table 6: Constraints to Adoption of Aquaculture Technology in the study area

S/N	Statement	Not constraints	Minor constraints	Major constraints
1.	Inadequate information on aquaculture technology	43(42.2)	38(37.3)	21(20.6)
2	Insufficient financial support	29(28.4)	23(22.5)	50(49.0)
3	Inadequate technology	33(32.4)	40(39.2)	29(28.4)
4	Inadequate technical know how	46(45.1)	41(40.2)	15(14.7)
5	In-availability of extension agent	46(45.1)	39(38.2)	17(16.7)
6	Unfavorable environmental condition	53(52.0)	41(41.2)	7(6.9)
7	Inadequate training and technical support	48(47.1)	38(37.3)	16(15.7)

Percentage (%) in parenthesis

Table 6 above shows that few (20.6%) of the respondents considered inadequate information on aquaculture of technology as a major constraint while (42.2%) of them considered inadequate information on aquaculture technology not a constraints but (37.3%). More so, forty nine percent of the respondent considered insufficient financial support as major constraints while only 38.8% see it is as not a constraint. The table also revealed that the few (28.4%) of the respondents considered inadequate technology as a major constraint while to about 45.1% of the respondents did not see inadequate technical know-how as a major constraint. Furthermore, majority (45.1%) of the respondents submitted that unavailability of extension agent is never a a major constraints while some respondents with 38.2% considered it as their minor constraints but a few respondents (16.7%) considered this as the major constraints. This is close to the findings of Akinwole *et al.*, (2014) and Sanusi *et al.*, (2016) that reported funding as one of the major constraints of fish farmers in Ibarapa LGA of Oyo State.

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Table 7: Relationship between socio-economic characteristics of the respondents and their level of adoption of aquaculture technologies.

Variable	X2-value	p-value	Decision
Age	25.037	0.015	Ns
Sex	3.639	0.303	Ns
Marital status	20.354	0.061	Ns
Educational status	39.835	0.000	S
Secondary occupation	41.375	0.000	S
Year of experience	12.996	0.163	Ns

Ns= Not significant N = significant

The chi-square analysis shows that there was no significant relationship between gender, marital status, year of experience and the level of adoption of aquaculture technology. Meanwhile, there is significant relationship between the educational status (X2 = 39.835, p = 0.000) as education will help the fish farmers to understand the aquaculture technology more and this will consequently improve their level of adoption that is, the more educated they are the more their level of adoption may be. Also there is significant relationship between the secondary occupation (X^2 = 41.375, p = 0.000) and level of adoption of aquaculture technologies, secondary occupation will serve as an alternative source of income for the farmer and this will make their level of adoption to be high.

Table.8: Relationship between the constraints faced by respondents in adoption of aquaculture technologies and their level of aquaculture technologies adoption

Variable	r-value	p-value	Decision
Constraints and level of adoption	-0.498	0.000	S

S= significant

The table reveled that there is significant relationship (P<0.05) between the constraints faced by the fish farmers and their level of adoption of aquaculture technologies. This implies that the higher the constraint the lower the level of adoption of aquaculture technologies.

IV. CONCLUSION AND RECOMMENDATION

Results from this study showed that, the level of adoption of aquaculture technologies in the study area was low. Less than half of the respondents adopted most of the technologies. Apart from the liming of pond, pond outlet and inlet as well as feed technology which were fully adopted by the majority which were usually even not to specifications. The farmers found it difficult to adopt the other recommendations, (for example, Use the chilled holding for preservation, hatchery technique, water quality test before). It was discovered that the farmers did not have adequate funds to maintain their small ponds and to purchase the necessary feed and other necessities for aquaculture technology adoption. To increase the level of adoption of aquaculture technologies in the study area, it is necessary to change farmers' perception from subsistence to commercial and sustainable farming practice; to assist the farmers with credit facilities and to intensify activities of the extension agents.

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