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DIFFERENTIALS IN ADOPTION OF IMPROVED FISH FARMING TECHNOLOGIES AMONG FARMERS IN IMO STATE, NIGERIA: A GENDER ANALYSES

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Abstract
Women are key players in fish farming and their participation is critical to achieving food security and economic well-being. The study was designed with the purpose to address the gender gap in the adoption of fish farming technologies and output in Imo State, Nigeria. The study described the socio economic characteristics of fish farmers, investigated level and determinants of adoption of fish farming among the respondents in the study area. Multistage and purposive sampling techniques were used for the selection of Sixty (60) respondents interviewed for the study. Descriptive statistics and Tobit regression procedure were used to analyze the data obtained. Results indicate that 43.3% and 30.0% of male and female fish farmers respectively, were within the age group of 41-50 years. Majority (72.2%) of the male fish farmers inherited their land, while 80% of female fish farmers had theirs through lease. About 70% of the males had 1-2 number of extension contacts, and 50.0% of the female farmers also. Results showed that male fish farmers dominated in the adoption of 5 improved fish farming technologies compared to their female (3) counterparts. Stocking density had the highest mean level of adoption (3.97) for the male fish farmers, while, feed formulation had the highest (3.67) for the female fish farmers. Important factors influencing the probability and intensity of adoption of improved fish farming technologies among the farmers include; education, extension, farm size, access to credit, membership of cooperatives, and environmental attribute. The results therefore, call for the need for policies aimed at free and affordable education, especially targeted at women to enable them access and process information on improved fish farming technologies. There is also need to increase the number of extension visits to enhance gender balance in adoption of fish farming technologies in the study area. Fish farmers should be encouraged to belong to or form cooperatives/groups to enable them ease of access to inputs and resources, especially credit and information that will enhance adoption.

Keywords: Education, Farm Size, Credit, Cooperatives and Gender

Introduction

The need to increase fish production in Nigeria has become most desirable because of the exorbitant cost of beef (Fagade and Olaniyan, 2015). Njoku (2014) asserted that gender differences in farming household vary widely across cultures but some characteristics are common. Fishery is important to Nigeria agricultural economy because it provides employment and income for fish farmers (Njoku, 2000). The bedrock of aquaculture production in Nigeria is adoption of fish technologies without which all efforts at aquaculture development will be in vain, following Ejechi *et al.* (2009). This condition of aquaculture production system in Nigeria is inappropriate because large proportion of aquaculture output is in the hands of those small holder fish farmers whose average pond is about 1-3 ponds (Nlewadim *et al*., 2004). Incidentally, there is very limited access to improved aquaculture technologies and the general condition does not merit tangible investment in capital inputs and labor (Deji and Koledoye, 2013). Aquaculture has limited application of new biotechnologies and most farmers are working with wild stocks collected from the capture fishery, but new biotechnology linked resources are needed if advanced selective breeding programmes are to be developed and the potential gains realized for the economic benefits of fish farmers (Madji and Rachel, 2017). Women contribute heavily in aquaculture, but they hardly benefit from aquaculture incentives because of economic, social and traditional practices which undermine constitutional provision on the equality of men and women (Ironkwe and Ekwe, 2007). Studies show that the formation of Women in Agriculture (WIA) farmer groups have facilitated the dissemination of improved aquaculture technologies and provided women with better access to farm inputs and credit than they would have as individuals Uche *et al.* (2018). Nigeria aquaculture produces about 25,000 tons per

annum and currently generates less than 3% of fish production which is less than the annual fish requirement, but with appropriate adoption of improved aquaculture innovations. It would match capture fish output to enhance increased fish productivity (Yarhere, 2004; Wambugu, *et al*, 2018).

Njoku (2014) identified improved aquaculture technologies as the process of establishing a fish farm which include; water quality, supply soil topography, pond use, stocking techniques, improved fish species, pond construction and fish pond management. Ogbonna (2018) revealed that higher number of fish farmers in Nigeria gets a higher income from its production than they get from other agricultural enterprises; hence it has great potentials and plays an important role in contributing to food security, income generation poverty reduction and socio-economic growth of Nigeria. However, it is known that men and women perform different functions have unequal decision power, and differences in access to production technologies. Because of these differences, men and women's views, needs and priorities to improve their productive potentials differ strongly and would affect their various outputs in fish production and adoption of innovations. Agricultural extension serves both male and female fish farmers but females appear not to be receiving much of aquaculture information innovation (Jiggins *et al.,* 1998).

Agricultural extension is a potent and critical force in the rural development process because it is a service which assists farm people through education on how to improve farming method to quick increase in productivity and income to better their level of living and improve their socio cultural and economic standard through effective transfer and adoption (Sule *et al*., 2004). Gender refers to a socio-economic parameter that is useful in analyzing the roles responsibilities, opportunities and constraints of both men and women along different ethnic, religious and ecological lines (Mohammed *et al.,* 2009).

Fish production in Nigeria is plagued with a myriad of problems that include; adverse climatic change and poor technology adoption, different types of shocks that result in reduced fish output, consequently fish farmers adopt different fish farming technologies in order to exploit the potential advantage. However, literature show quite a number of studies conducted on fish farming in Nigeria and Imo State in particular but none seems to have done any in relation to gender and adoption and given the significance of fish as an important source of livelihood, mitigation of hunger and poverty, coupled with means of food and nutrition security to people of Imo State, an empirical study of the type of resource used and the level of use of these resources is of practical value on account of the insight that such a study will provide for the understanding of the technologies used in fish production. Therefore the study was designed to unveil the gender gap in the adoption of fish farming technologies and output in Imo State, Nigeria.

Methodology

The study was conducted in Imo State of Nigeria. The State is located within the rainforest zone in the Southern part of Nigeria. It lies between latitudes 6° 45″ and 7° 15″ North of the Equator and longitude 6° 50″ and 07° 25″ East of the Greenwich Meridian (Ogbonna 2018). It shares boundaries with Abia State in the East, North West by Anambra State and South West by Rivers State. The population of the study consists of all fish farmers in the State. Data for the study were collected through primary sources obtained using an interview schedule which was administered to fish farmers selected from three Agricultural Zones of Imo State; Orlu, Owerri and Okigwe. Multistage purposive sampling technique was used for the study. In the first stage, one extension block was selected from each of the three (3) Agricultural Zones making a total of three (3) extension blocks, out of 27 extension blocks in the State. In the second stage, 2 extension cells/circles each were selected from each of the 3 blocks making it a total of 6 extension circles. Third, five (5) females and male fish farmers each were purposively selected in each of the 6 extension circles that had adopted aquaculture technologies giving a sample size of 30 males and female fish farmers each (60 fish farmers). The list of fish farmers from each circle was collected with the aid of extension workers' resident in the area. The list served as a sample frame from which the respondents were drawn randomly for the study. The data obtained were analyzed using descriptive and inferential statistics. The descriptive statistics such as means, frequency counts and percentage were used, The adoption level of improved fish farming technologies by male and female fish farmers was analysed using the 6-point rating scale thus; Unware = 1, Aware = 2, Interest = 3, Evaluation = 4, Trial = 5, and Adoption = 6. Fish farmers with adoption by score of 3.5 and above were regarded as having reached average score of technologies adopted. To determine the mean of the adoption level: any mean score of 3.5 and above were considered as within the level of evaluation, trial and adopted.

$$X = \frac{\Sigma fn}{N} \ldots\ldots\ldots (1)$$

Where, ∑=summation, f=frequency, n =Likert nominal value, N=number of respondents.

$$X = 1 + \frac{1+2+3+4+5+6}{6}$$
$$= \frac{21}{6} = 3.5$$

Tobit regression estimate was used to analyze the determinants of adoption of improved aquaculture technologies in the study area. The dependent variable is level of adoption of improved aquaculture technologies by male and female fish farmers, a Tobit censored at zero was used because level of adoption smaller than zero, was not observed. The model employed in the analysis is specified as follows:

$$P = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + u \ldots\ldots 2$$

Where,

P = probability of male and female fish farmers who adopted improved technologies which ranges between 0-6

b_0 = constant

b_1- b_8 = Tobit regression coefficients

X_1= farm income

X_2= educational level (years)

X_3= number of extension contacts

X_4= farm size (ha)

X_5= access to credit (dummy variable; 1 = yes; 0=no)

X_6= membership of cooperatives (dummy variable; 1 = yes; 0=no)

X_7= technology attribute (dummy variable; 1=simple, 0=otherwise)

X_8= environmental factor (dummy variable; 1= suitable, 0=otherwise)

u = error term

Results and Discussion

Table I revealed that none of the male fish farmers were within the age range of 21 – 30years, while 10.0% of the female fish farmers were in the age group of 21 – 30years. This implies that majority of the fish farmers in Imo State were older people. Result shows that 36.7% of male fish farmers had no formal education, while 33.3% of their female counterparts had secondary education, whereas, 36.7% of the female fish farmers have primary education. This implies that a high proportion of male and female fish farmers are educated. This finding indicates that both male and female fish farmers are moderately literate. This is an advantage to adoption of aquaculture technologies which enhance output of fish farmers in Imo State. Result shows that 46.7% of the female has less than 10 years of fishing experience, and also 60.0% of the male. The finding implies that many of the respondents have less than 10 years of fishing experience. This finding do not auger well for the production and adoption of fish technologies. This also implies that fish farmers in the State were mostly inexperienced in fish farming. Similarly, 63.3% of males had household size of 5 – 8 persons, while, 33.3% of the female had 5 – 8 persons. This supports the assertion of Kebede *et al.* (1990) which states that larger households adopt innovations more than smaller households. The findings imply that most of the male had enough family labor than female fish farmers. Result indicates that 53.3% of male fish farmers had 1 – 3 ponds and 90.0% of the female fish farmers also. The finding implies that majority of the fish farmers were operating on small scale. This result does not auger well with adoption of aquaculture practices and increased output of fish in Imo State. Similarly, 60.0% of the male had access to credit in form of inputs received, and 20.0% of the female fish farmers also. About 20.0% of the male fish farmers received credit in the form of cash, and 18.67% of female also. The finding indicates that fish farmers had various forms of credit, but male fish farmers had more access to credit than their female counterparts in Imo State. Result revealed that 73.3% of the male fish farmers indicated they own farm land, while, none of the females own farm land. The finding obviously constitutes a major constraint to increased output of fish by female fish farmers. This finding supports the gender discrimination and in equality principle of gender inequality and power relation to produce these differences (Olowu and Anyanwu, 2004). About 70.0% of the male fish farmers had 1 – 2 times of extension contact and 50.0% of the female also. More extension contact is expected to promote higher level of adoption of aquaculture technologies. Result reveals that 70.0% of female fish farmers had low income of N100,000 – N150,000 per annum, and 6.9% of their male counterparts. This finding implies that more female fish farmers had lower income or output from their aquaculture enterprise than their male counterparts.

Table1: Distribution of Respondents by Socio- economic profile

Variables	Male	Female	Total
Age			
21-30	0(0.0)	3(10.0)	3(5.00)
31-40	9(30.0)	10(33.3)	19(31.7)
41-50	13(43.3)	9(30.0)	22(36.7)
51-60	8(26.7)	6(20.6)	14(23.35)
61-70	0(0.00)	2(6.7)	2(3.38)
Educational status			
Formal education	11(36.7)	8(26.7)	19(31.7)
Education	10(26.7)	11(36.7)	21(35.0)
Ordinary Education	8(26.7)	10(33.3)	18(30.6)
Tertiary	1(3.3)	1(3.3)	2(2.3)
Household size			
1 – 4	5(16.7)	15(50.0)	20(33.3)
5 – 8	19(63.3)	16(33.3)	29(48.2)
9 – 12	6(20.3)	5(16.7)	11(18.3)
Fishing experience			
<10	18(60.0)	14(46.7)	32(53.3)
10 – 15	6(20.0)	8(26.7)	14(23.3)
16 – 21	4(13.3)	6(20.0)	10(33.3)
22 – 27	2(6.7)	2(6.7)	4(6.7)
Pond size			
1 – 3	27(90.3)	16(53.3)	43(71.6)
4 – 6	10(33.7)	10(33.7)	20(70.1)
7 – 9	2(6.7)	3(10.0)	5(80.3)
10 – 12	1(3.3)	1(3.3)	2(3.3)
Land ownership			
Inheritance	22(73.3)	0(0.00)	22(36.7)
Purchase	2(6.7)	7(20.0)	8(13.3)
Lease	6(20.0)	24(80.0)	30(50.0)
Extension contact			
Nil	2(6.7)	10(33.7)	12(20.0)
1 – 2	21((70.0)	15(50.0)	36(60.0)
3 – 4	7(23.3)	5(16.7)	12(20.0)
Annual income			
100 – 150,000	21(70.0)	2(6.7)	23(38.3)
151 – 200,000	8(36.7)	3(10.0)	11(18.3)
201 – 250,000	9(36.7)	2(6.7)	11(18.3)
251 – 300,000	3(10.0)	2(6.7)	5(8.3)
301 – 350,000	3(10.0)	1(3.3)	4(6.7)
351 – 400,000	2(6.7)	1(3.3)	3(5.0)
401 – 450,000	2(6.7)	0(0.00)	2(3.3)
451 – 500,000	1(3.3)	0(0.00)	1(1.7)
Access to credit			
Inputs received	18(60.0)	6(20.0)	24(40.0)
Cash received	6(20.0)	5(18.67)	11(16.7)
Loan received	5(18.66)	3(10.0)	8(13.3)
Kindness	1(3.3)	16(53.3)	17(23.3)
Technology attributes			
Simple	23(76.7)	17(36.7)	40(66.6)
Complex	7(20.0)	19(63.3)	26(18.25)

Source: Field survey, 2019

Adoption of improved fish technologies disseminated to male and female fish farmers are presented in Table 2. A total of 10 improved aquaculture technologies were investigated. Result shows that stocking density had the highest mean level of adoption (3.97), for the male farmers, while feed formulation had the highest mean level of adoption (3.76) for the female fish farmers. The mean adoption level of these technologies implied that the fish farmers were at the evaluation stage for stocking density and feed formulation respectively. These technologies were followed by; pond fertilization (3.67), feeding rate (3.60), improved fish species hybrid (3.5), and handling of fingerlings (3.5) indicating male fish farmers were at the evaluation level of adoption. Also, the male fish farmers were at the interest stage of adoption for the following technologies; site selection and construction (3.4), use of natural fish food (3.3), feed formulation (3.02), water quality practice (3.03)

and fish disease control (2.96). The female fish farmers were at the evaluation stage of adoption for technologies such as stocking density (3.60), and fish disease control (3.5), and at the interest stage for pond fertilization (3.4), feeding rate (3.3), use of natural fish food (3.2), site selection construction (3.13), fingerling handling (3.13) and improved hybrid (2.8). This result also shows that the male fish farmers adopted five (5) aquaculture technologies, while their female counterparts adopted three (3). Although, this results implies that the level of adoption of these aquaculture technology by fish farmers were generally low. This might be explained by the fact that extension agent/service had various limitations such as lack of motivations or incentives or the inability of extension agents to regularly visit the fish farmers. Nwaobiala and Anyanwu (2017) indicated that gender disparities on access to ownership of farmland have negatively contributed to low fish production. Onumadu (2009) observed that lack of infrastructural facilities worsened adoption of improved technologies by rural farmers.

Table 2: Distribution of Male and Female Fish farmers by level adoption of improved fish farming technologies

Improved Fish Technologies	Male							Female						
	Unaware(1)	Aware (2)	Interest (3)	Evaluation(4)	Trial (5)	Adoption (6)	Mean	Unaware (1)	Aware (2)	Interest (3)	Evaluation (4)	Trial (5)	Adoption (6)	Mean
Site selection and pond construction	0(0.0)	6(20.0)	15(50.00)	3(10.0)	3(10.0)	3(10.0)	3.4	0(0.0)	8(26.7)	16(53.3)	2.(6.7)	2(6.7)	2(6.7)	3.13
Handling of fingerlings	2(6.7)	6(20.0)	10(33.3)	4(13.3)	4(13.3)	4(13.3)	3.5	3(10.0)	7(23.3)	10(33.3)	5(16.7)	3(10.0)	2(6.7)	3.13
pond fertilization	1(3.3)	5(16.7)	8(26.7)	10(33.3)	2(6.7)	4(13.3)	3.67	1(3.3)	8(26.7)	3(10.0)	15(50.00)	2(6.7)	1(3.3)	3.4
Stocking Density	0(0.0)	1(3.3)	10(33.3)	11(36.7)	5(16.7)	3(10.0)	3.97	1(3.3)	5(16.7)	8(26.7)	10(33.3)	2(6.7)	4(13.3)	3.6
Feeds/feeding rat	2(6.7)	7(23.3)	4(13.3)	7(23.3)	7(23.3)	3(10.0)	3.60	10(33.3)	2(6.7)	3(10.0)	5(16.7)	5(16.7)	5(16.7)	3.3
fish disease control	2(6.7)	10(33.7)	15(50.00)	2(6.7)	2(6.7)	1(3.3)	2.96	2(6.7)	6(20.0)	11(33.3)	4(13.3)	4(13.3)	4(13.3)	3.5
Use of natural fish pond	5(16.7)	7(23.3)	6(20.0)	4(13.3)	5(16.7)	3(10.0)	3.0	2(6.7)	3(10.0)	17(56.7)	4(13.3)	3(10.0)	1(3.3)	3.2
Fish/feed formulation	5(16.7)	6(20.0)	7(23.3)	5(16.7)	4(13.3)	3(10.0)	3.2	1(3.3)	2(6.7)	13(43.3)	7(23.3)	4(13.3)	3(10.0)	3.76
Water quality and practice	4(13.3)	10(33.3)	5(16.7)	5(16.7)	4(13.3)	2(6.7)	3.03	0(0.0)	7(23.7)	15(50.0)	5(16.7)	2(6.7)	1(3.3)	3.17
Improve species/hybrid	0(0.0)	6(20.0)	15(50.00	2(6.7)	2(6.7)	5(16.7)	3.5	3(10.0)	10(33.3)	12(40.0)	2(6.7)	1(3.3)	2(6.7)	2.8
Grand mean	6.34	23.32	31.66	17.67	11.67	10.33		6.24	23.30	31.65	17.67	12.67	10.23	

Source: Field Survey, 2019

Results in Table 3 show the Tobit regression estimates of the adoption of improved fish farming technologies among farmers in Imo State. The Chi^2 value of 21.7 and 15.6 were highly significant at 1% level probability each for the male and female farmers indicating a Tobit regression line of best fit. The coefficient of farm size was found to be negatively signed and significant at 1% level of probability implying that increase in farmer's farm size will lead to decrease in the probability and intensity of adoption of improved technologies in Imo State, contrary to *a priori* expectations. A counter argument on the effect of farm size can be found in Yaron *et al*. (1992) who demonstrate that a small land area may provide an incentive to adopt a technology especially in the case of an input-intensive innovation such as a labor-intensive or land-saving technology.

The coefficient of extension contact was found to be negative and significant at 10% level for the male farmers, implying that increase in extension contact will lead to decrease in the probability and intensity of adoption of improved fish farming technologies in the study area. This result is also contrary to *a priori* expectations, probably because majority of the farmers has little or no contact with extension (Table 1). The coefficient of membership of cooperative was found to be positive and significant at 5% and 10% level of probability for the male and female farmers respectively, implying that increase in membership cooperative will lead to increase in probability and intensity of adoption of improved fish technologies in the study area. Acquisition of information mostly from groups/cooperatives about a new technology demystifies it and makes it more available to farmers. Information reduces the uncertainty about a technology's performance hence may change individual's assessment from purely subjective to objective over time (Caswell *et al*., 2001). Exposure to information about new technologies as such significantly affects farmers' choices about it (Bonabana-Wabbi, 2002).

The coefficient of education was found to be positive and significant at 5% level for the female farmers, implying that increase in education will lead to increase in probability and intensity of adoption of improved fish farming technologies. This result is in line with the *a priori* expectation because education enhances farmers' ability to understand and evaluate new technologies. This finding agreed with Agwu et al (2008) that increase in education of farmers positively influenced adoption of improved technologies. Generally education is thought to create a favorable mental attitude for the acceptance of new practices especially of information-intensive and management-intensive practices (Caswell *et al*., 2001).

The coefficient for environmental attribute was found to be positive and significant at 1% level of probability among the male and female farmers each, implying that increase in environmental attribute will lead to increase in probability and intensity of adoption of improved fish farming technologies. Ango *et al*. (2013) also obtained a similar result in role of environmental factors in determining the efficiency of urban agriculture in providing food security in Benin Kebbi metropolis, Kebbi State, Nigeria. This is in line with *a priori* expectation as environmental attributes positively influence the effectiveness of farmers in technology adoption.

The coefficient of access to credit was found to be positive and significant at 1% level of probability among male and female fish farmers each, implying that increase in credit will lead to increase in probability and adoption of improved technologies. This result agreed with the *a priori* expectation the credit access enhances farmers' ability to adopt new technologies. The decision to adopt is often an investment decision. And as Caswell *et al*. (2001) indicated, this decision presents a shift in farmers' investment options. Therefore adoption can be expected to be dependent on cost of a technology and on whether farmers possess the required resources. Technologies that are capital-intensive are only affordable by wealthier farmers (El-Oster and Morehart, 1999) and hence the adoption of such technologies is limited to larger farmers who have the wealth (Khanna, 2001).

Table 3: Tobit Regression Estimates of determinants of adoption of improved fish farming technologies among farmers in Imo State, Nigeria

	Male farmers			Female farmers		
Variables	**Coefficient**	**Std. Error**	**Z-value**	**Coefficient**	**Std. Error**	**Z-value**
Income	-0.023	0.027	-0.830	-0.023	0.027	-0.860
Educational level	0.002	0.005	0.438	0.017	0.006	2.897**
Level of extension contact	-0032	0.019	-1.661*	-0.025	0.026	-0.939
Farm size	-0.097	0.035	-2.786**	-0.026	0.043	-0.593
Access to credit	0.417	0.072	5.829***	0.279	0.073	3.820***
Membership of cooperatives	0.170	0.054	2.670**	0.109	0.063	1.725*
Technology attribute	0.023	0.004	0.437	0.021	0.002	0.436
Environmental attribute	0.417	0.072	5.829***	0.029	0.023	3.820***
Intercept	-1.628	0.114	-14.275***	-1.947	0.146	-13.56***
LR Chi^2=	21.7***			15.6***		
Pseudo R^2	0.6450			0.4831		

Field survey, 2019

*, ** and *** represent 10%, 5% and 1% significant level respectively

Conclusion

Results of the study show generally, a low level of adoption of aquaculture technologies by fish farmers in Imo State, probably due to low ratio of extension staff to farmer, which is one of major problems facing extension service in Nigeria. Important factors influencing adoption include; education, extension, farm size, access to credit, membership of cooperatives, and environmental attribute. The results therefore call for the need for policies aimed at free and affordable education, especially for the women to enable them access and process information on improved fish farming technologies. There is also need to increase the number of extension visits to enhance gender balance in adoption of fish farming technologies in the study area. Fish farmers should be encouraged to belong to or form cooperatives/groups to enable them ease of access to inputs and resources, especially credit and information that will enhance adoption.

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