ISSN - 2277 - 078X

Journal of Humanities, Social Sciences and Creative Arts

DETERMINANT OF AQUACULTURE TECHNOLOGIES ADOPTION AMONG FISH-FARMERS IN OBAFEMI – OWODE LOCAL GOVERNMENT AREA OF OGUN STATE, NIGERIA

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ABSTRACT

The study was conducted to assess the determinant of aquaculture technologies adoption among fish-farmers in Obafemi – Owode local government area of Ogun State, Nigeria. Primary data were obtained from 224 fish farmers with an interview-schedule guide and field observation using simple random sampling and snow-balling sampling techniques during 2008 culture period. The study revealed that majority of the respondents were male (78.6%) within active age group of 41-50 years (47.0%), had primary education (51.0%), with household size of 7-8 persons (35.7%), farming as primary occupation (71.4%), fish farming experience of 3-4 years (40.0%) and belonged to fish farmers organization (51.4%). The major constraints in aquaculture were lack of access to appropriate land (31.4%), non-availability of micro-credits (97.1%), lateness in the supply of technological packages (75%), lack of infrastructural facilities (75%) and spatial factors to extension services and inputs (67.1%). The result of chi-square analysis showed that only sex (0.672, $p<0.01$) and extension agents (0.060; $p<0.01$) had significant association between socio-economic information variables and aquaculture technologies adoption. Based on the findings of this study, the following were therefore recommended: In an enterprise where a large proportion of the fish farmers were literate, adoption of disseminated improved innovation by extension agents will be embraced, high proximity to extension and communication services as well as aquaculture inputs will be enhanced if farmers formed themselves into cooperative societies, provision of rural infrastructures, as well as credit facilities should be provided by government. Participatory development of technologies between researchers and farmers are essential factors for adoption of new fish farming technologies.

Key Words: Aquaculture Technologies, Adoption, Fish-Farmers, Nigeria.

INTRODUCTION

Nigeria is blessed with inland water, brackish water and marine water fisheries resources. On the basis of her resources, fisheries can be broadly classified into: Artisanal fisheries (85%), Industrial fisheries (14%), and culture fisheries (1%) (FDF, 2005). Nigerians are high fish consumers and offer the largest market for fish and fisheries products in Africa. Out of a total annual demand of 1.5million tonnes (2005 projection), only about 511,000 tonnes are produced locally and supplemented with about 700,000 tonnes of imports worth about N50 billion (FDF, 2005). There is a shortfall of over 500,000 tonnes.

An alternative is how to substitute fish imports with domestic production in order to create jobs, reduce poverty in the rural areas where 70% of the population lives and to reduce the balance of payment deficits (FDF, 2005). Global total production of fish, crustaceans and molluscs has continued to increase and reached 142 million tonnes in 2008. While capture production has stayed around 90 million tonnes level since 2001, aquaculture production has continued to show strong growth, increasing at an average annual growth rate of 6.2 percent from 38.9 million tonnes in 2003 to 52.5 million tonnes in 2008. The value of aquaculture production was estimated at USD 98.4 billion in 2008 (FAO, 2008; 2011).

Aquaculture continues to be the fastest growing animal food - producing sector and outpace population growth (FAO, 2011) and it will play an increasingly important role in meeting the demand for fish. In 2006, China contributed 67 percent of the world's supply of cultured aquatic animals and 72 percent of its supply of aquatic plants.

World aquaculture has grown dramatically in the last 50 years. From a production of less than 1 million tonnes in the early 1950s, production in 2006 was reported to have risen to 51.7 million tonnes, with a value of US$78.8 billion. This means that aquaculture continues to grow more rapidly than other animal food-producing sectors. While capture fisheries production stopped growing in around mid-1980, the aquaculture sector has maintained an average annual growth rate of 8.7 percent worldwide (excluding China, 6.5 percent) since 1970. Annual growth rates in world aquaculture production between 2004 and 2006 were 6.1 percent in volume terms and 11.0 percent in value terms. If aquatic plants are included, world aquaculture production 2006 was 66.7 million tonnes and worth US$85.9 billion.

In 2006, countries in the Asia and the Pacific regions accounted for 89 percent of production by quantity and 77 percent of value. Of the world total, China is reported to produce 67 percent of the total quantity and 49 percent of the total value of aquaculture production (FAO, 2011).

ICLARM (2001), reported that aquaculture appear to be one of the last frontiers to increase contribution to food security in the developing world and it now represents the fastest growing agricultural industry in some countries, with fresh water aquaculture dominating total aquaculture production. Increased aquaculture production has been regarded by many people as an important option for dealing with the conflicting problem of over-fishing and increasing demand for fish. An increased in the supply of aquaculture product will reduce both the demand and price of capture fisheries. This could in turn reduce the investment and fishing effort in capture fisheries (Ye and Beddington, 1996).

Food and Agricultural Organization of United Nations (FAO, 2008) showed that Africa had much aquaculture potential indicating an opportunity to improve food security, nutrition and income generation among the poor. However, aquaculture is generally practiced on a small scale in Africa usually as simple, low input, fresh water pond culture, considering its size and demand for fish products, the continent produces very little only about 0.5% of the world aquaculture output and about 80% of this is produced by

just two countries viz: Nigeria (Tilapia, carp and catfish) and Egypt (Tilapia, carp and mullet) (Sverdrup-Jensen, 2000, FAO, 2011).

Fish farming is a feasible activity for small scale farmers to generate extra income and to add highly nutritious food to the daily diet. Fish farming can be combined with crop, animal husbandry and irrigation practices which can lead to a better utilization of local resources. However, to adopt fish farming as a new innovation, such household would have to relocate their time, labour and other resources to integrate fish farming with their traditional activities (Assiah *et al*., 1996; FAO, 2008).

Problem Statement

In spite of all the benefits associated with aquaculture, the level of adoption of aquaculture technology among house hold appears to be very low due to low contribution made by aquaculture, this amount to 0.55 metric tonnes supply locally which still remains 1.1 metric tonnes to meet up with 1.5 metric tonnes of projected national fish demand of 2005 estimates. It could be scaled up to meet the projected shortfall from natural fisheries, through the development and adoption of improved technologies which plays a critical role in improving the productivity and welfare of limited resource farmers in low-income countries (Sall *et al.* 2000). The role of extension is to facilitate the adoption of new agricultural technologies or to influence its rate of diffusion and adoption of innovation by farmers. According to Feder *et al*. (1995) and Odhiambo, (1998), adoption as a process could be influenced by a number of notable factors which include socio-economic, extension contact, provision of infrastructures and institutional factors. The questions to be asked are; whether the fish farmers perceived the improved fisheries technologies as more productive and acceptable for adoption and what are the factors influencing adoption of fisheries technologies. This study is expected to fill this gap and to provide information for possible further interventions in the promotion of aquaculture.

The paper therefore, focus on determinants of aquaculture technologies adoption among households in Obafemi- Owode area of Ogun State. It was hypothesized that socio-economic, cultural and information factors of fish farmers could lead to significant adoption of improved fisheries technologies.

Theoretical Perspectives

The development and adoption of improved technologies play a critical and essential role in improving the productivity and welfare of limited resource farmers in Low Income Countries (Sall *et al.,* 2000). Kroma, (2003) has observed that, there is a wide gap between agricultural technologies produced in research institutions, and the adoption of such technologies by small-scale farmers and rural households in sub-Saharan Africa. However, considerable research had been directed to the adoption of innovations in agriculture since Griliches (1959) pioneering work on the adoption of hybrid maize in the United States of America.

Several socio-economic factors have contributed to the adoption of new agricultural technologies. For example, Daramola (1998) stated that household, farm size, farm income, and human capital are factors influencing the adoption of improved maize varieties in Oyo State. Adoption of new practices involves time dimension in which several steps including awareness, information seeking, decision process, trial, evaluation

and adoption come into play (Sall *et al.*, 2000). Farmers may be desirous of adopting new practices but may be constrained by inadequate information about that particular innovation, caused by the inability of the extension agents to reach the farmers. Tiamiyu *et al.* (2001) stated that the determinants of adoption of soybean cultivation in Niger State were farm size, farming experience and literacy level of the adopters. Onyenweaku and Mbuba, (1991) found out that the determinants of the adoption of the seed-yam minisett multiplication technique by farmers in Anambra State of Nigeria were: profitability, lack of awareness of the technique, labour availability, frequency of attendance at meetings and extension contact, farmer's age, education, farming experience, tenancy status, membership of cooperative societies and credits.

Another factor that tends to make farmers stick to old practices may be economic, in the sense that the average cost of agricultural innovation and the risks involved may be beyond the reach of most of the farmers. Farmers who can bear the risk need constant visits and assurance by extension officers. Where there are no good roads or adequate logistic arrangements provided, the number of times an extension personnel visits a farmer may be very minimal. Related to good roads is the distance that separates the farmer from the source of information. Where the source is far, it is likely to lead to low level of adoption (Osuji, 1983).

Where farmers are provided with credit facilities (either in cash, kind or both) and farmers with dependable income, their rate of adoption is expected to be high. The ratio of extension agents to farmers is very vital for effective contact and enhances adoption.

The study was conducted in the extension villages during the 2008 culture period and was restricted to all registered fish farmers under the Ogun State Agricultural Development Programme (OGADEP). Primary data were obtained from two hundred and twenty four (224) fish farmers with interview schedule guide and field observation, which were selected using simple random sampling and snow-balling sampling techniques. The study attempts to determine factors that impede effective adoption of improved aquaculture technologies.

RESEARCH METHODS

Study Area and Sample

Obafemi Owode is one of the twenty Local Government Areas of Ogun State, Nigeria. Its headquarters are in the town of Owode at 6^0 57'N, 3^0 30'E. It is predominantly a rural settlement of about 104,787.07 hectares of land, has an area of 1,410 km^2 (544.4 sq. miles) with a population of 228,851 people at the 2006 census (Wikipedia, 2010). The local government is bound in the East by Ikenne Local Government, in the West partly by Abeokuta South Local Government and Ifo Local Government, in the south by Ifo Local Government. Obafemi Owode Local Government belongs to Ikenne Agricultural Extension Zone of Ogun State Agricultural Development Programme (OGADEP) (Fig. 1). It has two extension blocks namely Shomeke and Obafemi. The blocks were randomly and purposively selected and they consist of eight (Iro, Mokoloki, Ofada, Mowe-Ibafo, Owode, Ajura, Kobape and Oba) and six (Adigbe, Kajola, Ayerose, Ajebo, Obafemi and Ogunmakin) extension circles respectively. Snow-balling sampling was used to select fish farmers from the towns and villages within the circles during the 2008 growing season. A total of two hundred and ten (210) returned the interview guides and

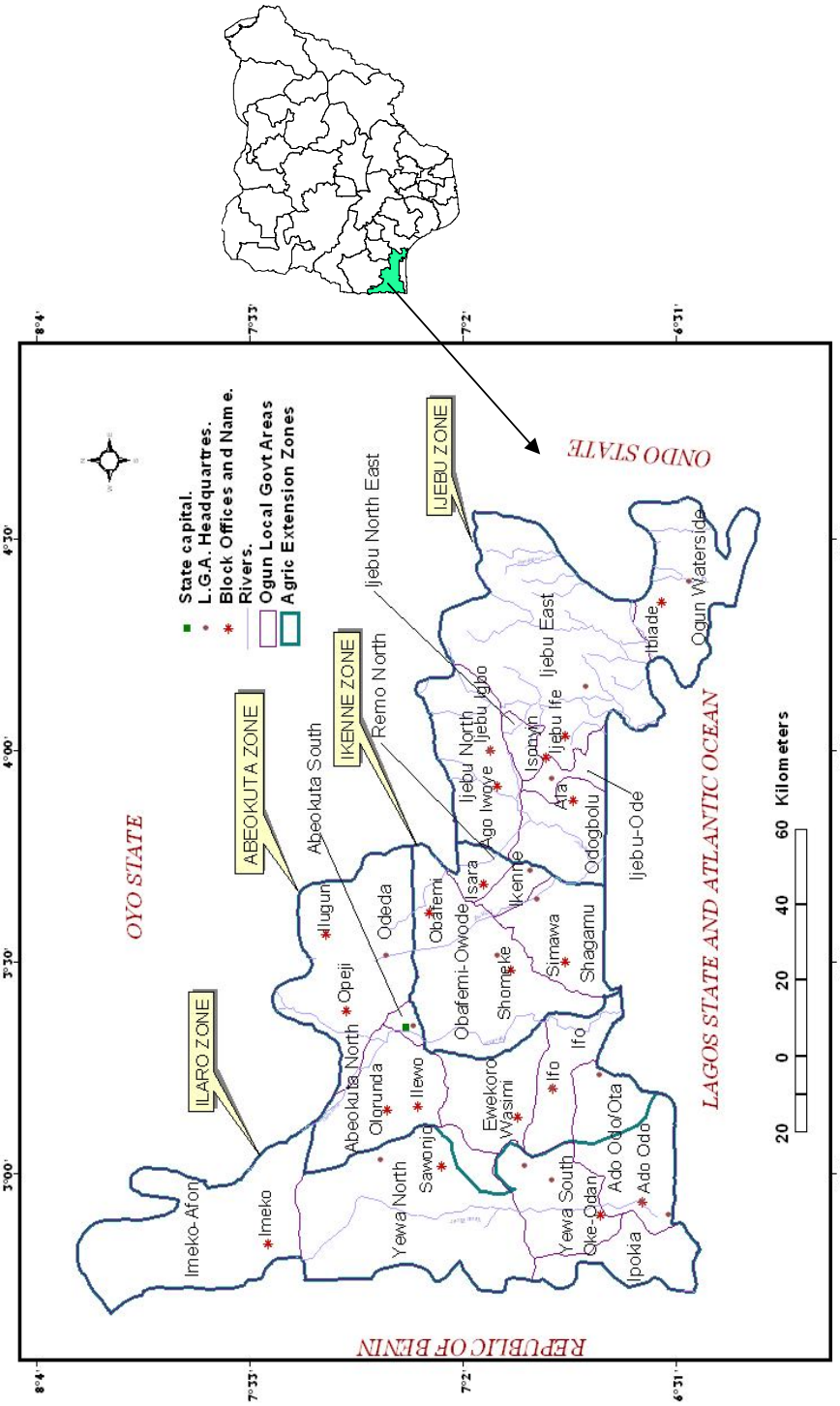

Figure 1: Ogun State ADP Zones and Blocks

the response rate of 93.8% was finally used for the study.

The data collected from the fish farmers include those on their socio-economic characteristics. These variables were based on personal characteristics that were shown in literatures to be related to adoption such as age, sex, marital status, business experience, level of education, access to appropriate land and training acquired. Part B of the instrument elicited information in factors affecting fish farming technology adoption. The farmers were asked to indicate their response on the degree of the severity of the problems encountered in the aquaculture technology adoption.

Instrument for Data Collection and Analysis

Quantitative data were collected with structured interview guide on sampled household by four trained enumerators under close supervision of the researchers. The contents of the interview guides were usually translated to the local dialect of the respondents (Yoruba) for those not literate and otherwise responses were recorded in English Language. The instruments were field tested for face and content validity by panel of experts in fisheries management, and agricultural extension and rural sociology. Minor corrections and restructuring o the instrument were made based on the recommendations of the panel of experts and reliability using the test-retest method. A reliability coefficient (r) of 0.75 obtained was considered a good and reliable measure as instrument for the data collection. Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS) version 12.0 for sample statistics and logistic regression. The probability was set *a priori* at 5% level.

RESULTS AND DISCUSSION

Sample Statistics

Key summary of statistics from the survey are presented in Table 1. Of the entire fish farming households interviewed, the age distribution of the respondents showed that many (47%) of the fish farmers fall between the age group of 41-50 years, indicating that the majority of the respondents were within economically active age distribution who constitute good and potential labour force for the fisheries enterprise (FAO, 1997), while minority (4.3%) of the respondents were above 60 years of age. This age bracket is a productive age which portends better future to fish production adoption. Majority (78.6%) of the fish farmers were male, while few (21.4%) were female. This implies that more males are involved in small-scale fish farming which is in line with the culture of the people in the area where men engage in aquaculture more than women and that women are mostly involved in processing and other post-harvest activities (Raufu *et al.,* 2009). This was contrary to Worby (2001), who reported that females were often motivated than male to adopt new technologies that provide nutritional benefits such as fish culture. Majority (90.0%) of the farmers were married, while (a few of them) 1.4% were widowed. This shows that most of the small-scale fish farmers are settled family men and women with responsibilities. These responsibilities would likely make them willing to seek innovations so as to increase their income earning capacity and improve their standard of living (Raufu *et al.,* 2009). Close examination of the variables related to household level showed that many (35.7%) of the farmers had between 7-8 persons living under the same roof, while few (1.4%) of the respondents had less than two persons.

Fifty one percent of the fish farmers had at

Table 1: Distribution of fish farmers by socio-economic characteristics

Variables	Frequency	Percentage
Age in Years		
25-30	9	4.3
31-40	57	27.1
41-50	99	47.1
51-60	36	17.1
Above 61 years	9	4.3
Sex		
Male	165	78.6
Female	45	21.4
Marital Status		
Single	6	2.9
Married	189	90.0
Divorced	12	5.7
Widow	3	1.4
Household Size		
Less than 2	3	1.4
3-4	33	15.7
5-6	57	27.1
7-8	75	35.7
9-10	24	11.4
Above 11	18	8.6
Level of Education (Years.		
No Formal Education	6	2.9
Elementary Education	117	51
Secondary Education	48	22.9
Tertiary Education	39	19
Secondary Occupation		
Farming	150	71.4
Teaching	18	8.6
Civil Servant	21	10.0
Tailoring	3	1.4
Carpentry	6	2.9
Trading	6	2.9
Banking	6	2.9
Years of Experience		
Less than 2	57	27.1
3-4	84	40.0
5-6	45	21.4
7-8	15	7.1
9-10	9	4.3
Fish Farming Training		
Yes	162	77.1
No	48	22.9
Fish Farmer Organization		
Yes	102	48.6
No	108	51.4
Access to Appropriate land		
Yes	183	87.1
No	27	12.9

least primary education which was regarded as an adequate level of education for an individual to read, write and understand agricultural instructions including extension services, management and technology adoption constraints. According to Osuji (1983), lack of access to education, failure of extension to visit farmers and lack of financial assistant are institutional factors hindering the adoption of innovations by farmers. Also, Ekoja (2004) conducted a study on 500 Nigerian farmers in five ecological zones and found that significant differences existed among farmers in the adoption of innovations on account of educational qualifications, farm size and mean perception of their access to information. Majority (71.4%) of the fish farmers interviewed claimed that farming was their primary occupation, which was in line with empirical evidence that majority of the rural dwellers engaged in agricultural production. Fifty percent of the respondents were observed to have fish farming experience of between 3-4 years, while few (4.3%) of them had 9-10 years' experience. This implies that the farmers in the study area had experience in fish farming but there was indication that the technologies were very new in the last 7 -10 years. Also 51.4% of the fish farmers belonged to fish farmers' organization.

Factors affecting Fish Farming Technology Adoption

In Nigeria, many researchers including Osuji (1983), Onyenweaku and Mbada, (1991) and Tiamiyu *et al.* (2001) have investigated factors related to the adoption of improved farm practices. Table 2 shows various factors that affect aquaculture technologies' adoption in Obafemi Owode, and these were rated according to their degree of severity. Most of the fish farmers (68.6%) claimed that access to appropriate land was not a problem, while few (31.4%) of the respondents said it was a serious problem. Majority (93.3%) of the fish farmers said that old age was not a problem, while 2.9% claimed that it was a serious problem. This was in agreement with the largest age distribution (47.1%) in Table 1. Majority of the respondents (77.2%) considered non-availability of micro-credits for the purchase of inputs as a serious problem. This implies that getting credits for aquaculture business was difficult making farmers to join cooperative society.

More than half of the fish farmers (55.7%) indicated that fisheries technologies were not adaptable to fish farming system. In adequate follow up of extension advice (60%) after the establishment of field trials and distance of the extension workers' office (67.1%) to the farm locations was not a serious problem hindering adoption of fisheries technologies. This implies that the farmers were early adopter of improved technology and this was expected to have negatively affected the frequency of extension contacts. Majority (80%) of the respondents claimed that lateness in the supply of technological packages and lacks of infrastructural facilities (76%) were serious factors affecting the adoption of aquaculture technologies.

Relationship between socio-economic, information variables and aquaculture technologies' adoption

The findings in Table 3 show that all the socio-economic variables were not significant except the sex of the respondents that was significantly ($p<0.01$) related to aquaculture technologies adoption. The significance of sex to aquaculture technologies adoption was also supported by findings of Okorie (2001) which indicated that in Nigeria, men utilized the acquired training in the art of

farming and hunting.

Only extension agents in all sources of information was significant ($P<0.01$) to aquaculture technologies adoption. This finding points to the dependence of fish farmers on extension agents for information on fisheries technologies and is in agreement with the work of Obinne and Anyanwu (1991) who reported that if farmers' use of extension agents as communication source was increased they would adopt more of improved crop technologies.

Table 2: Distribution of fish farmers by factors affecting aquaculture technology adoption

Problem Encountered	Severity					
	Serious		Not a problem		Don't know	
	Freq	%	Freq	%	Freq	%
Lack of appropriate land	66	31.5	144	68.6	0	0.0
Old Age	6	2.9	198	94.3	6	2.9
Insufficient Labour	51	24.3	156	74.3	3	1.4
Micro-Credit not available for input purchase	162	77.2	48	22.9	0	0.0
Technologies not adaptable to fish farming system	81	38.6	117	55.7	12	5.7
Difficulties in recalling main features of technologies.	66	31.5	105	50.0	39	18.6
Inadequate follow up extension advice after the trials establishment	48	22.8	126	60.0	36	17.1
Distance of extension staff office to the farm location	12	5.8	141	67.1	57	27.1
Lateness in supply of technological packages	168	80.0	42	20.0	0	0.0
Diseases and Predators	66	31.4	93	44.3	51	24.3
Infrastructure Facilities	159	75.7	51	24.3	0	0.0
Government Policy	30	14.3	78	37.1	90	429

Table 3: Chi-square analysis between socio-economic, information and aquaculture technologies adoption

Variables	X2	Df	Asymp.Sig.(2sided)	Decision
Length of residence	4.133	4	0.351	NS
Age	6.628	4	0.157	NS
Sex	0.068	1	0.672*	S
Marital Status	5.019	3	0.170	NS
Household size	1.555	5	0.907	NS
Education Level	0.014	3	0.791	NS
Primary Occupation	9.545	7	0.216	NS
Experience	4.546	4	0.337	NS
Extension Agents	7.624	1	0.060*	S
Radio Broadcast	0.575	1	0.448	NS
Television Broadcast	0.128	1	0.720	NS
Newspaper	2.154	1	0.142	NS
Friends and Relation	0.151	1	0.698	NS
Village Crier	0.095	1	0.758	NS

CONCLUSIONS AND RECOMMENDATION

The conclusions that could be drawn from both the descriptive and inferential statistics are as follows:

- The majorities (95.6%) of fish farmers were male and their age range was within the economic active range which favoured the adoption of aquaculture technologies.
- Most (90.0%) of the fish farmers were married and it also revealed that they have experience in fish farming.
- The study revealed the undermining role played by capital which poses very serious threat to adoption of aquaculture technologies.
- Majority (71.4%) of the farmers that engaged in fish farming did so either for profit-making or to augment income from other sources.
- Most (77.1%) of the fish farmers obtained information on aquaculture practices through the extension agents, training and mass media but the extension personnel needed to be provided with mobility for improved services delivery.
- The spatial factors (distance) to aquaculture inputs and communication services hindered the continuous adoption of aquaculture technologies.

Based on the findings of this study the followings were therefore recommended. In an enterprise where a large proportion of the fish farmers were literate, adoption of disseminated improved innovation by extension agents will be embraced, high proximity to extension and communication services as well as aquaculture inputs will be enhanced if farmers formed themselves into cooperative societies to access micro-credit and their collective input purchased will be easier provision of rural infrastructures, as well as credit facilities should be provided by government.

Participatory development of technologies between researchers and farmers are essential factors for the adoption of new fish farming technologies.

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(Manuscript received: 13th December, 2010; accepted: 22nd March, 2011).