Farmers' use of Improved Aquaculture Management Practices in Western Zone of Lagos State Agricultural Development Programme (ADP), Nigeria

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Abstract

Improved Aquaculture Management Practices (IAMP) always lead to increase productivity, generate greater income, reduce poverty and improve livelihood. This study assessed the extent of the use of IAMP by fish farmers in the Western Zone of Lagos state ADP, Nigeria to describe level of usage of IAMP and examine the constraints faced by fish farmers in the use of IAMP. The primary data were collected with the aid of structured interview guide, administered through personal interviews and observations to elicit information from 100 fish farmers using simple random sampling and purposive technique. Descriptive statistics was used to analysis the socio-economic characteristics, while budgetary analysis was used to determine the profitability and multiple regression analysis. Findings show that the mean age of the respondents was 42.6 years, 71.0% were male, 90.0% married, 63.0% secondary occupation and 84.81% were aware of IAMP. On a daily basis, 87.0% of the respondents were involved in record keeping, 82.0% carried out general observation in the farm and used concrete tanks while site selection, tank construction, pond liming and use of drugs were done occasionally. Constraints faced by the respondents were high cost of inputs (88.0%), flooding (79.0%), predators (71.0%), mortality (61.0%), pollution (61.0%), inadequate technical know-how (61.0%) and disease outbreak (58.0%). Respondents' household size ($r = -0.202$, $p<0.05$) and marital status ($\chi^2 = 61.082$, $p<0.05$) were significantly associated with factors affecting the use of IAMP. There were significant differences between IAMP used and revenue generated ($t = 4.641$, $p<0.05$). In conclusion, adoption of IAMP leads to increase aquaculture productivity and changes of social status. Government should provide assistance in loan at low interest, appropriate land, grants, fish farm input at subsidized rate adequate marketing information and networking among fish farmers.

Key words: Aquaculture, Improved, Aquaculture management practices, Fish farmers.

Introduction

Aquaculture is the cultivation of aquatic organisms in controlled environment such as ponds, dams, cages, pens, concrete tanks, raceways, aquaria, reservoirs, etc (Omotayo *et al.*, 2006). The most reared aquatic organism is fish which is an excellent source of proteineous food for the rapid increasing population of the world. Fisheries and aquaculture make crucial contributions to the world's wellbeing and prosperity (Food and Agricultural Organization "FAO", 2012).

Often, Nigeria has been regarded as the biggest importer of fish in Africa considering the present per capital fish consumption level in the country. The problem is that total domestic fish production is far less than the total domestic demand (Bada and Rahji, 2010). The fear is that the unsatisfied demand will continue to be met through importation unless policies and actions are geared towards improving domestic production in a sustainable way

through aquaculture (Rahji *et al.*, 2001). A review of aquaculture in Nigeria showed that only extremely small proportions of the resources available were being utilized. Nonetheless, Nigeria has a great potential to increase the availability of fish by supporting and expanding aquaculture (Olomola, 1991).

Oyetoro and Akinboye (2010) stated that fish provides roughly 40% of the protein intake for nearly 2/3 of the world's human population. Nevertheless, FAO (2012) noted that in many areas of sub-Saharan Africa and South Asia, fish consumption levels remain too low and the people are failing to benefit from the contributions that fisheries and aquaculture are increasingly making elsewhere in terms of sustainable food security and income.

Globally, fish production through aquaculture is on the increase with output reaching 59.9 million tonnes in 2010 as against 55.7 million tonnes in 2009. The case is not different with Nigeria where output reached 200,535 tonnes in 2010 ranking only behind Egypt (919,585 tonnes) in Africa (FAO, 2012). In 2010, fish production through aquaculture also increased in Lagos to 15,007 tonnes from 11,556 tonnes in 2009 (NAERLS and NPAFS, 2010).

Ogunremi and Oladele (2012) stated that the rapid increase in the world population has resulted in a huge increase in the need for animal protein and other nutritional requirements. In this area, fish makes a vital contribution to the survival and health of a significant portion of the world's population (Falodun, 2011). Thus, in most of the developing countries including Nigeria, aquaculture has become a very useful industry. Production of various fish species is being enhanced by carefully adopting IAMP. This makes an up-to-date knowledge of the various activities in fish farming essential. Increasing aquaculture production is required to meet the current demand for fish particularly, as the capture fisheries resources are declining due to over fishing, habitat destruction and pollution (Dunham *et al.*, 2001 and Olaoye, 2010). Fish culture permits the supervision, regulation of reproduction, feeding, growth, control of fish size, as well as stocking and maintenance of fish species instead of leaving it to nature (Abowei and Tawari, 2011).

In fish farming, improved management practices focuses on key activities including site selection, pond/tank construction, pond liming, fertilizer application, monitoring of pond walls (dyke), fish seed selectivity, acclimatization of fish seed, stocking of fish pond/tank, desilting, cleaning and hygiene, flushing, feed purchase, feed formulation and locally made feed, transportation of fish in plastic bags and so on. Fish farmers are expected to produce fish bearing in mind environmental implications. It must be stressed that these management practices for aquaculture are strictly voluntary and are simply suggestions that may be adopted by existing and potential aquaculture producers to increase efficiency and reduce effluent discharge from production facilities (Howerton, 2001). Improved aquaculture management practices are mostly concerned with how fish farming activities are carried out in an orderly manner and with better approach.

Problem statement

Aquaculture has contributed remarkably to the Nigerian economy by boosting fish production in the country (WFC, 2005). Consequently, this has assisted to augment fish supply from the wild. However, considering the high level of demand for fish and fish products in Nigeria due to

inadequate aquaculture management practices to sufficiently complement for fish products from the wild, it becomes highly necessary to assess farmers' use of improved aquaculture management practices in the nation (Ojo and Fagbenro, 2004). Ultimately, this will assist fisheries extension agents in disseminating IAMP more vigorously to fish farmers in the study area and the nation at large in order to increase domestic fish production (Alamu *et al.*, 2004).

This study has been able to:

i. identify the socio-economic characteristics of fish farmers in the study area,
ii. ascertain the level of awareness of fish farmers' improved aquaculture management practices in the study area.
iii. describe level of usage of improved aquaculture management practices in Lagos state ADP Western Zone.
iv. examine the constraints faced by fish farmers in the use of improved aquaculture management practices.

Materials and Methods

The study area

As one of the coastal states in Nigeria, Lagos state lies to the south-western part of Nigeria and has boundaries with Ogun state both in the north and east. It is bordered on the west by the Republic of Benin and in the south, stretches for 180 km along the coast of the Atlantic Ocean. It lies within longitudes 2°42'E and 3°22'E of the Greenwich Meridian and latitudes 6°22'N and 6°42'N of the equator (Akinmoladun and Adejumo, 2011). Lagos is the smallest state in Nigeria. It covers an area of 3,577 km^2 representing 0.4% of Nigeria's land mass and has a network of Lagoon systems beginning with Badagry from the western end bordering Benin Republic through the Lagos and Epe Lagoon and finally to Lekki Lagoon at the Eastern end (Figure 1). There are also numerous rivers; together with the flood plains and creeks (Gomna, 2006). The network of lagoons and Waterways in the state constitute about 22% or 787 km^2 of the state total landmass.

National Population Commission (NPC) of Nigeria in 2006 population census put the population of Lagos state at 9,013,534 of a national estimate of 140 million (NPC, 2006). Lagos State is divided into five Administrative Divisions which are further divided into 20 Local Government Areas.

The study was conducted in Western Zone of Lagos state ADP. Western Zone is one of the three ADP zones in Lagos state. Others are Eastern Zone and Far Eastern Zone. The zone consists of six extension blocks namely: Apa, Badagry, Ikeja, Ikoga, Ibeshe and Ojo blocks, each managed and headed by block extension supervisor (BES). Each of these blocks is made up eight cells wherein the fish farmers were sampled.

The dominant vegetation of the zone is the tropical swamp forest which consists of the fresh water and mangrove swamp forests both of which are influenced by the double rainfall pattern of the State, which makes the environment a wetland region for rice, maize, fish farming, coconut and plantain cultivation. Generally, the zone has two climatic season: Dry (November-march) and Wet (April-October) suitable for fish farming activities. The presence of numerous rivers, flood plains and creeks for fish farming activities lead to study area selection.

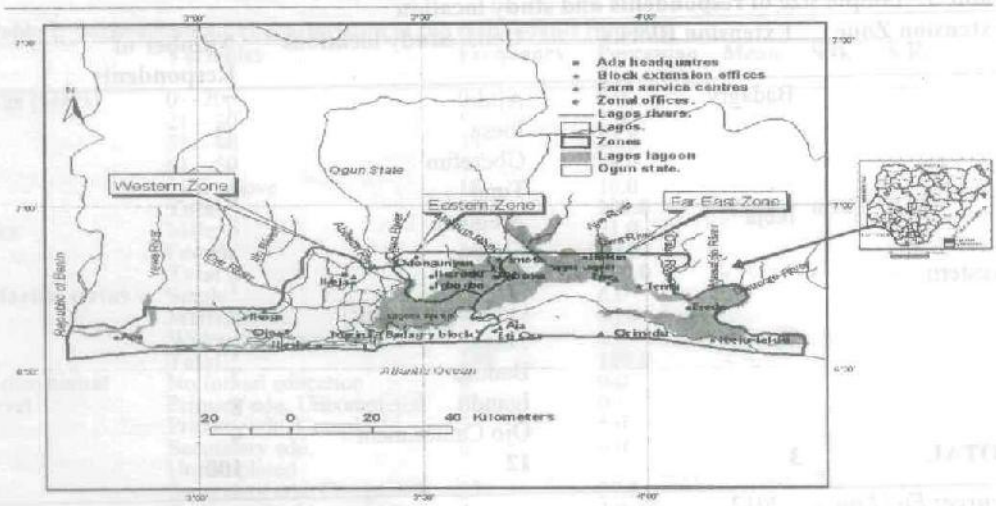

Figure 7: Lagos State ADP Zones & Blocks showing study location

Figure 1: Lagos state ADP Zones and Blocks showing study location
Source: *Olaoye, 2010*

Data collection and sampling procedure

Purposive and simple random sampling techniques were used to select the respondents for the study. As shown in Table 1, a total of three blocks (i.e. Ojo, Badagry and Ikeja) were purposively selected from the Western zone and four cells were also purposively selected from each of the blocks making a total of twelve cells based on frame survey information and high degree of fish production activities. Structured interview schedule was used to elicit the primary data/information from 100 randomly selected fish farmers from the twelve cells in the study area and the method was an adaptation of the method used by (Nwachukwu and Onuegbu, 2007).

Data analysis

Data obtained from the field survey were subjected to descriptive and inferential statistical analysis. Frequency counts, percentages, means and standard deviations were used to describe the socio-economic characteristics of the respondents while hypotheses were tested with Pearson Product Moment Correlation (PPMC), Chi-square test and T-test

.Results and Discussions

Socio-economic characteristics of the respondents

Table 2 shows that 46.0% of the fish farmers were within the age range of 41-50 years, with a mean age of 42.60 years (SE = 0.69) while 58.0% had tertiary education. This age categories were considered as a highly productive and active age to undertake strenuous task associated with farm work (FAO, 1997 and Olowosegun *et al.*, 2004). This is also in line with Bello (2000) assertion that age has positive correlation with acceptance of innovation and risk taking. Also, 71.0% of the fish farmers were male which implies that the business is energy tasking, 90.0% were married while 57.0% having a household size of 1-5 people with a mean household size of 5 (SE= 0.13).

Similarly, Table 2 shows that 77.0% of the fish farmers had 5 years' experience in fish farming and 38.0% undertake fish farming as a primary occupation while the

Table 1: Sample size of respondents and study location

Extension Zone	Extension Blocks	Cells/ Study locations	Number of Respondents
Western	Badagry	Ajido	7
		Ibesa	11
		Gberefun	9
		Topo	6
	Ikeja	Ajegunle	8
		Ejigbo	10
		Meiran	7
		Odo-Ogun/Isheri	8
	Ojo	Festac	10
		Badore	7
		Igando	8
		Ojo Cantonment	9
TOTAL	**3**	**12**	**100**

Source: Field survey, 2012

remaining 62.0% had other sources of livelihood apart from fish farming. Thus, it could be asserted that the presence of a secondary occupation adversely affected the focus of respondents in the management of their fish farm. In addition, 58.0% of fish farmers were part time farmers and most (78.0%) fish farmers' source of labour is their family. Also, 37.0% of the respondents had undergone fish farming training and only 24.0% of the fish farmers were co-operators. Also, 8.0% of the fish farmers had access to finance. This implies that the respondents need government assistance in loan accessibility at low interest, grants, fish farm input at subsidized rate to boost their fish production.

Farm pattern and characteristics

Table 3 shows that 87.0% of the respondents' cultured catfish (*Clarias gariepinus*) while 13.0% cultured both catfish and tilapia. Also, 98.0% practiced monoculture, 64 percent were using intensive culture system and 74.0% having concrete tanks with 4-6 ponds on their farm (54.0). The mean total number of fish harvested was 880.68 (SE = 109.92), with a mean average fish weight of 1.27kg (SE = 0.06) and a mean selling price per kilogram of catfish was N693.20 (SE = 99.41).

Respondents' awareness of IAMP

Table 4 shows that most of the fish farmers in the zone were aware of IAMP. This can be attributed to level of education of the respondents, the received fish farming training and encouragement received through extension agents. Also, that Lagos is a gateway and commercial nerve centre of Nigeria (Ebuehi *et al.*, 2007 and Kumar, 2012).

Usage of IAMP by respondents

Table 5 shows that 87.0% of the fish farmers kept record of activities, general observation (82.0%) and feeding operation (69.0%) in the farm on daily basis. This was the reflection of education status of the respondents, extension services presence and experiences from primary.

Constraints affecting usage of IAMP in Lagos state ADP Western Zone

Table 6 shows that high cost of inputs (88.0%), flooding (79.0%), predators (71.0%), lack of technical know-how (61.0%), mortality and pollution (61.0%) were considered by the fish farmers as

Table 2: Socio-economic characteristics of the respondents (n=100)

	Variables	Frequency	Percentage	Mean	S.D.	S.E.
Age (years)	0 – 20	0	0.0			
	21 – 30	5	5.0			
	31 – 40	33	33.0			
	41 – 50	46	46.0			
	51 & above	16	16.0			
	Total	**100**	**100.0**	**42.60**	**6.94**	**0.69**
Sex	Male	71	71.0			
	Female	29	29.0			
	Total	**100**	**100.0**	-	-	-
Marital status	Single	6	6.0			
	Married	90	90.0			
	Widow/Widower	4	4.0			
	Total	**100**	**100.0**	-	-	-
Educational level	No formal education	0	0.0			
	Primary edu. Uncompleted	0	0.0			
	Primary edu. Completed	5	5.0			
	Secondary edu. Uncompleted	6	6.0			
	Secondary edu. Completed	27	27.0			
	Tertiary edu. Uncompleted	4	4.0			
	Tertiary edu. Completed	58	58.0			
	Total	**100**	**100.0**	-	-	-
Household size	1 -5	57	57.0			
	6 -10	43	43.0			
	Total	**100**	**100.0**	**5.36**	**1.28**	**0.13**
Family type	Nuclear family	94	94.0			
	Extended family	6	6.0			
	Total	**100**	**100.0**	-	-	-
Religion	Christianity	76	76.0			
	Islam	24	24.0			
	Total	**100**	**100.0**	-	-	-
Years of experience	0 -5	77	77.0			
	6 -10	21	21.0			
	11 & above	2	2.0			
	Total	**100**	**100.0**	**4.73**	**2.86**	**0.29**
Reason for establishing the fish farm	To increase income	29	29.0			
	For interest	2	2.0			
	To make profit	61	61.0			
	To earn a living	8	8.0			
	Total	**100**	**100.0**	-	-	-
Secondary occupation	Fish farmers with secondary occupation	63	63.0			
	Fish farmers without secondary occupation	37	37.0			
	Total	**100**	**100.0**	-	-	-
Mode of fish farming operation	Part-time	58	58.0			
	Full time	42	42.0			
	Total	**100**	**100.0**	-	-	-
Source of labour	Family member	78	78.0			
	Hired labour	22	22.0			
	Total	**100**	**100.0**	-	-	-
Fish farming training	Trained fish farmers	37	37.0			
	Untrained fish farmers	63	63.0			
	Total	**100**	**100.0**	-	-	-
Membership of cooperative society	Co-operators	24	24.0			
	Non-co-operators	76	76.0			
	Total	**100**	**100.0**	-	-	-
Access to finance	Fish farmers with access	**8**	**8.0**			
	Fish farmers without access	**92**	**92.0**			
	Total	**100**	**100.0**	-	-	-

Source: Field survey, 2012

Table 3: Distribution of the Farm pattern and characteristics of the respondents

	Variables	Frequency	Percentage	Mean	S.D.	S.E.
Fish species cultured	Catfish	**87**	**87.0**			
	Catfish and Tilapia	**13**	**13.0**			
	Total	**100**	**100.0**	-	-	-
Culture method	Monoculture	98	98.0			
	Polyculture	2	2.0			
	Total	**100**	**100.0**	-	-	-
Culture system	Extensive	13	13.0			
	Semi-intensive	23	23.0			
	Intensive	64	64.0			
	Total	**100**	**100.0**	-	-	-
Types of fish pond	Earthen pond	14	14.0			
	Concrete tank	74	74.0			
	Wooden VAT	12	12.0			
	Total	**100**	**100.0**	-	-	-
Source of fingerlings (Young fish)	From the wild	2	2.0			
	Fish hatcheries	98	98.0			
	Total	**100**	**100.0**	-	-	-
Total number of fish harvested	1 – 5000	93	93.0			
	5001 – 10000	6	6.0			
	10001 & above	1	1.0			
	Total	**100**	**100.0**	**880.68**	**1099.15**	**109.92**
Average weight of fish harvested (KG)	<1	11	11.0			
	1 – 2	87	87.0			
	> 2	2	2.0			
	Total	**100**	**100.0**	**1.27**	**0.58**	**0.06**
Selling price of harvested fish (KG)	< 500	45	45.0			
	500 – 1000	50	50.0			
	> 1000	5	5.0			
	Total	**100**	**100.0**	-	-	-

serious constraints affecting their use of IAMP in the study area For these reasons, the respondents expect government assistance in providing low interest loan, provision of land, grants and fish farm equipment at subsidized rate. In addition, low quality fish seed resulting in stunted growth and poor returns on investment will be recorded in the area as majority of the respondents were not aware of the effect of quality fish seed despite the average level of awareness of IAMP in the study area. This is in line with George *et al.* (2010) assertion that quality seed and fish feed are the essential components for fish growth. Similarly, 54% of the fish farmers claimed not to be aware of importance of market structure; this has potential of making farmers sell their fish in fresh forms to middle men at very low prices. There should be need for adequate marketing information and networking among fish farmers.

Hypotheses testing

Ho1:- There is no significant association between fish farmers' awareness of IAMP and their level of usage of IAMP.

Table 7 revealed that out of 32 improved aquaculture management practices tested, 20 were significant at $P < 0.05$. Therefore, awareness of improved aquaculture management practices was significant to their usage.

This findings concur with the study of Olaoye, 2010 that improved fisheries technologies must pass through awareness, trial and adoption if it has economic advantages, not too complex, relative comparative merits, not too costly and environmental friendly.

Table 4: Distribution of respondents' awareness of IAMP

Practices	Frequency	Percentage
Site selection	99	99.0
Pond/tank construction	100	100.0
Pond liming	80	80.0
Fertilizer application	81	81.0
Monitoring of pond walls(dyke)	75	75.0
Fish seed selectivity	54	54.0
Acclimatization of fish seed	77	77.0
Stocking of fish pond/tank	95	95.0
Desilting	72	72.0
Cleaning & Hygiene	99	99.0
Flushing	93	93.0
Feed purchase (Imported feed)	100	100.0
Feed formulation & Locally made feed	100	100.0
Feeding operation	96	96.0
Fish seed production technique	63	63.0
Regular sorting	89	89.0
Steady water supply	97	97.0
Monitoring of water parameters	89	89.0
Isolation of sick fish	89	89.0
Use of drugs	81	81.0
Weed control	64	64.0
Predator control	76	76.0
Test cropping	92	92.0
Harvesting techniques	78	78.0
Preservation techniques	75	75.0
Transportation of fish in plastic bags	100	100.0
Sales/Marketing	99	99.0
Record keeping	100	100.0
General observation	99	99.0
Maintenance of facilities	93	93.0
Management review	47	47.0

Ho2:- There is no significant relationship between the socio-economic characteristics of fish farmers and their level of usage of IAMP.

Table 8 shows that PPMC analysis reveals that there was significant relationship between household size ($r = -0.20, p < 0.05$) of fish farmers and **their level of usage of** IAMP. This implies that large household size will aids adoption of IAMP and cost of hiring labour shall be to a minimal thus leads to increase productivity and income as well lead to change in social status.

Ho3:- There is no significant difference between IAMP used and income generated.

Table 5: Distribution of IAMP by respondents

Practices	Daily Used	Weekly Used	Monthly used	Occasion-ally used	Never used
Site selection	0.0	0.0	5.0	78.0	17.0
Pond/tank construction	0.0	0.0	10.0	87.0	3.0
Pond liming	0.0	2.0	26.0	59.0	13.0
Fertilizer application	2.0	1.0	1.0	26.0	70.0
Monitoring of pond walls(dyke)	44.0	16.0	8.0	6.0	26.0
Fish seed selectivity	11.0	13.0	37.0	8.0	31.0
Acclimatization of fish seed	10.0	12.0	39.0	17.0	22.0
Stocking of fish pond/tank	9.0	10.0	56.0	12.0	13.0
Desilting	9.0	2.0	2.0	5.0.0	82.0
Cleaning & Hygiene	46.0	26.0	14.0	10.0	1.0
Flushing	2.0	46.0	6.0	36.0	10.0
Feed purchase (Imported feed)	15.0	35.0	38.0	7.0	5.0
Feed formulation & Locally made feed	31.0	31.0	30.0	8.0	0.0
Feeding operation	69.0	10.0	8.0	8.0	5.0
Fish seed production technique	16.0	24.0	11.0	14.0	35.0
Regular sorting	33.0	41.0	18.0	8.0	0.0
Steady water supply	62.0	16.0	14.0	6.0	2.0
Monitoring of water parameters	46.0	23.0	19.0	11.0	1.0
Isolation of sick fish	36.0	11.0	9.0	42.0	2.0
Use of drugs	17.0	7.0	16.0	52.0	8.0
Weed control	15.0	5.0	16.0	31.0	33.0
Predator control	31.0	8.0	30.0	26.0	5.0
Test cropping	32.0	14.0	32.0	22.0	0.0
Harvesting techniques	12.0	8.0	47.0	31.0	2.0
Preservation techniques	13.0	10.0	11.0	48.0	18.0
Transportation of fish in plastic bags	14.0	7.0	50.0	26.0	3.0
Sales/Marketing	18.0	10.0	60.0	12.0	0.0
Record keeping	87.0	4.0	5.0	4.0	0.0
General observation	82.0	3.0	8.0	7.0	0.0
Maintenance of facilities	54.0	1.0	22.0	22.0	1.0
Management review	31.0	2.0	14.0	16.0	37.0

Source: Field survey, 2012

Table 9 shows that improved aquaculture management practices used had significance ($P<0.05$) on income generated. Thus, null hypothesis is rejected. This means that the utilization of IAMP by fish farmers lead to increase productivity and income, and vice versa. This will eventually encourage other farmers to adopt IAMP.

Conclusions

Outcome of the study revealed that majority of the fish farmers in the area were not totally new to many of the improved

Table 6: Distribution of factors affecting usage of IAMP in Lagos state ADP Western Zone

Constraints	Very serious	Serious	Not a problem	I don't know
Lack of appropriate land	1.0	54.0	18.0	27.0
Insufficient fund	0.0	0.0	29.0	71.0
Poaching	0.0	50.0	28.0	22.0
Lack of technical know-how	0.0	61.0	25.0	14.0
Mortality	0.0	61.0	26.0	13.0
Diseases outbreak	5.0	58.0	23.0	14.0
Predators	0.0	71.0	15.0	14.0
Flooding	0.0	79.0	6.0	15.0
pH variation	0.0	54.0	31.0	15.0
Pollution	0.0	61.0	27.0	12.0
Cannibalism	0.0	30.0	47.0	23.0
High cost of inputs	88.0	3.0	8.0.	1.0
Low quality fish seed	11.0	5.0	21.0	63.0
Market structure	2.0	6.0	38.0	54.0
Inadequate extension services	1.0	55.0	34.0	10.0
Difficulty in transporting organic fertilizer	26.0	16.0	47.0	11.0

Source: Field survey, 2012

aquaculture management practices and that the male dominated. Also, the mean age of fish farmers in the zone favoured fish farming activities. Though high cost of inputs was a huge limiting factor for the fish farmers, awareness proved significant to the use of improved aquaculture management practices in Lagos state ADP Western zone.

Likewise, from the result of the research, it was established that improved aquaculture management practices used had significance on the income generated by fish farmers.

Recommendations

From the study, following recommendations are proffered:

i. To meet the level of fish demand in the state and the entire country,

Table 7: Chi-square test result of the awareness of IAMP to their level of usage by respondents

Variables	χ^2	Df	CC	Decision
Site selection	4.932	2	0.085	NS
Pond/tank construction	0.000	4	0.000	S
Pond liming	14.052	3	0.003	S
Fertilizer application	10.053	4	0.040	S
Monitoring of pond walls(dyke)	71.350	4	0.000	S
Fish seed selectivity	51.836	4	0.000	S
Acclimatization of fish seed	7.286	4	0.122	NS
Stocking of fish pond/tank	4.135	4	0.388	NS
Desilting	8.537	4	0.074	NS
Cleaning & Hygiene	9.091	4	0.059	NS
Flushing	4.921	4	0.295	NS
Integrated fish farming system	6.318	4	0.177	NS
Feed purchase (Imported feed)	0.000	4	0.000	S
Feed formulation & Locally made feed	0.000	4	0.000	S
Feeding operation	3.202	4	0.525	NS
Fish seed production technique	22.248	4	0.000	S
Regular sorting	17.820	3	0.000	S
Steady water supply	7.280	4	0.122	NS
Monitoring of water parameters	11.476	4	0.022	S
Isolation of sick fish	24.858	4	0.000	S
Use of drugs	8.914	4	0.063	NS
Weed control	47.052	4	0.000	S
Predator control	47.787	4	0.000	S
Test cropping	1.384	3	0.709	NS
Harvesting techniques	20.833	4	0.000	S
Preservation techniques	52.947	4	0.000	S
Transportation of fish in plastic bags	0.000	4	0.000	S
Sales/Marketing	9.091	3	0.028	S
Record keeping	0.000	3	0.000	S
General observation	0.222	3	0.974	NS
Maintenance of facilities	10.911	4	0.028	S
Management review	63.165	4	0.000	S

X^2 =Chi-square calculated, *Df= Degree of freedom, S=Significant (P<0.05), NS=No significant (P>0.05)*

***Source:** Field survey, 2012*

more energy should be directed by extension agents on programmes that will encourage and persuade fish farmers to adopt improved management practices especially on a large scale.

ii. The government should increase provision of low interest loans to fish farmers, enlighten them through extension agents on the various ways of raising fund and to intensify effort on fish farming as

Table 8: PPMC result of the socio-economic characteristics and usage of improved aquaculture management practices of the fish farmers

Variables	R	P	Decision
Age (Years)	0.014	0.889	NS
Household size (Persons)	-0.202	0.044	S
Fish farming experience (Years)	0.114	0.260	NS

Df= Degree of freedom, S=Significant (P<0.05), NS=No significant (P>0.05)
Source: *Field survey, 2012*

Table 9: T-test result of the level of usage of IAMP by respondents to income generated

	T	Df	Sig (2-tailed)	Decision
Income	4.641	99	0.000	Reject H_0

Decision criterion is reject null hypothesis when P<0.05, Df = Degree of freedom
Source: *Field survey, 2012*

primary occupation.

iii. Extension agents should encourage fish farmers to join cooperative societies so as to make receiving of aids either from the government or from public and private financial institutions easier.

iv. Fish farmers should only source fingerlings (young fish) from reputable fish hatcheries.

v. Improved aquaculture management practices should be continually refined to meet current realities.

vi. Generally, to solve the major input problem facing fish farmers in the zone, there is need for both government and private organization to provide credit facilities at subsidized rate to fish farmers.

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