



Assessment of the Usage of Information and Communication Technology (ICT) for Fish Farming among Smallholder Fish Farmers in Niger State, Nigeria

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ABSTRACT

The study investigated the impact of Information and Communication Technologies (ICTs) usage on fish farming among smallholder fish farmers in Niger State, Nigeria. The objectives were to describe the socio-economic characteristics of fish farmers, ascertain the types of ICT tools used, determine the ICT accessibility levels, investigate the effect of usage and identify constraints to ICT adoption in fish farming. A multistage method was used randomly select a total of 300 respondents from the population of smallholder fish farmers in the study area. Structured questionnaire was used for data collection which were analyzed with the aid of descriptive (frequency, percentage) and inferential statistics (linear regression). The findings showed that, mobile phones (23.58%) and WhatsApp (12.41%) were the most used ICT tools among the fish farmers. The results of the regression analysis showed that, internet (0.2076 at 1% significance), television (0.3728 at 1% significance), desktops (0.8212 at 1% significance), sex (0.1758 at 5% significance), fish pond capacity (0.21-9 at 5% significance) and laptop (-0.6341 at 1% significance) statistically influenced ICT usage for fish farming. The major constraints based on the outcome of the study are lack of awareness (10.87%), inadequate ICT knowledge (5.35%), and low income (10.69%), high cost of ICT facilities (9.37%), inconsistent government policies (9.15%), and low education levels (8.31%). The results of the study showed that, ICT usage enhances fish farming activities and the author thereby recommends friendly policies that will enhance ICT accessibility and literacy among fish farmers.

Keywords: ICT, fish farming, smallholder fish farmers, Niger State

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INTRODUCTION

The evolution of Information and Communication Technology (ICT) in agriculture brought a great change to farming practices by facilitating access to reliable agricultural information which enhanced productivity and

efficiency. ICT has a wide range of applications in different fields such as e-agriculture; a new ICT innovation that targets improved agricultural productivity through effective dissemination of relevant agricultural information which

was launched in 2007 by FAO and some partners in Nigeria (Lai-Solarin, Adeoye and Sennuga, 2022). Despite the contribution of smallholder fish farmers to fish production, they still struggle to get reliable agricultural information and on time which are required to optimize farming activities. Research results according to Ijatuyi, Abiou and Olaniyi (2016) showed that, updated information on farming technologies are needed by fish farmers without which there will be no increase in their production and they will also experience poor marketing and distribution strategies for their produce. ICT tools that can serve as channels for the dissemination of agricultural related information and timely are mobile phones, internet, radio, and television. However, despite the boost in information sharing using ICT for the purpose of improving farm technologies, findings revealed the gap of illiteracy of ICT facilities usage due to lack of adequate and appropriate information especially for the smallholder fish farmers in the rural areas as well as the gap between the local production and consumption due to lack of technical know-how by the farmers (Ijatuyi, Abiou and Olaniyi (2016)). The author investigated ICT usage among smallholder fish farmers in Niger State, Nigeria, with a focus on its impact on productivity and adoption. Therefore, this study assessed the usage of Information and Communication Technology (ICTs) for fish farming among smallholder fish farmers in Niger state, Nigeria.

The specific objectives of the study were to:

- i. Describe the socio-economic characteristics of the respondents in the study area;
- ii. Ascertain the type of ICT tools used by farmers to access information on fish farming in the study area;
- iii. Determine the level of ICT accessibility by the farmers in the study area;
- iv. Investigate the effect of ICT usage on fish farming by the fish farmers in the study area;
- v. Identify the constraints that prevents farmers from using ICT for fish farming in the study area

MATERIALS AND METHODS

This study was carried out in Niger State, in the North Central Nigeria with twenty-five Local Government Areas. The State has three major ethnic groups, three languages viz: Gbagyi, Hausa and Nupe and practiced Christianity, Islamic and Traditional religions. Over 80% of the population depends on agriculture for their livelihood and their crops includes guinea corn, millet, maize, rice, cowpeas, bambara nut, yam, cassava, potato, soya beans, shea nut, groundnut, cotton and kenaf. The practice of artisanal and catfish fish farming is scattered across the state but concentrated in the local governments of Borgu, Bida and Chanchaga.

Population of the study and research design

The population of the study consisted of smallholder fish farmers because they constitute the largest population in the study area. Survey design was used for this study and data were collected using structured questionnaires.

Sampling technique and sample size

Niger State has three Agricultural zones viz: A, B and C., A and B has 10 Agricultural extension blocks each while C has 5. A multi-stage sampling technique was employed in selecting the respondents for this study. Borgu, Bida and Chanchaga were purposively selected for this study because fish farming is their source of livelihood.

Sample size

A total of five agricultural extension blocks were selected: two from Borgu, two from Bida and one from Chanchaga. Followed by the random selection of 10% from each of the population of the smallholder fish farmers in the selected study area giving a total of 300 respondents.

Data collection

Primary data were collected with the aid of questionnaire which consists of five sections:

Section A described the socio-economic characteristics of the smallholder fish farmers viz age, gender, educational level, marital status, etc; Section B ascertained the type of ICT used by the smallholder fish farmers' to access information on fish farming; Section C centered on the effect of ICT usage by fish farmers for farming; Section D determined the level of accessibility of ICT by fish farmers and Section E identify the constraints faced by farmers for fish farming.

Data analysis

The collected data were analyzed using descriptive statistics such as mean, frequency and percentage for objectives i, ii, iii and v and inferential statistics such as linear regression for

Objective iv to investigate the effect of ICT usage by smallholder fish farmers on fish farming in the study area.

RESULTS AND DISCUSSION

Socioeconomic characteristics of the respondents

The socioeconomic characteristics of the smallholder fish farmers in the study area are presented in (Table 1) showed 59.18% of male fish farmers higher than the 40.82% of women which may be as a result and in

Table 1: Frequency distribution of socioeconomic characteristics.

Variables	Frequency	Percentage (%)	Mean
Sex			
Male	158	59.18	
Female	109	40.82	
Age			
19 – 29	38	14.23	
30 – 40	89	33.33	
41 – 51	120	44.94	
≥ 52	20	7.49	40.46 years
Marital status			
Single	50	18.73	
Married	155	58.05	
Divorced	20	7.49	
Widowed	25	9.36	
Separated	17	6.37	
Level of education			
Adult Education	33	12.36	
Primary Education	66	24.72	
Vocational Education	73	27.34	
Secondary Education	53	19.85	
Tertiary Education	42	15.73	
Household size			
1 – 5	176	65.92	
6 – 10	82	30.71	
11 – 15	9	3.37	5 persons
Fish farming experience			
1 – 6	122	45.69	
7 – 12	134	50.19	
13 – 18	11	4.12	7.31 years
Number of fish pond			
1 – 7	191	71.54	
8 – 14	73	27.34	
15 – 21	3	1.12	5 ponds
Cooperative membership			
Yes	230	86.14	
No	37	13.86	
Annual income			
₦1,000,000 – ₦4,000,000	239	89.51	
₦4,001,000 – ₦7,001,000	25	9.36	
₦7,002,000 – ₦10,002,000	3	1.12	₦2,603,071.00
Total	267	100	

Source: Field survey, 2024

accordance with Kachina and Hiam, (2025), that most of the women spent most of their time on caring for their household, leaving little or no time for fish farming. The approximate mean and age bracket of the farmers revealed that, they are in their active and potentially economically productive age hence will dedicate time and energy to fish production and management (Oke, Olorunsogo and Akerele, 2021). Also, the majority (58.05%) that are married has good decision-making processes that can influence productivity in accordance to Malabayabas, Mishra and Pede, (2023) that, joint decision-making by spouses enhance productivity that leads to higher yields and improved food security. The education of the farmers though with the majority (48.75%) having vocational education can influence their decisions which will bring about higher productivity and profitability as contained in the findings of Amachree, Jamabo and Joseph, (2019). The result also revealed an average household size of 5 persons where 65.92% had between 1 to 5 persons while 3.37% had 11 to 15 persons in their

household. A larger household size implies availability of labour, income diversification, stronger community network, knowledge sharing, robust social networks, financial behaviours and support systems (Udichibarna, Arun and Arun, 2021). The mean farming experience was 7 years which showed that, they adequate fish farming experience that can enhance productivity based on the range of 1-18 years (Kachina and Hiam, 2025). The high number of ponds especially smaller ones has great influence on production capacity due to effective management: determines stocking capacity, specie diversification, revenue potential, risk mitigation, easy storage and distribution/market supply (Ogunmefun and Achike, 2018). The table showed number of ponds ranges between 1 and 21 with an average number of 5 ponds. The majority (86.14%) belongs to cooperative which may be due to their part of decision-making environment where members share common goals and interests which can influence productivity and promote ICT usage among members (Oke *et al.*, 2021). The mean annual income of

Table 2: Distribution of the type of ICT tools used by farmers to access information on fish –farming.

ICT tools	Frequency	Percentages (%)	Ranks
Mobile phone	266	23.58	1 st
Whatsapp	140	12.41	2 nd
Internet	138	12.23	3 rd
Facebook	133	11.79	4 th
Radio	122	10.82	5 th
Television	98	8.69	6 th
Youtube	31	2.75	7 th
Laptop	30	2.66	8 th
Desktop	30	2.66	8 th
Instagram	29	2.57	9 th
Telegram	29	2.57	9 th
Twitter	28	2.48	10 th
Tablet	27	2.39	11 th
Artificial Intelligent (AI)	27	2.39	11 th
Total	1128	100	

Source: Field survey, 2024

Table 3: The distribution of the level of ICT accessibility by the farmers.

Usage	High	Medium	Low	Total	Mean	Remark
Mobile phone	654 (87.1%)	96 (12.8%)	1 (0.1%)	751	2.81	High
Radio	237 (71.4%)	90 (27.1%)	5 (1.5%)	332	2.57	High
Internet	258 (70.1%)	100 (27.2%)	10 (2.7%)	368	2.52	High
Laptop	45 (40.5%)	38 (34.2%)	28 (25.2%)	111	1.79	Medium
Television	165 (64.7%)	80 (31.4%)	10 (3.9%)	255	2.43	High
Desktop	21 (26.3%)	22 (27.5%)	37 (46.3%)	80	1.45	Low
Tablet	45 (47.9%)	24 (25.5%)	25 (26.6%)	94	1.81	Medium
Facebook	216 (65.9%)	102 (31.1%)	10 (3.0%)	328	2.47	High
Whatsapp	264 (74.2%)	88 (24.7%)	4 (1.1%)	356	2.62	High
Instagram	81 (71.7%)	10 (8.8%)	22 (19.5%)	113	2.09	Medium
Twitter	81 (72.3%)	8 (7.1%)	23 (20.5%)	112	2.07	Medium
Telegram	84 (75.7%)	2 (1.8%)	25 (22.5%)	111	2.06	Medium
AI	75 (73.5%)	0 (0.0%)	27 (26.5%)	102	1.96	Medium
Youtube	81 (75.7%)	2 (1.9%)	24 (22.4%)	107	2.06	Medium

Percentage in bracket.

Source: Field survey, 2024

₦2,603,071.00 revealed the economic capacity of the farmers which according to World Bank (2018) higher income will enhance access to broader range of services increase in productivity that will impact positively on the living standard of the farmers.

Type of ICT tools used by farmers to access information on fish farming in the study area

The result in (Table 2) showed the ranges of different types of ICT tools used by farmers to access information based on the farmers' preference. The high usage of mobile phone (23.58%) may be due to portability, affordability and provision of easy access to various information and communication platforms (Kachina and Hiam, 2025). This is followed by 3 platforms that are dependent on mobile phone viz: WhatsApp (2nd -12.41%), internet (3rd - 12.23%) and Facebook (4th - 11.79%) whose popularity are attributed to its user-friendly interface and widespread use for information and knowledge sharing (Lamriji, El Makkaoui, Maleh, Beni and Ouahbi, 2023; Benard, Dulle and Lamtane, 2018). Radio (5th - 10.82%) and TV (6th - 8.69%); are traditional medium that are still

relevant due to their wider coverage. YouTube (7th - 2.75%); Laptops and desktops (8th - 2.66%); Instagram, Twitter, and Telegram ranked 9th and 10th respectively (2.57% and 2.48%) and Tablets and AI tools (2.39%) were low due to high costs, lack of portability (Ntiri et al., 2022; Bolarin et al., 2021; Elbaşı et al., 2023).

The level of ICT accessibility by the farmers in the study area

Table 3 showed the mean result of the varying level of ICT accessibility by the small-scale fish farmers in the study area: Mobile phones (2.81), Radio (2.57), Internet (2.52) and Television (2.43), Facebook (2.47) and Whatsapp (2.62) are highly accessible reflecting widespread adoption due to their affordability, portability, and multi-functionality (Mdoda, Christian and Agbugba, (2023); Bolarin, Oyekunle and Adebayo, 2021). The medium category Laptop (1.79), Tablet (1.81), Instagram (2.09), Twitter (2.07), Telegram (2.06), AI (1.96), and Youtube (2.06) due to higher costs and its newness to the farming sector compared to other tools while Desktop (1.45) has the lowest level of accessibility due to high cost

Table 4: The effect of ICT usage for fish farming among the farmers in the study area.

Variables	Param	Coeff	Std. Err	t-value
ICT Specific Variables				
Radio (X ₁)	β_1	-0.0762	0.0969	-0.79
Internet (X ₂)	β_2	0.2076*	0.1230	1.69
Laptop (X ₃)	β_3	-0.6341***	0.2255	12.81
Television (X ₄)	β_4	0.3728***	0.1098	3.40
Desktop (X ₅)	β_5	0.8212***	0.3013	2.73
Facebook (X ₆)	β_6	0.1034	0.1090	0.95
Whatsapp (X ₇)	β_7	-0.0455	0.1070	-0.43
Instagram (X ₈)	β_8	0.0901	3938	0.23
Telegram (X ₉)	β_9	0.3681	0.3961	0.93
Socio-economic Variables				
Age (X ₁₀)	β_{10}	0.0001	0.0053	0.02
Sex (X ₁₁)	β_{11}	0.1758**	0.0736	2.39
Household size (X ₁₂)	β_{11}	0.0173	0.0737	0.23
Fish farming experience (X ₁₃)	β_{13}	-0.0848	0.1019	-0.83
Number of fish pond (X ₁₄)	β_{14}	0.2109**	0.0871	2.42
Constant	β_0	1.2193	0.1849	6.59
Diagnostics Statistics				
R-Square	0.3896			
Adjusted R-Square	0.3557			
F-cal	11.49			
F-tab	3.20			
Prob > F	0.0000			
Observation	267			

*** = significance @ 1%, ** = significance @ 5% and * = significance @ 10%.

Source: field survey, 2024

(Lamriji et al., 2023).

The effect of ICT usage on fish farming by the farmers in the study area

The result in Table 4 showed the estimated coefficient of multiple determinations (R^2) of 0.3896 indicated approximately 38% of the variation in the fish farming activities in the study area, while the remaining variation in the fish farming activities were due to error term (omitted variables). The F-cal of 11.49 is greater than the F-tab of 3.2 revealing that, it was statistically significant (i.e., F-cal > F-tab at 1%), indicating the significance of R^2 , which is the measure of goodness of fits of the linear regression model in explaining the effect of ICT usage by the farmers on fish farming in the study area. Thus, the null hypothesis that there is no significant effect of ICT usage for fish farming among fish farmers in the study is rejected. Six of the fourteen variables in the model were statistically significant at different levels (coefficients of internet, laptop, television, desktop, sex, and numbers fish ponds). The coefficient of internet use (0.2076) is positive and had a statistically significant effect on the smallholder fish farming activities in the study area at a 10% probability level suggesting increased internet use can enhance productivity, efficiency, and access to relevant information which supports Benard *et al.*, (2018) submission that, internet is a vital resource for farmers by providing access to a wealth of information on best agricultural practices. Laptops (0.6341) is negative and had a statistically significant effect on the smallholder fish farming activities in the study area at a 1% level of probability, implies increase use of laptops will lead to a decrease in

productivity or effectiveness in fish farming activities which may be due to its high cost that may limit accessibility. The coefficient of the use of television (TV) (0.3728) and desktop (0.8212) were positively significant at a 1% level of probability, respectively, in relation to the smallholder fish farmers' fish farming activities in the study area which the importance of these technologies in enhancing the productivity and efficiency of fish farming. Television can broadcast specialized programs that provide valuable information on best practices in fish farming which often feature experts and provide visual demonstrations that can be very effective for learning (Oke *et al.*, 2021). Desktops are tools for managing large volumes of data for record keeping, data analysis and make informed decisions based on trends and patterns (O'Donncha, Stockwell, Planellas, Micallef, Palmes, Webb, Filgueira and Grant, 2021). The socioeconomic variables of sex (0.1758) and number fish pond (0.2109) were positive and statistically significant at a 5% level of probability, respectively, in relation to the fish farmers' fish farming activities in the study area indicating the importance of sex and number of the fish pond in productivity and effectiveness of fish farming operations. However, higher number of ponds can lead to economies of scale, where the cost per unit of output decreases with increasing production (Oparinde, 2021).

Constraints that prevent farmers from using ICT for fish farming in the study area

Table 5 showed the result of constraints preventing farmers from using ICT tools for fish farming and their ranks. 1st is lack of awareness and inadequate knowledge

Table 5: Distribution of constraints preventing farmers from using ICT for fish farming

Constraints	Frequency	Percentages (%)	Rank
Lack of awareness and inadequate knowledge of ICT	246	10.87	1 st
Fish farmers low low-income	242	10.69	2 nd
High cost of the facilities/accessories	212	9.37	3 rd
Poor handling of complaints Inconsistency in Government's policy	207	9.15	4 th
Low level of education	188	8.31	5 th
Erratic power supply	174	7.69	6 th
Poor access to loan facilities	167	7.38	7 th
High charges for internet subscription	151	6.67	8 th
Poor connectivity and network challenges	141	6.23	9 th
Inadequate access to ICT devices	121	5.35	10 th
Lack of training on ICT usage	108	4.77	11 th
Difficulty in finding reliable information	94	4.15	12 th
Challenges with regard to facility maintenance	86	3.80	13 th
Poor handling of complaints	67	2.96	14 th
Privacy and security concerns	59	2.61	15 th
Total	2263	100	

Source: Field survey, 2024

Table 6: Factors affecting ICT usage for fish farming among the Farmers in the Study Area.

Variables	Parameter	Coefficient	Std. Err	t-value
ICT Specific Variables				
Internet (X ₁)	β_1	0.2076*	0.1230	1.69
Laptop (X ₂)	β_2	-0.6341***	0.2255	12.81
Television (X ₃)	β_3	0.3728***	0.1098	3.40
Desktop (X ₄)	β_4	0.8212***	0.3013	2.73
Socio-economic Variables				
Sex (X ₁₁)	β_{11}	0.1758**	0.0736	2.39
Fish pond capacity (X ₁₄)	β_{14}	0.2109**	0.0871	2.42
Constant	β_0	1.2193	0.1849	6.59
Diagnostics Statistics				
R-Square		0.3896		
Adjusted R-Square		0.3557		
F-cal		11.49		
F-tab		3.20		
Prob > F		0.0000		
Observation		267		

*** = significance at 1%, ** = significance @ 5% and * = significance @ 10%.

Source: Field survey, 2024

of ICT (10.87%), 2nd is low income (10.69%), followed by high cost of the facilities/accessories (9.37%), inconsistency in government's policy (9.15%), and low level of education (8.31%). These revealed the constraints of gap in knowledge and awareness about ICT tools and their potential benefits, the inconsistent policies, high cost of ICT tools and accessories, income limits of the fish farmers to invest in ICT tools and services, lower level of education (Omotesho, Akinrinde, Adenike and Awoyemi, 2019). Other barriers are erratic power supply (7.69%), poor access to loan facilities (7.38%), high charges for internet subscription (6.67%), poor connectivity and network challenges (6.23%), inadequate access to ICT tools (5.35%), lack of training on ICT usage (4.77%), facilities maintenance (3.80%), difficulty in finding reliable information (4.15%), poor handling of complaints (2.96%), and privacy and security concerns (2.61%). Erratic power supply and connectivity issues can prevent farmers from accessing online resources and services (Omotesho *et al.*, 2019).

Test of Hypotheses

Table 6 showed the result of the test of the null hypothesis that, there is no significant effect of ICT usage for fish farming among fish farmers in the study area using regression analysis and the t-value embedded in the analysis. The estimated coefficient of multiple determinations (R^2) of 0.3896 indicates that the variables included in the regression model explained approximately 38% of the variation in the fish farming activities in the study area, while the remaining were due to error term (omitted variables). The result showed F-cal of 11.49 to be more significant than the F-tab of 3.20, (i.e., F-cal > F-tab at 1%), indicating the significance of R^2 , which is the measure of goodness of fits of the linear regression model used in explaining the effect of ICTs usage for fish farming among the farmers in the study area. Thus, the null hypothesis that there is no significant effect of ICT usage for fish farming among fish farmers in the study is rejected. Six of the fourteen variables in the model were statistically

significant. The coefficients of internet, laptop, television, desktop, sex, and number of fish pond were statistically significant at different confidence levels. This implies that, the six independent variables had strong influence on the dependent variables while the other ones had weak influence. This revealed that, there is a strong correlation between ICT and the enhancement of productivity in fish farming. This result supports the findings of Benard *et al.*, (2018) on the impact of ICT adoption on fish farming productivity.

Conclusion

The null hypothesis that there is no significant effect of ICT usage by the farmers on fish farming in the study area is rejected based on the result of the study which showed that, some specific ICT's and socioeconomic factors of the smallholder fish farmers such as mobile phone, internet, radio, television, farming experience, household size, sex, and fishpond capacity, affected ICT usage on fish farming among fish farmers in the study area.

Recommendation

Policymakers and stakeholders should focus more on targeted interventions, ICT training programs, subsidy schemes for ICT tools and improved internet infrastructure so as to encourage ICT adoption among fish farmers.

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