 Nigerian Journal of Animal Production

Comparative evaluation of economic benefits of adopters and non-adopters of improved fish production technologies in Oyo State, Nigeria

[1*] Ashley-Dejo, S. S., [2] Olaoye, O. J. and [1] Adelaja, O. A.
[1]Department of Aquaculture and Fisheries Management,
[2]Agricultural Media Resources and Extension Centre,
Federal University of Agriculture, Abeokuta, Nigeria
Corresponding author: ashleydejosamuel@gmail.com

Abstract

This study assessed the comparative evaluation of economic benefits of adopters and non-adopters of improved fish production technologies in Oyo State, Nigeria. Primary data were collected with the aid of structured interview schedule administered to 222 active fish farmers using purposive and simple random sampling procedure. Data were analyzed using descriptive statistics, budgetary analysis profitability ratios and inferential statistics. The study revealed that adopters of improved fish production technologies earned mean revenue of N4,873,521.29 with gross margin of N2,376,616.36 while non-adopters earned N3,347,719.08 with gross margin of N1,432,805.00. The results showed Benefit Cost Ratio (1.69 and 1.49), Rate of Return on Investment (0.69 and 0.49), Gross Revenue ratio (0.59 and 0.67), Expenses Structure Ratio (0.15 and 0.17) and Net Profit Margin (0.41 and 0.33) for both the adopters and non-adopters. There was a significant association between adoption of improved technologies and sex, educational level, occupation and marital status. Also, there was a significant relationship between adoption of improved technology and age, years of experience and house hold size. There was a significant difference between the profit level of adopters and non-adopters of improved technologies. Significant level of profit obtained from the study is evidence that adopters had more profit than non-adopters.

Keywords: Adoption, aquaculture, fish farmers, income, profit

Introduction

The level at which most households, particularly in the Sub-Sahara Africa experience food insecurity in today's world call for ultimate attention, out of the one-sixth (800 million people) of the developing countries purported to have access to productive life about 180 million of them are found in Sub-Sahara Africa (Pinstrup – Andersen *et al.*, 2001). United Nation World Food Programme (WFP) reported that 36.4 million of the food insecure people are found in the West Africa (Pinstrup – Andersen *et al.*, 2001). Food security has continued to be a major concern for developing countries as global community strives to meet the Millennium Development Goals (MDGs). It has been internationally observed that food security at all levels (individual, household, national, regional and global) can only be achieved when all people at all times, have physical and economic access to sufficient safe and nutritious food, more importantly is the provision of suitable technologies for use. Food consumption in Nigeria has been found to be inadequate both in quality and quantity. According to Food and Agriculture Organization, (FAO), (2008) the minimum food requirement to be consumed is 2,660 kcal and 69 gm of protein per day. Fish is acclaimed to be the principal source of animal protein for over one billion people globally and provides many important nutritional and health benefits (FAO 2012). Fish has the highest level of easily metabolisable proteins; it is reputed for its high quality proteins, fats, vitamins, calcium, iron and essential amino acids. Per caput consumption of animal

protein in the country has been put at 5gm per day, this is far below the FAO's recommended level of 35gm per day (Raufu *et al.,* 2009). From this fact it is evidence that there is a serious deficiency of nutrition in Nigeria and the result of this inadequate food intake is a problem of under-nutrition and malnutrition. Therefore to bridge this gap, food producers especially the fish farmers need new technologies and resourceful inputs to increase fish production. FAO, 2005 maintained that the World fish catches appear to be levelling off below the estimated Maximum Sustainable Yield (MSY) to 100 metric tonnes per annum. For example, it is projected that developing countries needed an additional 22.5 million metric tonnes of fish in the year 2020, which highlighted the need to increase the food production.Nigeria is among the largest fish consumers in the world with over 1.5 million tonnes of fish consumed annually. This large dependence on imported fish has adversely affected her economy and mostly foreign reserves. Fish production from aquaculture accounted for about 152,796 metric tonnes in year 2009, while only 143,207 metric tonnes in 2008 (Federal Department Fisheries (FDF), 2010). It is obvious from these fact that aquaculture has the potential to help expand the resource base and reduce the pressure on conventional sources of fish, generating employment, foreign exchange and elevating socio-economic of the farmers. The involvement of small scale aquaculture projects in the towns and villages will create employment and thereby alleviate poverty among our youths (Davies, 2005).

The development of aquaculture can only be enhanced by the introduction of new technologies. While there have been instances of successful introduction of improved technology to boost production of aquaculture (Thompson *et al.,* 2005), the major problem has been the lack of appropriate innovation (Toure and Noor, 2001; Gupta *et al.,* 2004; UNDP, 2004). Aquaculture innovation have been developed and disseminated to fish farmers. While some scholars have stated that what is needed is to develop the technologies and make them available (Joshua and Omidiji, 2002), others insist that the transfer of technology would be more effective when there is a greater interaction among the developers, transfer agencies and the farmers (Dlamini, 2003; Yap-Gnaore *et al.,* 1995). However, the crucial point is for the farmers to be able to afford any technology extended to them. UNDP report 2004 indicated that it was the inability of farmers to afford the technologies extended to them that made farmers abandons the ponds. Rogers (2003) added another dimension by stating that the adoption of technology can be affected by the way it is named and positioned.

The demand for fish and fish products has increased worldwide as population is increasing (FAO, 2010). Most of the fish consumed are from the wild, which has reached their maximum sustainable yield due to over fishing, habitat degradation, pollution, and usage of inappropriate technologies (Fagade, 1998; FAO, 2000). This is an indication that the future of capture fisheries is at bleak (Olaoye, 2010). Based on these, it is therefore important that a system of farming which will give lasting solution to the problem must be given adequate attention. It is of great importance that research and extension services on new technologies should be directed to domestic fish production (aquaculture) at both Federal and State levels in Nigeria. Recently, some level of advancement and capacity building programme has led to modern way of production with the adoption of new technologies of fish farming practices which aimed at boosting their production. This research work focus

on sustaining the gains of technology adoption. The objective of this research was to make comparative evaluation of economic benefits of adopters and non-adopters of improved fish production technologies in Oyo State, Nigeria

Materials and methods

The Study Area

The study was conducted in Oyo State South - West Nigeria. Oyo State is one of the thirty-six States of the Federal Republic of Nigeria. It came into existence with the break-up of the old Western State of Nigeria during the State creation exercise of 1976. Ibadan, the capital which is reputed to be the largest indigenous city in Africa, South of the Shara, had been the center of administration of the old Western Region since the days of the British colonial rule in Nigeria. The State has an estimated population of over 5,591,589 million people (N.P.C, 2006). The State is located in the rainforest vegetation belt of Nigeria within longitude 7023'47"N and 3055'0". It is bounded in the south by Ogun State and in the north by Kwara State, in the west by the Republic of Benin while in the east it is bounded by Osun State (Figure 1). Oyo state exhibits the typical tropical climate of averagely high temperatures, high relative humidity and generally two rainfall maxima regimes during the rainfall period of March to October. Oyo State now consists of thirty three Local Governments and the capital of the state is Ibadan. The main occupations of the people in the state are: Agriculture which is the mainstay of the economy of the State. The tropical nature of the climate favours the growth of variety of food and cash crops are yam, maize, cassava, millet, plantain, banana, rice and fishing. It is concerted efforts to revitalize agriculture in the state and thereby boost food production, the State Government has established the sate-wide Oyo State Agricultural Development Programme (OYSADEP), which is an offshoot of the defunct Oyo North Agricultural Development Project (ONADEP).According to OYSADEP, Oyo State was divided into four Agricultural extension zones namely: Ibadan/Ibarapa, Ogbomoso, Oyo and Saki.

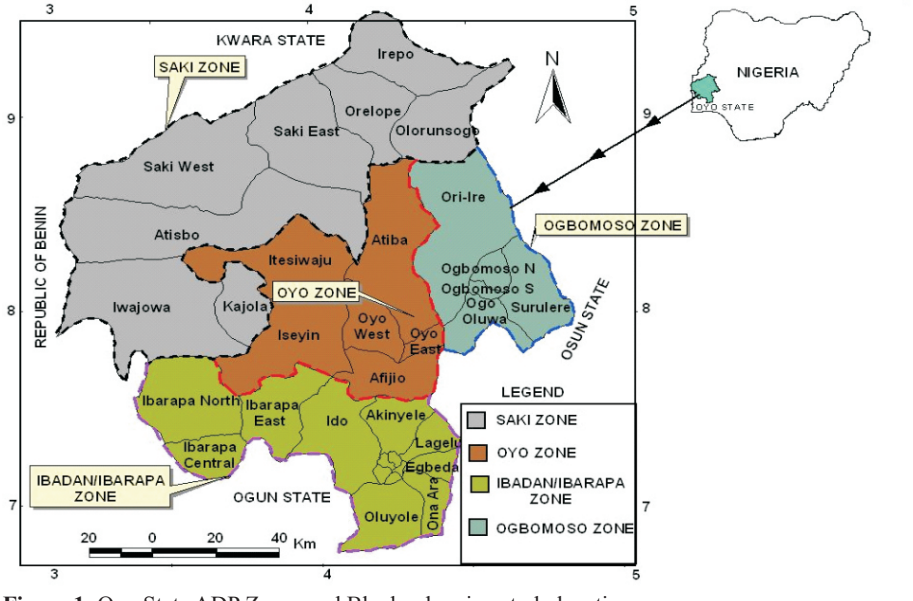

Figure 1: Oyo State ADP Zones and Blocks showing study location

Sampling Procedure and Sample Size

Multi-stage random sampling technique was used for the selection of two hundred and twenty two (222) fish farmers throughout the four extensional zones. In stage 1, 60% extensional blocks from each of the four zones to give a total of 16 blocks were purposively selected for the study. In stage 2, from each of the selected extensional blocks 60% were also randomly selected to give a total of 79 cells in all the selected blocks. In stage 3, from each cells, 60% fish farmers were selected using simple randomly sampling techniques to give a total of 222 fish farmers. Thus a total number of two hundred and twenty (222) fish farmers were selected throughout the four extensional zones.

Data Collection Instruments

A well-structured interview schedule was administered to two hundred and twenty two (222) respondents which were used for primary data collection. The interview schedules were divided into four (4) sections: A, contains socio-economic characteristics of fish farmers in the study area; B, contains the types of fish farming practices and characteristics; C, contains the costs and returns involved in fish farming in the study area and D, contains the constraints'/problems of fish farming in the study area.

Measurement of variables

In order to determine the socio-economic characteristics of the fish farmers questions were asked with respect to:

i. Age was measured at interval level by obtaining the specific age of the respondents and categorized in ranges as follows: 0 - 20 years = 1, 21-30 years = 2, 31-40 years = 3, 41-50 years = 4, and above years = 5.
ii. Sex was assessed at nominal level as male = 1 and female = 2.
iii. Marital Status was measured at nominal level and respondents were categorized into single = 1, married = 2, widowed = 3, and separated = 4.
iv. Educational Background was measured at ordinal level by indication of level of education attained and the respondents were categorized into: no formal education = 1, adult education = 2, primary education = 3, secondary education = 4, tertiary education = 5 and others = 6. This was interpolated at interval level by conversion of level of education qualification attained to years of education for regression analysis
v. Years spent in School was measured at interval level and categorized in ranges as follows: 1 - 5 years = 1, 6 - 10 years = 2, 11 - 15 years = 3, and above 15years = 4.
vi. Religion was measured at nominal level as Christianity = 1, Islam = 2, and traditional religion = 3.
vii. Household size was measured at interval level by indicating the specific number of persons living and feeding under the same roof and the response categorized with their corresponding values as follows: 1 – 3 = 1, 4 - 7 = 2 and 8 - 11 = 3.
viii. Other occupation was measured at interval level by indicating the specific occupation that generates income apart from fish farming.
ix. Fish farming experience was

measured at interval level. Less than 5 years = 1, 5 – 10 years = 2, 11 – 15 years = 3 and above 15 years = 4.

x. Membership of cooperative society was measured at nominal level and respondents were asked to answer yes = 2 and no = 1 to whether member of cooperative society or not.

xi. Water source was measured at nominal level and respondents were asked to indicate the water source that applied to them e.g. streams/river = 1, borehole = 2, deep well = 3.

Data Analysis Techniques

Various analytical tools were used to achieve the objectives of the study and they include: descriptive statistics such as frequency distribution tables, percentages, averages (mean), net farm income (NFI), gross margin (GM) and profitability ratios and inferential statistics.

Gross Margin (GM)

Gross margin is the difference between the gross farm income and the total variable cost (Olukosi and Erhabor, 1989).

Therefore; GM = GFI – TVC

Where GM = Gross margin

GFI = Gross farm income

Net Farm Income (NFI)

According to Olukosi and Erhabor (1989), net farm income gives an overall level of profitability of an enterprise by putting both fixed and variable costs into consideration and subtracting the cost from the total revenue.

Therefore; NFI = TR - TC

Where TR = Total Revenue

TC = Total cost.

Profitability Ratios

Profitability ratio is a class of financial metrics that helps investors assess a business's ability to generate earning compared with its expenses and other relevant costs incurred during a specific period. When these ratios are higher than a competitor's ratio or than the company's ratio from a previous period, this is a sign that the company is doing well (Okwu and Acheneje, 2011). Some examples of profitability ratios are listed and explained below:

Benefit Cost Ratio BCR)

Benefit cost ratio or analysis is the term that either refers to helping to appraise, or assess the case for a project programme or policy proposal and an approach to making economy decision of any kind. From the above definition, the process involves whether explicitly or implicitly weighing the total expected costs against the total expected benefits of one or more actions in order to choose the best or most profitable option.

Therefore; BCR = TR/TC

Where TR = Total Revenue

TC = Total cost

Expense structure ratio (ESR) = FC/VC

Where, FC = Fixed cost and VC = Variable cost

Rate of return (ROR) = NR/TC

Where, NR = Net Return

Gross Revenue Ratio (GRR) = TFE/GI

Where, TFE = Total farm expenses and

GI = Gross income.

Results

Socio-economic characteristics of small scale fish farmers from Oyo State

The socio economic characteristics of the fish farmers were presented in Table 1. Most (49.1%) of the fish farmers fell within the age bracket of 41 – 50 years, 37.8 percent fell within 31 – 40 years, 8.1 percent were above 50 years of age while 2.0 percent fell within the age range of 21 – 30

years. This age bracket (41-50) is majorly considered as productive age which portends better future for catfish production. Also it is considered as economically active age (Olowosegun*et al*., 2004). This indicates that very few young and old people are involved in fish farming. This is because fish farming requires adequate attention and a lot of sense of responsibility. Udoh and Nyienakuma, (2008) observed that this age bracket composed of the innovative, motivated and adoptable individuals which is an indication that middle-aged people had higher aspiration to easily adopt improved technologies and could take risk.

It was observed that majority (84.2%) of the fish farmers were male while 15.8 percent were female. Sex plays a very important role in fish farming and agriculture, in terms of property acquisition, for example, fixed assets like land and machines. This indicates that fish farming in Oyo state is predominantly a male occupation. This result can be justified by the assertion of Brummett*et al*. (2010) that fisheries activities are mostly dominated by men. The low involvement of females in fish farming may be due to the inability of most women to own their personal land for farming (Olaoye, 2010 and Ashley-Dejo, 2012).

Result also shows that majority (76.1%) of the fish farmers were married, 11.3 percent were single, 3.6percent were separated while 9.0 percent were widowed. Ekong, 2003 pointed out that marriage in our society is highly cherished. This ascertain was further confirmed by the report of Fakoya (2000) and Oladoja*et al.* (2008) who assert that marriage confer some level of responsibility and commitment on individual who are married.

Respondents without formal education were 3.2 percent while 87.3 percent had tertiary education.Considering the educational level of fish farmers in the study area, it was observed that majority of the respondents were educated. This implies that fish farming was dominated by the educated class and mostly by those armed with high level of education. The farmers can therefore be said to be literate since only small proportion of them had no formal education. The result compares favourably with the findings of Lawal and Idega (2004**)** who observed that level of education attended by fish farmers to a large extent determine the strategies which he/she may use to adopt the new technology without difficulties and this will increase his/her profit as soon as they become available to him/her. High level of education recorded in this study might be due to the nature of the study area which was also in with the findings of Olagunju*et al.* (2007) may be very receptive to the new technology. Asiabaka (2008) reported that education had a positive influence on farmers' adoption behaviour. Majority (58.1%) spent above 15 years in school, 23.0 percent spent between 11 – 15 years while 14.4 percent spent between 6 – 10 years. It was found that, majority (53.2%) of the fish farmers were Christians, 43.2 percent of them practiced Islam while 3.6 percent were traditional worshippers. The mean household size was found to be 9 person per household.Majority of the respondents' household size falls within the range 4 – 7. This was an indication that the more educated and urban-based an individual is, the less family-size that individual will keep (Yarhere, 2004).

Result shows that most (63.1%) of the fish farmers also depend of arable farming as source of income, 18.0 percent were civil servant while 9.0 percent were traders. It revealed that 40.5 percent had fish farming experience ranging between 11 and 15 years, 35.6 percent had between 5 and 10 years, and 15.8 percent had less than 5 years

while 8.1 percent had above 15 years' experience in fish farming. Experience is the act of gaining knowledge through constant practices of skill, which brings about specialization. The sum of these then results in increase in output. Experiences played prominent role in any farming enterprise (Olaoye, 2010). From the findings of this study, almost 50.0 percent had fish farming experience of over 10 years. Through experience, farmers who had the longer years of experience in fish farming business were more inclined to adopt improved technology because past experiences will enable the farmers to learn how to overcome constraints faced in the past as a result of adoption of improved technology and thus will be able to pull other resources together to enable him/her increase is output.

Generally, in our society people have the right to hold, use and possess the natural resources found in the land profile. These rights may consist of legal, contractual or customary agreement (Ekong, 2003). It was shown that majority of the respondents got their land through purchase, transfer of land is very common in our society as one of the ways inheritor's claims what belong to their father.

Fish Farming Practices and characteristics by the Fish Farmers

Table 2 revealed the fish farming practices and characteristics of fish farmers in the study area. Most (89.2%) of the fish farmers went into fish farming in other to make profit while 8.6 percent and 2.3 percent went into fish farming to augment income and for household consumption respectively. Source and quantity of water available are one of the most important factors to be considered when selecting a site for aquaculture practice. The quantity of water needed for commercial aquaculture varies with the production method employed, type of aquaculture chosen, scale of operation, and species cultured. Most of the respondents depend directly on either stream or river as their major source of water. This may be due to the fact that Oyo State has rivers located within the geographical area of the State.

Majority (44.1%) of the respondents used both earthen ponds and concrete ponds, 27.5 percent used only concrete ponds, and 26.1 percent used only earthen ponds while 2.3 percent very small percent used wooden troughs. Fish farmer in the study area preferred monoculture to polyculture system. This may be as a result of poor market price for tilapia. This was also supported by Reddy and Debusk (1985) who observed that fishes grow better when cultured individually under monoculture system and also help the specie to grow to its biggest size.

Based on the types of species cultured, over 70.0 percent of the fish farmers in the study area culture mainly *Clarias spp.* under the influence of high market price, greater demand preferences, hardiness of the stock, fast growth, high feed conversion ratio high survival rate under captivity ((Olaoye*et al.*, 2007; Olaoye, 2010). This may be due to the fact that cat fish appears to be hardy and generally accepted by people. The choice of culture period is usually influenced by factors such as timing towards festive period or due to the lack of feeds as explained by Okoye and Omorinkoba (1994).

Majority (63.1%) of the respondents sourced their fish seed from personal own fish farm, 28.4 percent sourced from fish hatchery, while 8.6 percent sourced from Government fish farms. Based on culturing period (production of table size), more than half of the respondents (57.7%) cultured their fish for five months, 22.1 percent cultured for six months, 14.4 percent

Table 1: Percentage distribution of the socio-economic characteristics of small scale fish farmers in Oyo states (N = 222)

Variables	Frequency	Percentage (%)	Mean	Std
Age (years)				
Bellow 20	0.00	0.00		
21-30	11.00	5.00		
31-40	84.00	37.80		
41-50	109.00	49.10		
Above 50	18.00	8.10	46	0.709
Sex				
Male	187.00	84.20		
Female	35.00	15.80		
Marital Status				
Single	25.00	11.30		
Married	169.00	76.10		
Widowed	20.00	9.00		
Separated	8.00	3.60		
Educational status				
No formal Education	7.00	3.20		
Adult Education	0.00	0.00		
Primary Education	44.00	19.80		
Secondary Education	62.00	27.90		
Tertiary Education	88.00	39.60		
Others	21.00	9.50		
Number of years spend in school				
1 – 5	10.00	4.50		
6 – 10	32.00	14.40		
11 – 15	51.00	23.00		
Above 15	129.00	58.10	16	0.866
Religion				
Christianity	118.00	53.20		
Islam	96.00	43.20		
Traditional	8.00	3.60		
House Hold Size (Persons)				
1 – 3	35.00	15.80		
4 – 7	152.00	68.50		
8 – 11	35.00	15.80	6	0.563
Other occupation that generate income apart from fish farming				
Farming	140	63.1		
Civil servant	40	18.0		
Trading	20	9.0		
Vocational job	22	9.9		
Fish Farming Experience (Years)				
Less than 5	35	15.8		
5 – 10	79	35.6		
11 – 15	90	40.5		
Above 15	18	8.1	9.3	0.850
Mode of Land Acquisition				
Purchase	150	67.6		
Lease/Rent	51	23.0		
Inheritance	17	7.7		
Gift	4	1.8		

Source: Field Survey, 2011

cultured for four months, while 13.0% cultured their fish for more than six months. Majority (86.9%) of the respondents harvested twice in a year while 7.2 percent and 5.9 percent harvested once and thrice in a year respectively. Cooperative society is a social participation that helps farmers to pool their resources in order to have access to fisheries inputs and to have insights in their fishing issues. Membership of cooperatives is also a factor that influences the adoption of improved fisheries technologies and poverty alleviation (Olaoye, 2010). This shows that the respondents in the study area subscribe to member of cooperative societies (62.6%) while others do not belong to any registered or unregistered society which may be as a result of lack of awareness and interest. Hence, being a member of association group could create peer pressure for farmers to adopt new technologies. This was in line with Akinbile (1998) who observed that groups ensure that members derive benefits from the groups in which they cannot derive individually if they were acting alone. Those that finance their farm through cooperative society constituted 24.8 percent of the respondents, 47.8 percent of them finances their farm trough personal savings while 9.9 percent financed their farm through friends/relatives.

Income of adopters and non–adopters per production cycle

The income level of respondents as shown in Table 3 depends directly and indirectly on financial status of the respondents and rate of adoption of improved technologies**. The result of this study shows that on average the income of adopters were ∆4,873,521:29, while that of non-adopters were ∆3,347,719:08.**

Economic analysis

The economic and profitability analysis was represented in Table 7 above, which shows that cost of feed accounted for the largest proportion (86.45 and 90.36%) of the cost of fish farming in the study area for both adopters and non-adopters respectively. This shows that large amount of money was spent by fish farmers in the study area for purchase of feeds and fish feed. This finding is in agreement with Louise (1977) who said that the cost of feed was very high in catfish production. The fixed cost of production consists of cost of land, pond construction, and wheel barrow, pond equipment such as net, weighing scale etc which accounted for 13.41 and 14.60 percent of the total cost for both adopter and non-adopters respectively. Equally, the result showed that an average total cost of ∆2,883,515.08 and ∆2,240,959.86was incurred by the respondents per cropping season for adopters and non-adopters, while the gross margin (GM) was ∆2,376,616.36 and ∆1,432,805.00 respectively. This indicates that fish farming in the study area was profitable. This result is consistent with the finding of Ashaolu*et al.*(2005) and Olaoye and Odebiyi (2011) who observed that fish farming is profitable. The cost analysis of ratios revealed that the benefit cost ratio (BCR) is greater than one emphasizing the profitability of fish farming in Oyo State. This result shows that fish farming as a business in Oyo state is viable since BCR is greater than one. The finding in this study compares favourably with that of Emokaro and Ekunwe (2009) who examined the efficiency of resource-use among catfish farmers to be viable. The rate of returns, (0.69 and 0.49) for adopters and non-adopters respectively, implies that for every one naira invested, ∆ 0.69 and ∆ 0.49 was gained and a gross revenue ratio of 0.59 and 0.97 indicates that for every one naira return to fish farm enterprise, 59kobo and 97kobo for adopters and non-adopters respectively

Table 2: Fish Farming Practices and characteristics by the Fish Farmers in Oyo states (N = 222)

Variables	Frequency	Percentage (%)
Reason for going into Fish Farming		
To make profit	198	89.2
To argument income	19	8.6
For house hold consumption	5	2.3
Source of Water		
Stream/river	137	61.7
Borehole	56	25.2
Deep well	29	13.1
Rearing Structure/Facilities		
Earthen pond and concrete tank	98	44.1
Concrete pond only	61	27.5
Earthen pond only	58	26.1
Fish trough	5	2.3
Types of culture		
Monoculture	148	66.7
Polyculture	53	23.9
Integrated	21	9.5
Types of Cultured Specie		
Clariasspp	164	73.9
*Clarias*and *Tilapia spp*	47	21.1
Heterobranchusspp	11	5.0
Source of Fingerlings		
Own fish farm	140	63.1
Fish hatchery	63	28.4
Government fish farm	19	8.6
Culturing Period		
Four months	32	14.4
Five months	128	57.7
Six months	49	22.1
More than six months	13	5.9
Harvesting Period (Year)		
Once	16	7.2
Twice	193	86.9
Thrice	13	5.9
Cooperative Society		
Yes	139	62.6
No	83	37.4
Source of finance		
Personal savings	106	47.8
Friends/Relatives	22	9.9
Cooperatives society	55	24.8
Bank loan	39	17.6

Source: Field Survey, 2011

Table 3: Distribution of the total income (∆) of the fish farmers per production cycle

Total income (∆)	Adopters (172)		Non-adopters (25)	
	Freq	%	Freq	%
Less than 499,999:00	0	0.0	1	2.0
500,000- 999,999	3	1.7	3	6.0
1,000,000-1,499,999	11	6.4	7	14.0
1,500,000-1,999,999	13	7.6	3	6.0
2,000,000-2,499,999	11	6.4	5	10.0
2,500,000-2,999,999	12	7.0	11	22.0
3,000,000-3,499,999	18	10.5	19	38.0
3,500,000-3,999,999	39	22.7	1	2.0
4,000,000 and above	65	37.8	0	0.0
Mean (∆)	**4,873,521.29**		**3,347,719.08**	

Source: Field survey, 2011

is being spent. The result is also in line with work of Raufu*et al,* (2009) and Okwu and Acheneje (2011) who also affirmed that fish farming is profitable.

Table 4: Economic analysis and profitability ratio of the respondents

Items	Adopters Amount (∆)	% Total Cost	Non-Adopters Amount (∆)	% Total Cost
VARIABLE COST				
Fish Feed	2,158,456.01	86.45	1,730,344.49	90.36
Fish seed	211,801.59	8.48	97,108.14	5.07
Lime/Fertilizer	3,473.18	0.14	1,371.21	0.07
Labour	69,296.88	2.78	53,187.10	2.78
Fuel	21,314.19	0.86	9,553.13	0.50
Transportation	17,351.08	0.85	11,174.88	0.58
Others	15,212.00	0.61	12,175.13	0.64
TOTAL VARIABLE COST	2,496,904.93	**86.60**	**1,914,914.08**	**85.45**
FIXED COST				
Land purchase/rent	18,616.43	4.82	15,570.51	4.78
Water pump	9,293.85	2.40	8,729.31	2.68
Concrete tanks	78,154.59	20.22	64,320.63	19.73
Deep well	21,570.00	5.58	19,184.00	5.88
Earthen pond	26,514.11	6.86	23,122.81	7.09
Plumbing materials	3,010.45	0.78	2,790.13	0.85
Building/Shed	167,856.00	43.41	134,434.54	41.23
Generator	45,761.00	11.84	43,241.00	13.26
Drag net,	10,694.62	2.77	9,773.96	3.0
Weighing Scale/Cutlass/ Wheel barrow/ Shovel/ Head pan/ Bowls	5,139.10	1.33	4,878.89	1.50
TOTAL FIXED COST	386,610.15	13.41	326,045.78	14.60
TOTAL COST	2,883,515.08		2,240,959.86	
TOTAL REVENUE	4,873,521.29		3,347,719.08	
GROSS MARGIN	2,376,616.36		1,432,805.00	
NET FARM INCOME	1,990,006.21		1,106,759.22	
Benefit Cost Ratio	1.69		1.49	
Rate of Return on Investment (RRI)	0.69		0.49	
Gross Revenue Ratio (GRR)	0.59		0.67	
Expenses Structure Ratio	0.15		0.17	
Net Profit Margin (NPM)	0.41		0.33	

Source: Field survey, 2011

Production constrain among fish farmers in Oyo State, Nigeria

Aquaculture production constrain was elicited and presented in Table 5. Various factors affecting fish farming in the study area were rated according to the degree of severity. Majority (58.6%) of the fish farmers identified land accusation as not a serious problem while 40.5 percent identified land accusation a serious problem. Fifty percent of the fish farmers identified insufficient labour a problem facing aquaculture development in Oyo state while 42.8 percent claimed that it was not a problem. Majority (74.3% and 63.5%) of the respondents identified strong co-operative society and lack of finance (capital and credit) as major challenges affecting aquaculture production in the study area but majority (90.1%) of the fish farmers identified non-availability/high cost of quality fish seed a factor militating against aquaculture development in Oyo State. Furthermore, majority (94.6% and 96.0%) of the fish farmers also identified poaching/predators and high cost/lack of construction equipment respectively as one of the major challenges hindering aquaculture development in the study area. It was also observed in table 14 that one hundred percent of the respondents considered market price fluctuation and high cost of fish feed as a problem facing fish production. Some other factors militating aquaculture production include; water shortage during dry season (92.3%), diseases and pest infestation (32.4%) and lack of technical know-how (42.4%).

Table 5: Percentage distribution of the fish farmers by aquaculture production constraints

PROBLEMS	SEVERITY					
	Very serious Freq (%)	Serious Freq (%)	I don't know Freq (%)	Not a serious problem Freq (%)	Mean	Inference
Land accusation	18 (8.1)	72 (32.4)	2 (0.9)	130 (58.6)	1.90	12TH
Insufficient labour	48 (21.6)	79 (35.6)	0 (0.0)	95 (42.8)	2.36	8TH
Distance of the extension staff's office to the village/farm	39 (17.6)	53 (23.9)	20 (9.0)	110 (49.5)	2.09	10TH
Preservation/Storage/Processing Facilities	71 (32.0)	96 (43.2)	15 (6.8)	40 (18.0)	2.89	7TH
Inadequate Motivation from extension officer	31 (14.0)	49 (22.1)	73 (32.9)	69 (31.1)	2.19	9TH
Absence of strong co-operative society	0 (0.0)	47 (21.2)	10 (4.5)	165 (74.3)	1.47	15TH
Lack of finance (capital and credit)	12 (5.4)	34 (15.3)	35 (15.8)	141 (63.5)	1.63	14TH
Non-availability/High cost of quality fish seed	152 (68.5)	48 (21.6)	0 (0.0)	22 (9.9)	3.49	3RD
Poaching/predators	40 (18.0)	170 (76.6)	0 (0.0)	12 (5.4)	3.07	5TH
High cost/lack of construction equipment	91 (41.0)	122 (55.0)	0 (0.0)	9 (4.1)	3.33	4TH
Market price fluctuation	167 (75.2)	55 (24.8)	0 (0.0)	0 (0.0)	3.75	2ND
High cost of fish feed	200 (90.1)	22 (9.9)	0 (0.0)	0 (0.0)	3.90	1ST
Water shortage during dry season	31 (14.0)	174 (78.4)	17 (7.7)	0 (0.0)	3.06	6TH
Disease and pest infestation	8 (3.6)	64 (28.8)	0 (0.0)	150 (67.6)	1.68	13TH
Lack of technical know-how	41 (18.5)	53 (23.9)	0 (0.0)	128 (57.7)	2.03	11TH

Source: Field Survey, 2011

Hypotheses of the study

This section shows the relationship/difference between some of the independent variables and dependent variables.

Ho_1: There is no significant relationship between the socio-economic characteristics of the fish farmers and adoption of recommended aquaculture production technologies.

The socio-economic characteristics of the respondents were significantly related to adoption of recommended aquaculture production technologies. The independents variables considered were; age, sex, educational level, occupation, marital status, years of experience, and house hold size. Each of these variables was tested

against each of the scores for the dependent variables in line with the set hypotheses. To test for the relationship Pearsons Product Moment Correlation (PPMC) and Chi-square (χ^2) analysis were used. PPMC was used for the variables that were measured at the interval level, while Chi –square was used for variables that were measured at nominal level.

Table 6 revealed the result obtained from Chi – square analysis, from the result there was a significant association between adoption of improved technologies and sex ($\chi^2 = 2.16$, $P > 0.05$), educational level ($\chi^2 = 9.30$), occupation ($\chi^2 = 4.81$) and marital status ($\chi^2 = 5.32$).The significant relationship between that exists between sex and adoption of innovation was due to the fact that most of the fish farming operations are gender roles of men and men are more risk taking than women in nature. The gender related roles of men mostly in fish farm operations also account for the male dominance in fish farming. Educational level of fish farmers has significant relationship with adoption of innovation because educational level influences (technology) information utilization. From the findings it was observed that the higher the educational level of the fish farmers, the more they are willing to use innovation provided on fish production. This is congruent with Eze*et al.*(2006) who discovered that the level of formal education was positively correlated with adoption of improved production technology. This is also in consonance with (Lemchi *et al*., 2003) as they noted that technological change is achieved through formal education.

The result (Table 7) from the correlation coefficient obtained from the statistical analysis shows that, there was a significant relationship between adoption of improved technologies and age ($r = 0.05$), This result (Table 7) was in agreement with the report of Adeniji (2005) who reported a similar significant relationship between age and adoption process among farmers. Also, Age is related to adoption of improved technology because the stage of life of farmers affects his attitude towards technology adoption. The older fish farmer becomes, the more he is willing to put improved technology into use. This does not agree with Lemchi *et al.,* 2003 who stated that the older one become, the more risk averse he is. Years of experience ($r = 0.72$) Farming experiences has a significant relationship with adoption of improved technology among fish farmers for the fact that farmers' behaviour is in accordance with the old adage which says “experience is the best teacher”. With years of faming the fish farmers learn from their various past experiences and experience must have taught then about the benefits of improved technology utilization and house hold size ($r = 0.52$).

Table 6: Chi-square analysis of respondent’s socio-economic characteristics and adoption of improved technologies by fish farmers

Variables	χ^2	Df	CC	Decision
Sex	2.16	1	0.03	S
Educational level	9.30	3	0.02	S
Occupation	4.81	3	0.01	S
Marital status	5.32	3	0.03	S

Source: Field survey, 2011.

χ^2= chi square calculated, df = Degree of freedom, CC = Contingency Coefficient, S = Significant, NS = Not significant ($p < 0.05$).

Table 7: Correlation analysis of the respondent's personal characteristics and adoption of improved technologies by fish farmers

Variables	r	P	Decision
Age	0.50	0.04	S
Years of experience	0.72	0.01	S
House hold size	0.52	0.00	S

Source: Field survey, 2011.
NS = Not significant, S = Significant (p > 0.05)

Ho_2: There was no significant difference between the profit level (net farm income) of adopters and non-adopters of aquaculture production teschnologies.
Table 8 shows the test of difference in profit level (Net Farm Income) per culture periods of *Clariasgariepinus* of adopters and non-adopters. The average Net Farm Income (NFI) of adopters was N1,990,006.21, while of non-adopters was N1,106,759.22, and the mean difference of N883,249.99 with t-value of 42.43($p<0.05$).However, as reflected in the net farm income analysis (Table 8), the analysis of the difference of means at the same scale of operation also showed that there was a significant difference between the income of adopters and non – adopters of improved technologies.

Table 8: The result of the profit level (net farm income) analysis

Variable	Average (NFI/ Season ₦)	Df	Sig	t - value	Decision
Adopters	1,990,006.21	171	0.001	42.43	Accept H_1
Non – Adopters	1,106,759.22	49	0.020		
Mean difference	883,246.99				

Source: Field survey, 2011.

Conclusion

It was observed that education played an important role in the adoption of improved aquaculture production technologies, fish farmers with high level of education were able to adopt the technology compared to their counterparts with lower education. The age of most of the farmers was equally within the economic active age; result gotten from gender was so sensitive that male dominated compared to female counterpart. In addition, majority of the respondents got their land thorough purchased. Most of the respondents were aware of extension officers and can handle most of the improved technology introduced to them. The study revealed that adoption of improved technology had resulted into increase in the output and income of the farmer as shown in the profitability analysis since the Benefit Cost Ratio (BCR) is greater than one although the BCR of non-adopters was also greater than one but there was a significant difference between the income of adopters and non-adopters. This implies that the adopters had more income to cater for other needs compared to non-adopters. This study further showed factors affecting aquaculture development, some of the constraints faced by fish farmers include market price fluctuation, high cost/lack of construction equipment, high cost of fish feed, poaching/predators and water shortage during dry season all these constitute a very serious problem towards

aquaculture development. There is need for urgent attention from government in taking positive step to bring this problem to halt.

Recommendation

Based on the findings of the study, the following recommendations are hereby made to enhance fish production in Oyo State Nigeria.

I. There should be regular training programmes to educate the farmers especially females so that fish farming will not be gender-sensitive in order to reverse the present situation of males dominating the industry.

II. Based on the high variable cost of production for both adopters and non-adopters more research should be done for cheap alternative feed that would be economically friend.

III. Fish farmers should be encourage to come together to form co-operative/organisation so as to facilitate access to financial assistance either from Government or Non-Governmental Organisation

References

Adeniji, G. B. 2005. Training need of extension agents in agriculture development programmes of selected state of South Western Nigeria. *Journal of Agriculture Extension*. 9: 31 – 37.

Akinbile, L. A. 1998. Group formation and group dynamics. Paper presented at National Agricultural Extension and Research Liaison Services workshop on Extension Communication Techniques. Moor Plantation, Ibadan, 11pp.

Ashaolu, F. O, Akinyemi, A. A. and Nzekwe, L. S. O, 2006. Economic Viability of homestead FishProduction in Abeokuta Metropolis of Ogun State, Nigeria.*Asset Series* A, 6(2): 209-220.

Ashley-Dejo, S. S. 2012. Adoption of improved aquaculture production innovations by small scale fish farmers in Oyo State, Nigeria.MAF.Dissertation Federal University of Agriculture, Abeokuta, Nigeria. 199pp.

Asiabaka, C. 2008. The need for agricultural extension policy in national development. A key note address presented at 13th AESON conference held at Michael Okpara University of Agriculture, Umudike, Abia State, 8th-11th April, pp 1 - 48.

Brummett, R. E., Youaleu, J. L. N., Tiani, A. M. and Kenmegne. D. 2010. Women's traditional fishery and alternative aquatic resource livelihood strategies in the southers Cameroonian Rainforest.*Fisheries Management and Ecology* 17: 221 – 230.

Davies, R. M. 2005. Sustainable fish supply through intensive fish farming for Nigeria's teeming population. A paper presented at a one-day workshop on intensive fish farming in Rivers State Nigeria. pp 8.

Dlamini, B. M. 2003. Effective linkages among national agricultural research institute, universities and extension systems; challenges and opportunities. In P. Anandajayasekeram and R. J. Sebola (Eds.).*Science and technology strategy for improved*

agricultural productivity and food security.(proc) South Africa/ Inter Academy council.Megaliesberg, South Africa, 42 – 47pp.

Ekong, E. E. 2003. *Anintroduction to rural sociology*(2nd edition).Uyo. Nigeria dove educational publishers. Pp 259-285.

Emokaro, C. O and Ekunwe. P. A. 2009. "Efficiency of Resource-Use and Elasticity of Production Among Catfish Farmers in Kaduna, Nigeria". *Journal of Applied Sciences Research,* 5(7): 776-779.

Eze, C. C., U. C. Ibekwe, P. J. Onoh and C. U. Nwajiuba., 2006. Determinants of Adoption of Improved Cassava production Technologies Among Farmers in Enugu State of Nigeria. *Global Approaches to Extension Practice*, 2(1): 37-44.

Fagade, S. O., 1998. In the Belly of our Waters.Inaugural Lecture, University of Ibadan.27th August 65pp.

Fakoya, E. O. 2000. Farmers Use of Sustainable Land Management Practices in Ondo State, Nigeria. Unpublished PhD. Thesis, Department of Agricultural Extension and Rural Development, University of Ibadan, Nigeria.Pp 160.

Federal Department of Fisheries (FDF). 2010. Fisheries Department in Nigeria; the current challenges, Paper presented by the Honourable of state of agriculture to the Fisheries Society of Nigeria (FISON), Lagos state. 23pp.

Food and Agricultural Organization (FAO) 2000. The State of the World Fisheries and Aquaculture, FAO Fisheries department, Rome. Italy. 87pp.

Food and Agricultural Organization, 2005. Review of the state of world fishery resources in 2003: marine fisheries, by S.M. Garcia, I. De Leiva Moreno and R.J.R. Grainger. FAO Fisheries Technical Paper No.457. Rome 34pp.

Food and Agricultural Organization, 2008. *Report of the FAO Expert Workshop on the Use of Wild Fish and/or Other Aquatic Species as Feed in Aquaculture and Its Implications to Food Security and Poverty Alleviation, Kochi, India, 16–18 November 2007*. FAO Fisheries Report No. 867. Rome.

Food and Agricultural Organization, 2010. Aquaculture development, FAO technical guidance for responsible fisheries.N0.5 Food and Agriculture Organization of the United Nations. Rome. Pp 73-76.

Food and Agricultural Organization, 2012. The State of World Fisheries and Aquaculture 2012. Rome. 209 pp.

Gupta, M. V, Bartley, D. M and Acosta, B. O. 2004. Use of genetically improved and alien species for aquaculture biodiversity in Africa.World Food Centre. 107pp.

Joshua, A. and Omidiji, M. O. 2002. *Rural development strategy in Nigeria, West and Central Africa.*Paper presented at the international workshop on rural development in West and Central Africa. IITA, Ibadan. pp 3-5.

Lawal, W. L. and Idega, E. O. 2004. Analysis of Fish Marketing in Benue State. A paper presented at 2004 Annual Conference of the Association of Agricultural Economists (NAAE) Held at

A.B.U. Zaria, November, 3-5.

Lemchi, J. M. Tshiuza and Tenkouano, A. 2003. Factors Driving the Intensity and Rate of Cooking Banana Adoption in Nigeria.*Journal of Agricultural. Sociology Resources*, 3(2): 67-78.

Louise, V. R. 1977. Fish Farming International Unit of Aquatic Pathobiology. University of Stirling, Scotland, 4: 17 – 19.

National population Commission (NPC). 2006. 'The 2006 census result' Census News, NPC quarterly publications. 7pp

Okoye, F. C. and Omorinkoba, W. S. 1994. *Fish Pond Construction and Management*. In: Proceeding of National Fisheries Workshop on Aquacultural Development Fish Seed Production and Post-Harvest Technology. 20-23 September New Bussa Nigeria.NFER pp. 6-11.

Okwu, O. J. and S. Acheneje., 2011. Socio-Economic Analysis of Fish Farming in Makurdi Local Government Area, Benue State, Nigeria.*European Journal of Social Sciences – Vol. 23(4): 508 – 514.*

Oladoja, M. A., Adedoyin, S. E. and Adeokun, O. A. 2008. Training needs of fisher folks on fishing technologies. *Journal of Food Agriculture and Environment Science and Technology.* Vol. 6: (1) 281 – 290.

Olagunju, F. I., Adesiyan, I. O. and Ezekiel, A. A. 2007. Economic viability of cat fish production in Oyo – State, *Nigeria Journal of Human Ecology* 21(2): 121 – 124.

Olaoye, O. J. 2010. Dynamics of the adoption process of improved fisheries technologies in Lagos and Ogun States Nigeria. A Ph. D thesis in the Department of Aquaculture and Fisheries Management, University of Agriculture, Abeokuta, Ogun State, Nigeria. 337 pp.

Olaoye, O. J. and Odebiyi, O. C. 2011. Economic viability for the use of microfinance bank loan on aquaculture development in Ogun State, Nigeria.*International Journal of Fisheries and Aquaculture* Vol. 3 (4): 70-77.

Olaoye, O. J., Adekoya, B. B., Ezeri. G. N. O., Omoyinmi, G. A. K. and Ayansanwo, T. O. 2007. Fish Hatchery Production Trends in Ogun State: 2001-2006. *Journal of Field Aquatic Studies- Aquafield,* Vol. 3, pp. 29-40.

Olowosegun, T., Sanni, A. O., Sule, A. M. and Bwala, R. L., 2004.Contribution of Women to Fisheries development in Kainji Lake Basin. Proceedings of the 19th Annual Conference of Fisheries Society of Nigeria (FISON) Held 29th Nov – 3rd Dec, 2004 at Kainji, Niger State, Nigeria Araoye, P. A. (ed). pp 91 – 97.

Olukosi, J. O. and Erhabor, P. O. 1988. Introduction to Farm Management Economics: Principle and Application. Pub. Ltd., Zaria. 64pp.

Pinstrup – Anderson, P., Pandya – Lorch, R. and Rosegrant, M. W. 2001. Global Food Security – A Review of the challenges In: Pintrup – Anderson and Pandya – l – Lorch (eds). The Unfinished Agenda perspectives on Overcoming Hunger, Poverty and Environmental Degradation

International Food Policy research Institute (IFPRI). Washington DC. Pp 5 – 17.

Raufu, M. O., Adepoju, A. A. Salau A. S. and Adebiyi. O. A. 2009. Determinants of yield performance in small scale fish farming in Alimosho local government area of Lagos state. *International journal of Agricultural economics and rural ondevelopm*ent. Vol. 2 (1): 9 – 14.

Reddy, K. K and W. F. Debusk., 1985. Nutitional removal potential of seleted aquatic macrophytes.*Rev. Environ. Sic Biotechnol* 7:255 – 266.

Roger, E. M. 2003. Diffusion of Innovations, 5th Edition, New York: Free Press.

Thompson, P. M., Sultana, P., and Khan, A. K. M. 2005. *Aquaculture extension impact in Bangladesh*.World Fish Centre.Toure, M. K., and Noor, M. 329 – 343.

Toure, M. K. and Noor, M. 2001. The role of agricultural technology in food and nutritional security on Africa.*Journal of Food and Nutritional Security*. Vol. *1(*1): 790 - 812.

Udoh, A. J. and Nyienakuma, M. G. 2008. Examining socioeconomic characteristics and adoption trend of artisanal fishers of AkwaIbom State in West Africa. *J. Agri. Soc. Sci.,* 4: 141–46.

United nation Development Programme (UNDP) 2004. *Sharing innovative experiences. Agricultural and rural development in the South.*http/tcdc.undp.org/experiences /vol5/improved, retrieved on December 2, 2006.

Yap-Gnaore, V. C., Ehui, S. K. and Shapiro, B. 1995. Peri-urban livestock production and development in sub-Sahara Africa: A review of opportunities and constraints. *Tropical Veterinary Medicine*, 1: 151-163.

Yarhere, M. 2004. A study of Women's Participation in Food Security and Poverty Alleviation in Lagos and Ogun States. In: FISON Conf. Proceedings. P. A. Araoye (ed). pp. 167-178.

Received: 27th August, 2016
Accepted: 4th March, 2017