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Baseline Socio-Economic Study of Sustainable Integrated Pond Based Aquaculture with Rice and Poultry Production in North Central and South West, Nigeria

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Abstract

Integrated aquaculture production with livestock have achieved major breakthrough in Asia. Despite the several benefit associated with the production system, not much has been achieved in Nigeria. A baseline study was carried out to assess the perception, levels of awareness and adoption of fish farmers of integrated pond based aquaculture with rice and poultry productions. The study area was the wet lands located in the North Central (NC) and South West (SW) agro-ecological zones of Nigeria. Qualitative and quantitative data were collected for the study. A three stage stratified sampling method was used to select fish farmers from agro-ecological zones, states, and Agricultural Development Programme zones. Structured questionnires were administered to 100 and 200 registered fish farmers from NC and SW respectively. Descriptive statistics and linear regression were used for the analysis. Majority of fish farmers were male (82.2%), attained post secondary education (60.5 %), and a fair proportion had fish farming as their primary occupation (35.9%). Streams and rivers were the main source of water for fish culture in earthen pond, while most aquaculture production was rain fed, operating during the rainy season only. A fair proportion of the farmers (42.4%) were able to generate annual profit of more than ₦300, 000. The most preferred fish species for culture was the African catfish (*Clarias species*,). Sales at farm gate (51.1%) was the main form of disposing the cultured fish. Value addition by smoking was practiced by 28.6% of farmers. Half of the fish farmers (50.4%) favoured integrated pond based aquaculture with rice and poultry. Only 1.8% and 6.5% of fish farmers adopted rice and poultry integration respectively. No fish farmer adopted rice and poultry integrated aquaculture production simultaneously. Data analysis revealed that ecological zone, household size and willingness to adopt integrated aquaculture significantly ($P< 0.05$) influenced perception of fish farmers to integrated aquaculture. It was concluded that many fish farmers were not aware of integrated fish farming.

Keywords: Integrated Aquaculture production, agro-ecological zones, socio-economics, fish sustanability

Introduction

Integrated farming involving aquaculture defined broadly is the concurrent or sequential linkage between two or more activities, of which at least one is aquaculture. These may occur directly on-site or indirectly through off-site needs and opportunities, or both (Edwards, 1997). On a global basis, most cultured freshwater fish are produced in Asia in semi-intensive systems that depend on fertilizer nutrients. An analysis of China, the ancestral home of aquaculture,

according to Little and Edwards (2003) indicates that whilst intensive practices based on formulated pelleted feed are developing rapidly, much of the vast increase in China's recent inland aquaculture production is linked to organic fertilization, provided by the equally dramatic growth of poultry and pig production.

The integration of agriculture and aquaculture can contribute to the alleviation of food insecurity, malnutrition and poverty through the provision of high nutritional food value, income and employment generation, decreased risk of production, improved access to water, sustainable resource management and increased farm sustainability (Little and Edwards, 2003). A sustainable integrated aquaculture production system also aims at ensuring diversification of livelihoods in rural areas, improved nutritional status, increased income-generating capacity, as well as provision of additional off-season activities through enhanced land and water resources utilization. Although significant breakthrough has been achieved in Asia through integrated aquaculture, not much has been achieved in Africa with special reference to Nigeria (AIFP, 2005; Eyo *et al*., 2006). In order for the country to be self sufficient, there is the need for farmers to engage in a result-oriented farming system that can guarantee and sustain adequate food security in environmentally friendly manner (Ayinla, 2003). A baseline study was therefore conducted to identify the extent of fish integrated with rice and poultry production in Nigeria.

The main objective of the study was to provide baseline data on integrated fish farming practices in Nigeria. Scope of the study included documenting the socio-economic characteristics of the fish farmers; the current production facilities, sources of water, annual yield and profit; identification of methods of value addition, market outlets and challenges of marketing; as well as the levels of perception, awareness and adoption by the fish farmers of integrated pond-based aquaculture with references to rice and poultry production.

Methodology

The study area was the wet lands located in the North Central (NC) and South West (SW) Agro-ecological zones of Nigeria. Presented in Figures 1 and 2 are the wetlands of Nigeria, North Central and South West respectively. North Central zone lies between latitude 6^0 17' 4" N and 11^0 20' 15" N, longitudes 2^0 30' 30"E and 10^0 34' 30" E. The states in the NC include Benue, Kwara, Kogi, Niger, Plateau, Nassarawa and Federal Capital Territory (FCT). The total population of NC is 20,266,257.

South West zone lies between latitude 5^0 47' 30" N and 9^0 19' 15" N, longitudes 2^0 30' 30"E and 6^0 2' 15" E. States in SW of Nigeria, Lagos, Ogun and Ondo, States are maritime (coastal), while Ekiti, Osun and Oyo are land-locked. Southwest Nigeria has a total population of about 28 million people (NPC, 2007). The tropical climate has moderate temperatures the year round, rainy season from April to October, and a dry season from November to March.

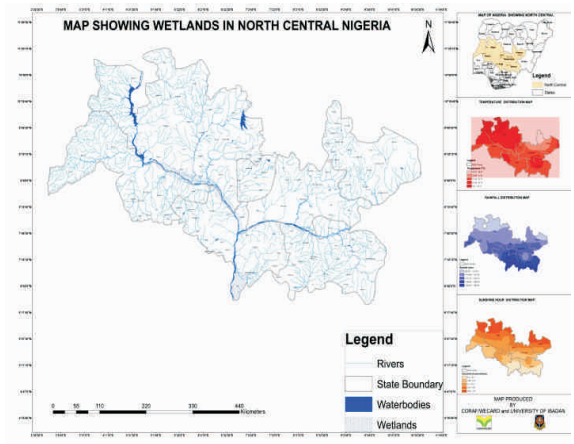

Figure 1: Wetlands of North Central Zone of Nigeria

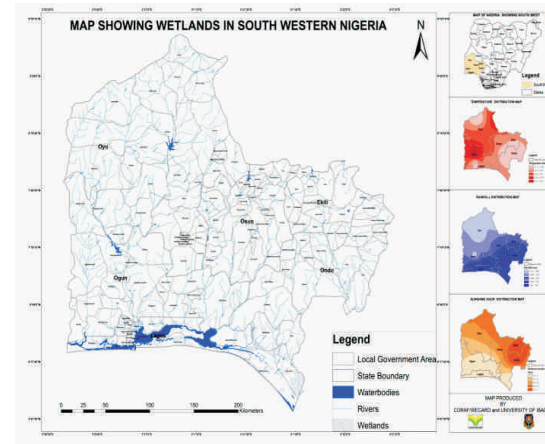

Figure 2: Wetlands of South West Zone of Nigeria

Both primary (qualitative and quantitative) and secondary data were used for the study. Qualitative primary data were collected through In-Depth Interviews with Presidents of Catfish Farmers' Association of Nigeria (CAFAN), while the quantitative primary data was through structured questionnaires administered to practicing fish farmers located in wet lands of sampled states within NC and SW zones. The secondary data used include official documents and publications from the various states' Agriculture Development Programme (ADP) Unit of the Ministry of Agriculture and Rural Development.

A multistage stratified sampling method was used for the selection of the fish farmers based on the agro-ecological zones, states and ADP zones. Three states were randomly selected each from the NC and SW agro-ecological zones. Federal Capital Territory (FCT) Abuja, Niger and Kwara States from NC, while Lagos, Ogun and Oyo States from SW, were selected for the study.

A sample size of 300 fish farmers were sampled, 100 from NC and 200 from SW. When the study was conducted, comprehensive lists of registered fish farmers were not available especially in the NC zone. The selection was based on the *abundance of fish farms and* 80% of the hatchery seed produced from South West of the country (Atanda, 2007). Table 1 is the list of states, ADP zones and number of fish farmers sampled.

Presidents or key officers of Catfish Farmers' Association of Nigeria were interviewed for the collection of qualitative data. A total of three hundred copies of the structured questionnaire were administered to fish farmers for the study. Extension personnel located in their various ADP zones were used as enumerators after they had been trained for the filling of the questionnaires by the fish farmers.

Data analyses

Data analyses used include descriptive statistics and linear regression. Descriptive statistics were frequency counts, percentages and means derived from four-point Likert type scale as follows: 4 = strongly agree, 3 = agree, 2 = disagree, and 1 = strongly disagree. The regression model is as follows:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, U)$

Where Y = Perception (total Likert type scale of each fish farmer)

X_1 = Ecological Zone
X_2 = Age (in years)
$X_{3=}$ Level of education (in years)
X_4 = Household size
X_5 = Membership of cooperative society
X_6 = Number of earthen ponds
X_7 = Awareness of ADP extension agents in the community

Table 1: Sampled States, ADP Zones, LGAs and Fish Farmers

Ecological Zone	States	ADP Zones	Number of Fish Farmers Sampled
North Central			
	FCT	Central, Eastern and Western	30
	Niger	A, B, C, and D	30
	Kwara	A, B, C and D	40
South West			
	Lagos	West, East and Far East	70
	Ogun	Abeokuta, Ilaro, Ijebu and Ikenne	60
	Oyo	Ibadan/Ibarapa, Ogbomoso, Oyo and Shaki	70
Total			**300**

X_8= Willingness to adopt improved methods of integrated aquaculture with rice and poultry production
X_9= Perception level
U = error term

Results and Discussion

Socio-economic Characteristics of the Fish Farmers

Total number of questionnaires retrieved was 276, making 92.0% of the 300 copies administered. Results of the questionnaires analyzed showed that 95 and 181 fish farmers were from the NC

Table 2: Number of Fish Farmers Sampled by States and ADP Zones (n= 276)

Ecological Zone	States	ADP Zones	Number of Fish Farmers Sampled	
			Frequency	Percentage
North Central				
	FCT			
		Central	10	3.6
		Eastern	12	8
		Western	8	2.9
		FCT Subtotal	30	1.5
	Kwara			
		A	4	1.4
		B	5	1.8
		C	18	6.5
		D	3	1.1
		Kwara Subtotal	30	10.8
	Niger			
		A	20	7.2
		B	5	1.8
		C	10	3.6
		D	-	
		Niger Subtotal	35	12.6
South West	Lagos			
		West	23	8.3
		East	-	-
		Far East	35	12.7
		Lagos Subtotal	58	21.0
	Ogun			
		Abeokuta	15	5.4
		Ilaro	15	5.4
		Ijebu	15	5.4
		Ikenne	11	4.0
		Ogun Subtotal	56	25.2
	Oyo			
		Ibadan/Ibarapa	52	18.8
		Ogbomoso	5	1.8
		Oyo	3	1.1
		Shaki	7	2.5
		Oyo Subtotal	67	24.2
Total			276	100

Table 3: Socio-Economic Characteristics of Fish Farmers

Socio-Economic Characteristics	*Ecological Zones		*Total (276)
	NC Zone (95)	SW Zone (181)	
Sex			
Male	79 (28.7)	148 (52.5)	225 (82.2)
Female	16 (5.8)	33 (12.0)	49 (17.8)
Age			
<30	19 (6.9)	49 (17.8)	68 (24.6)
30-39	17 (6.2)	30 (10.9)	47 (17.0)
40-49	23(8.3)	41(14.9)	64 (23.2)
=50	36 (13.0)	61 (16.6)	97 (35.1)
Marital Status			
Single	15 (5.4)	21 (7.6)	36 (13.0)
Married	79 (28.6)	160 (58.0)	239 (86.6)
Widowed	1 (0.4)	-	1 (0.4)
Number of Wives			
None	19 (6.9)	20 (7.2)	39 (14.1)
1	48 (17.4)	146 (52.9)	194 (70.3)
2	12 (4.3)	13 (4.7)	29 (10.5)
3-4	36 (13.0)	2 (0.8)	14 (5.1)
Household Size			
1-5	8 (3.2)	49 (19.8)	57 (23.1)
6-10	18 (7.3)	83 (33.6)	101 (40.9)
11-15	34 (13.8)	27 (10.9)	61 (24.7)
>15	22 (8.9)	6 (2.4)	28 (11.3)
Educational Level			
None	9 (3.3)	13 (4.7)	22 (8.0)
Primary education	3 (1.1)	20 (7.2)	23 (8.3)
Secondary education	17 (6.2)	46 (16.7)	63 (22.8)
Post secondary education	66 (23.9)	102 (37.4)	168 (60.9)
Primary Occupation			
None	9 (3.3)	33 (12.0)	42 (15.2)
Fish farmers	24 (8.7)	99 (35.9)	123 (44.6)
Farmers	1 (0.4)	10 (3.6)	11 (4.0)
Civil servants	36 (13.0)	26 (9.4)	62 (22.5)
Traders	4 (1.4)	4 (1.4)	8 (2.9)
Artisans	21 (7.6)	9 (3.3)	30 (10.9)
Secondary Occupation			
None	20 (7.2)	87 (37.0)	107 (38.8)
Fish farmers	64 (23.2)	55 (19.9)	119 (43.1)
Farmers	1 (0.4)	13 (4.7)	14 (5.1)
Civil servants	1 (0.4)	6 (2.2)	7 (2.5)
Traders	5 (1.8)	10 (3.6)	15 (5.4)
Artisans	4 (1.4)	10 (3.6)	14 (5.1)
Membership of Cooperative Society			
Members	37 (13.4)	86 (34.5)	153 (55.4)
Non-members	58 (21.0)	95 (32.3)	123 (44.6)

* Percentages are in parenthesis

(FCT, Kwara and Niger States) and SW (Lagos, Ogun and Oyo) States respectively, presented in Table 2. Socio-economic characteristics in Table 3 revealed that majority of the fish farmers interviewed were male (82.2%), married (86.6%) and have attained post secondary education (60.5 %).

More (68.4%) fish farmers in both ecological zones were 40 years of age and above. Fish farmers in SW were monogamous (52.9%) and had smaller household size (53.4%) of not more than10; 35.9% had fish farming as their primary occupation and 34.5% as members of cooperative groups compared to NC. More of the fish farmers (55.4%) were members of fish farmers' association or other cooperative societies.

Production Facilities, Sources of Water and Annual Yield and Profit

Presented in Table 4 are the production facilities and sources of water. Majority of the fish farmers

Table 4: Production Facilities and Sources of Water of Fish Farmers

	Ecological Zones*		Total (276)*
Production Systems	**NC Zone (95)**	**SW Zone (181)**	
Number of Earthen Ponds			
None	35 (13.0	57 (20.7)	93 (33.7)
1-5	38 (13.8)	78 (28.3)	116 (42.0)
6-10	11 (4.0)	29 (10.9)	40 (14.5)
11-15	6 (2.2)	10 (3.6)	16 (5.8)
>15	4 (1.4)	7 (2.5)	11 (4.0)
Sources of Water for Earthen Ponds			
None operators	36 (13.1)	63 (23.0)	99 (36.1)
Stream	29 (10.6)	56 (20.4)	85 (31.0)
River	8 (2.9)	24 (8.8)	32 (11.7)
Borehole	12 (4.4)	22 (8.0)	34 (12.4)
Well	4 (1.5)	14 (5.1)	18 (6.6)
Dam	6 (2.2)	0	6 (2.2)
Number of Concrete Tanks			
None	48 (17.4)	97 (35.1)	145 (52.5)
1-5	29 (10.1)	45 (16.3)	74 (26.8)
6-10	10 (3.6)	29 (10.5)	39 (14.1)
11-15	6 (2.2)	6 (2.2)	12 (4.3)
>15	2 (0.7)	4 (1.4)	6 (2.2)
Sources of Water for Concrete Tanks			
None operators	52 (18.9)	106 (38.5)	158 (57.5)
Stream	0	4 (1.5)	4 (1.5)
River	0	3 (1.1)	3 (1.1)
Borehole	30 (10.9)	55 (20.0)	85 (30.9)
Well	12 (4.4)	12 (4.4)	24 (8.7)
Dam	1 (0.4)	0	1 (0.4)
Number of Plastic Tanks			
None	82 (29.7)	155 (56.2)	237 (85.9)
1-5	11 (4.0)	22 (8.0)	33 (12.0)
6-10	0	3 (1.1)	3 (1.1)
11-15	1 (0.4)	0	1 (0.4)
>15	1 ((0.4)	1 (0.4)	2 (0.7)
Sources of Water for Plastic Tanks			
None operators	87 (31.8)	157 (57.3)	244 (89.1)
Stream	-	1 (0.4)	1 (0.4)
River	1 (0.4)		1 (0.4)
Borehole	5 (1.8)	14 (5.1)	19 (6.9)
Well	2 (0.7)	7 (2.6)	9 (3.3)
Dam	1 (0.4)	0	1 (0.4)

* Percentages are in parenthesis

(42.0%) had at least five earthen fish ponds and stream was the main source of water (31.0%). Bore-hole water (12.4%) was used as a source for culture than rivers or well. Only six fish farms (2.2%) from the NC source the culture water from dams. A total of 66.7% fish farmers had at least one earthen fish pond. In another study by Fregene, *et al* (2001) in Delta State, the result revealed that 62% adopted the use of earthen pond for rearing fish because it is cheaper to construct.

Half of the fish farmers (52.5%) do not own concrete tanks. A likely reason could be the cost of construction which is more compared to construction of an earthen pond. One -fourth of the fish farmers owned between one and five concrete tanks. In the NC, the main source of water for concrete tanks was the bore-hole (10.9%). It is interesting to note that water from stream and river were not used for culturing fish in concrete tanks. In the SW, very few sourced for water from the streams (1.5%) and river (1.1%), but major source is the bore-hole (20.0%). Only 10.9% of fish farmers used plastics for rearing fish, sourcing water mainly from bore holes (6.9%) and wells (3.3%).

Table 5 revealed fish yield and profit of fish farmers. Half of the fish farmers (52.9%) reported annual fish yield of 10, 000kg. Only 21 (7.6 %) fish farms had fish yield of more than 30, 000kg. Almost one third (28.6%) had no data on fish yield. A likely reason could be the inability of the fish farmers to consistently keep records of their farm operations. The purpose of setting up an economic venture is to make profit. Unfortunately, 32.6% could not declare profit at the end of the production year. A proportion of 42.4% were able to generate profit of more than ₦300, 000. The variation in profit made may likely be related to the fish farmers' scale of production.

Preferred Fish Species, Type of Value Addition, Market Outlet and Challenges of Fish Farmers

The most preferred fish species for culture by the fish farmer is *Clarias species*, African catfish (Table 6). This is because the fingerlings are readily available for stocking, grows fast in earthen ponds and readily accepted by the consumers as being tasty. Only 20.3% of the fish farmers added value to the products by smoking using traditional and modern smoking kilns.

Sales at farm gate (51.1%) was the main form of disposing the cultured fish. Other means include the supply to eateries (6.9%), use of wholesales and middle men (39.8%). One of the challenges to marketing cultured fish was middle men exploitation (38.0%). Low fish demand (12.3%); poor road network (12.7%) and high transport cost (6.5%) were among other challenges encountered by fish farmers.

Table 5: Fish Yield and Profit of Fish Farmers

Fish Production	Ecological Zones*		Total (276)*
	NC Zone (95)	SW Zone (181)	
Fish Yield (Kg)			
No response	34(12.3)	45 (16.3)	79 (28.6)
=10, 000	40 (14.5)	106 (38.4)	146 (52.9)
10,001-20, 000	8 (2.9)	15 (5.4)	23 (8.3)
20, 001-30, 000	5 (1.8)	2 (0.7)	7 (2.5)
>30, 000	8 (2.9)	13 (4.7)	21 (7.6)
Profit of Fish Production (₦)			
No response	36 (13.0)	54 (19.6)	90 (32.6)
<100, 000	8 (2.9)	15 (5.4)	23 (8.3)
101, 000-200, 000	7 (2.5)	13 (4.7)	20 (7.2)
201, 000-300, 000	7 (2.5)	19 (6.9)	26 (9.4)
>300, 000	37 (13.4)	80 (29.0)	117 (42.4)

* Percentages are in parenthesis

Table 6: Preferred Fish Species, type of value addition, Market Outlet and Challenges of Fish Farmers

	Ecological Zones*		Total (276)*
	NC Zone (95)	SW Zone (181)	
Preferred Cultured Fish Species			
No response	7 (2.5)	12 (4.3)	19 (6.9)
Clarias species	88 (31.9)	167 (60.6)	255 (92.4)
Tilapia	0	2 (0.7)	2 (0.7)
Type of Value Addition			
Smoking	27 (9.8)	29 (10.5)	56 (20.3)
None	68 (24.6)	152 (55.1)	220 (79.7)
Market Outlet			
None	1 (0.4)	5 (1.8)	6 (2.2)
Sales at farm gate	38 (13.8)	103 (37.3)	141 (51.1)
Wholesales and middle men	49 (17.5)	61 (22.1)	110 (39.8)
Supplies to eateries	7 (2.5)	12 (4.3)	19 (6.9)
Challenges of Marketing Fish			
None	30 (10.9)	47 (17.0)	77 (27.9)
Low fish demand	10 (3.6)	24 (8.7)	34 (12.3)
Poor road network	17 (6.2)	18 (6.5)	35 (12.7)
Middle men exploitation	29 (10.6)	76 (27.5)	105 (38.0)
High transport cost	8 (2.9)	10 (3.6)	18 (6.5)
Irregular fish supply	1 (0.4)	6 (2.2)	7 (2.5)

* Percentages are in parenthesis

Extension Agents (EAs) Contact with Fish Farmers

The extension agents' primary contact with fish farmers involves the dissemination of some extension technology messages under a formal extension services delivery system. It was observed that 68.9% fish farmers were aware of their activities, 48.9% have not been visited by EAs in a month. A proportion of 34.0% have benefited from the fortnight visits (Table 7). Chikwendu (1995) identified characteristics of the change agents (number of visits, personal characteristics and communication techniques) as some of the variables that affect adoption of any technology. Due to the few EAs available to visit fish farmers, this has resulted to the problem of inadequate contact with fisher folks and fish farmers (Bolorunduro and Fregene (2000).

Table 7: Awareness of ADP Extension Agents (EAs) by Fish Farmers and Frequency of Visits

	Ecological Zones*		Total (276)*
Awareness of EAs	**NC Zone (95)**	**SW Zone (181)**	
Yes, aware	76 (27.6)	114 (41.3)	190 (68.9)
Not aware	19 (6.8)	67 (24.3)	86 (31.1)
Frequency of Visit of EAs per Month to Fish Farmers			
None	52 (18.8)	83 (30.1)	135 (48.9)
Once	18 (6.5)	21 (7.6)	39 (14.1)
Twice	20 (7.2)	74 (26.8)	94 (34.0)
Thrice	2 (0.7)	3 (1.1)	5 (1.8)
Four times	3 (1.1)	0	3 (1.1)

* Percentages are in parenthesis

Perception, Awareness and Adoption of Fish Farmers to Integrated Pond Based Aquaculture with Rice and Poultry

More fish farmers were aware of integrating rice with fish (28.4%) in NC and 3.2% had adopted it in the SW (Figure 3). On the contrary, more fish farmers had adopted integrating poultry with fish (7.2%). Overall, proportion of fish farmers aware of integrating rice and poultry with fish were 12.7% and 19.6% respectively (Figure 4). More fish farmers adopted poultry integrated with fish (6.5%) compared to integration with rice (1.8%). No fish farmer practiced integrated fish culture with rice and poultry. Many (69.2%) gave no reasons for not adopting as presented in Table 8. Reasons for not adopting include high cost (12.7%), lack of information (6.9%) and land (6.4%). Other reasons were no clear advantage and farmers not prepared. On the contrary, 51.4% are willing to adopt according to Table 9.

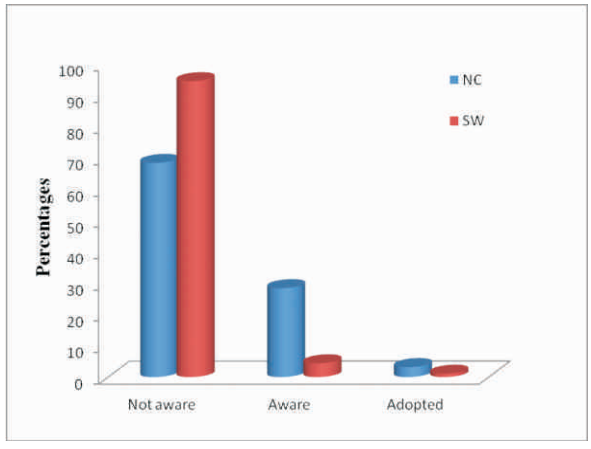

Figure 3: Level of Awareness and Adoption of Fish Farmers to Integrated Pond Based Aquaculture with Rice

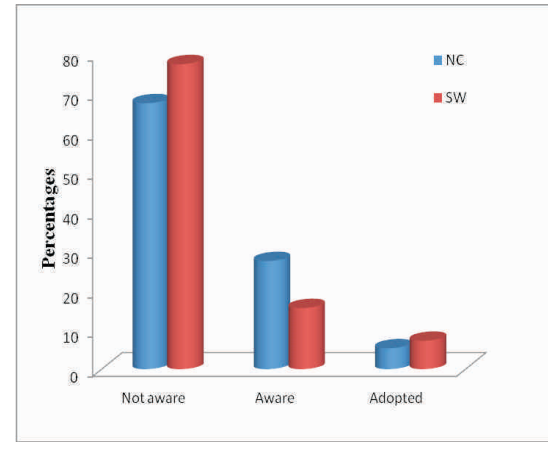

Figure 4: Level of Awareness and Adoption of Fish Farmers to Integrated Pond Based Aquaculture with Poultry

Table 8: Reasons for not Adopting Integrated Pond Based Aquaculture with Rice and Poultry

	Ecological Zones*		Total (276)*
	NC Zone (95)	SW Zone (181)	
No response	60 (21.7)	131 (47.5)	191 (69.2)
High Cost	10 (3.6)	25 (9.1)	35 (12.7)
Lack of Information	17 (6.2)	2 (0.7)	19 (6.9)
No land	6 (2.2)	12 (4.2)	18 (6.4)
Others	2 (0.7)	11 (4.0)	13 (4.7)

* Percentages are in parenthesis

Table 9: Willingness of Fish Farmers to Adopt Integrated Pond Based Aquaculture with Rice and Poultry

	Ecological Zones*		Total (276)*
	NC Zone (95)	SW Zone (181)	
No response	32 (11.3)	85 (30.8)	117 (41.1)
Yes	61 (22.1)	81 (29.3)	142 (51.4)
No	3 (11.1)	15 (5.4)	18 (6.5)

* Percentages are in parenthesis

Perception of Catfish Farmers Association of Nigeria (CAFAN) Presidents

In an interview with the President of CAFAN, Ilorin Chapter, Mr. Ajibola Olawole, Aqua-Fisheries, Irra-Offa, he said the fish farmers were aware of integrated fish farming in Kwara State. It was popular in the previous years when there were no foreign feed, no pelletizing machine, longer culture period; poly-culture of *Clarias species* and Tilapia was the practice. But now, 99% of the fish farmers practice monoculture production of *Clarias species* with shorter culture period. He said for example if a farmer stocked juvenile, after feeding with ₦200/fish, he can harvest after a period of 4 and 6 months. He observed that integrated fish farming is cumbersome with high risk in poultry compared to fish farming. He concluded that integrated fish farming requires more time compared to sole fish farming.

On the contrary, the immediate past CAFAN President of Oyo State, Mr. Adewoyin is convinced that integrated fish farming is profitable because he practiced it before. It is a worthwhile venture because he was able to sell eggs and chicken as well as generate maggot from the poultry waste. By the time a fish farmer integrates rice along with the poultry and fish, additional income will be generated from the sales of rice when harvested. He concluded that any agricultural venture a farmer is not committed to, will not produce the desired results.

In Nigeria, integrated fish farming has been reported in many states of the federation in which 50% of fish farmers integrate poultry, piggery or livestock with fish production, while integrated fish cum crop production is on the rise also in several states (AIFP, 2005). This corroborated the submission of Nnaji *et al* (2003) that integrated fish farming is more profitable than unitary system of farming. Fregene and Adewale (2011) observed in Ogun State that the most prevalent type of integration is fish cum chicken farming (56.5%) and the holding facilities for chicken, pig or crop were located beside the fish pond. *Clarias gariepinus* and *Oreochromis niloticus* are cultured in earthen ponds and concrete tanks and fed on supplementary feed, animal feed waste and droppings (61.1%). The study showed that integrated fish farming is more profitable than sole fish farming as it ensures a spread of financial risk for its varied and diversified nature in rearing of fish, animals and crops.

The variables in the regression model explained 75% of the variation of fish farmers' perception on adopting integrated fish farming. Table 10 shows that some socio-economic characteristics of fish farmers have significant effect on their perception of integrated fishing farming within the NC and SW agro-ecological zones of Nigeria. Ecological zone ($P < 0.01$), household size and willingness to adopt integrated aquaculture ($P<0.05$) significantly influenced perception of fish farmers to integrated aquaculture. The perception of fish farmers on integrated fish farming showed that fish farmers in the NC are more likely to practice integrated fish farming with rice and poultry compared to the SW.

Table 10: Factors Influencing Perception of Fish Farmers to Integrated Aquaculture in the all study areas

Socio-economic Characteristics	Coefficient	t-value	Level of Significance
Constant	4.685	6.578	0.000***
Ecological Zone	1.073	3.647	0.000***
Age	0.000	0.006	0.948
Educational level in years	0.007	0.392	0.696
Household size	-0.073	-3.450	0.001**
Membership of cooperative society	0.390	2.107	0.036
Number of earthen ponds	0.014	0.598	0.550
Awareness of ADP extension agents in community	-0.234	0.889	0.375
Willingness to adopt improved methods of integrated aquaculture with rice and poultry production	-0.592	-2.693	0.008***

R^2=0.754, * (p<0. 1) ** (p<0.05) *** (p<0.01)

Conclusion and Recommendation

Conclusion

Fish farmers in the NC and SW of Nigeria use earthen fish pond mainly and *Clarias species*, the African catfish is the preferred fish for culture. Market outlet through wholesales and middle men is a major challenge to marketing cultured fish because very few fish farmers are involved in value addition. The adoption level of integrated pond based aquaculture with rice and poultry is very low and some are not aware of the existence of such technology. Though profitable the venture may appear, many farmers have challenges that must be addressed apart from the inadequate EAs required to disseminate the technology.

Recommendations

There is a need to create more awareness about the benefits of integrated pond based aquaculture with rice and poultry to fish farmers. Extension bulletins in English Language, Yoruba and Hausa on economic benefits should be produced. Increase in rice production will also reduce the amount of foreign exchange spent in importing rice. Fish farmers should be taught how to add value to the fish cultured or sell directly to the end users, rather than sell wholesales and to whole sellers and middle men. Due to the inadequate EAs, it is necessary that contact fish farmers are trained to fill in the gap.

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