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Roles of Information and Communication Technologies in Adoption of Fishpond Management Practices among Fish Growers in Enugu State, Nigeria

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Abstract

This study assessed the roles of Information and Communication Technologies in the adoption of Fishpond Management Practices in Enugu State, Nigeria. Multi-stage sampling procedure was employed to select 253 fish farmers for the study. Data were collected with the aid of a well-structured questionnaire. Descriptive (percentages and mean) and inferential (factor analysis and Kruskal Wallis) statistics were used for data analysis. Result shows that 99.21%, 52.96% used mobile phone and internet respectively. While 35.57% used both television and e-mail respectively. The roles of ICTs to fish farmers included; information exchange 100%, promotion of training 99.60%, knowledge sharing 99.21% and promotion of education 99.21%. Socio-economic cum cultural, administrative and environmental-technological were constraints faced by fish farmers. The Kruskal Wallis test indicated a significant difference across agricultural zones in the use of ICT by fish farmers. The study concludes that the roles of ICTs in adoption of fishpond management practices as it affects increasing safety, vulnerability reduction and social inclusion are to be enhanced. It is recommended that training should be given to the fish farmers by the extension agents to help lift safety, reduce vulnerability and increase social inclusion and reduce constraints.

Keywords: ICTs, Roles, Adoption, Pond Management Technologies, Fish Farmers.

Introduction

Fish farmers need rapid access to emerging technologies to enable it enhance e-agriculture extension among fish farmers in Enugu State, as they are faced with many constraints in spite of job opportunities. In addition to being profitable, they need to meet environmental standards and regulations, as well as deal with direct and indirect consumer and lobby group pressures. Fish farmers may also be flooded with information from the government and industry that make choosing appropriate technologies difficult. Farmers also need to change their production and management practices in response to agricultural policies that include environmental conditions (Koira, 2014).

Technology and change are most likely assimilated and implemented when: the benefits of implementation are quickly realized (within one to two years), the tools for implementation are readily available and accessible in the local marketplace, the risk of the implementation is small and the change or new technology can be comfortably integrated into other basic

on-going aspects of daily life. The adoption process involves an interrelated series of personal, cultural, social and institutional factors, including the five stages of: awareness, further information and knowledge, evaluation, trial, and adoption. Characteristics of a technology, such as simplicity, visibility of results, usefulness towards meeting an existing need and low capital investment promote its eventual adoption and should be considered when transferring any technology. In most countries farmers are becoming better-educated and are continuing their education and training throughout their careers. This is good news, since better–educated and informed farmers have always been at the forefront of technology adoption (Gerard, 2014)

By increasing access to and exchanging of information, ICT offers the potential to increase efficiency, productivity, competitiveness and growth in various aspects of agricultural sector. Those that engage in agriculture in small scale utilize various forms of ICT such as mobile phones, computers, and the internet, and so forth. ICTs have been a great companion in sustainable development issues in remote areas as it enhances production capacity of the rural dwellers. Similarly, they can be used to breakdown both national and international barriers and turned the World into a universal village, through the available information to everyone, everywhere and at the needed time (Ogbonna and Agwu, 2013).

Furthermore, ICTs can also facilitate new business models by providing financial services to the underprivileged, helping them to afford higher-quality inputs and to secure prompt payment for their outputs. The use of ICTs by rural dwellers has most direct impacts on agriculture and other rural livelihood activities that can enhance their increase in productivity, environmental sustainability, lower costs and greater value generation. More so, it permits access to information worldwide, hence fostering empowerment of men, women and the youth in the communities (Mohammed and Shweta, 2014).

The rapid growth in the demand for Fish and fish products in Nigeria calls for provision of efficient flow of information and knowledge to the fish farmers, without gender prejudice, for better decision making. Fish farming has become a common practice to increase income of practitioners and in the process reduce the wage bill expended on fish importation. Fish farmers thus need information to optimize production (Zeinab *et al.,* 2014). The role of ICT therefore, in enhancing food security and supporting rural livelihoods have increasingly been reorganized; hence, had been officially endorsed at the World Summit on the Information Society (Agbaje, 2013). This role is in the inclusion of the use of computers, internet services, geographical information systems (GIS), mobile phones as well as traditional media such as the radio or television in the promotion of agricultural development.

Farmers need time and information to be persuaded to adopt new technologies. It is important that the public sector provides reliable and site-specific data that can aid adoption. Smooth dissemination of new technology requires reliable data and technical guidance adapted to local conditions. Demonstration plots in typical local condition are useful because farmers like to get first-hand information when deciding whether to adopt a new technology (Wole-Alo and Oluwagbemi, (2020). In most of sub-Saharan African

countries, conventional media for example radio, newspapers and television have played key roles in adoption of farming technologies. Agricultural innovations are disseminated to rural farmers through these media, hence the need to find out "The Roles of Information and Communication Technologies in Adoption of improved Fishpond management practices among fish farmers in Enugu State, Nigeria. The broad objective of this study is to access the ICTs roles in adoption of improved fishpond management practices among fish growers in Enugu State, Nigeria. The specific objectives were to:

i. identify level of utilization of ICTs by the respondents across the six agricultural zones of Enugu state;
ii. identify improved farming systems and fishpond management technologies used by the fish farmers across the six agricultural zones of Enugu state;
iii. identify ICT roles in adoption of improved innovations; and
iv. identify constraints to ICTs faced by fish farmers in the study area.

Based on the specific objectives, the following hypothesis was tested;

Ho_1; There is no significant difference in the use of ICTs by the respondents across the six agricultural zones of the State.

Literature Review and Theoretical Framework

Information and communication technology is defined as a technology that facilitate communication, processing and transmission of information through electronic means.

ICTs Utilized by Fish Growers

There is a dire need to make use of science and technology in the field of aquaculture. In this context, farmers require sufficient information and exposure to the latest technologies. Research has shown that farmers' information exposure is most likely to be a key factor influencing their adoption behaviour (Musingafi and Zebron, 2014). The methods implemented to undertake agricultural extension activities are classified into: individual, group and mass extension methods (FAO, 2017). But now, agricultural extension is taking a new way due to the global movement for reforming the national extension systems in developing countries that started late in the 20th century (Musingafi and Zebron, 2014).

In July 2010, the number of mobile phone subscriptions surpassed the 5 billion marks, further establishing mobile phones as the most popular form of global connectivity. In their various designs and capabilities, mobile phones can be found in the pockets of the wealthy and poor alike. Even in rural areas, mobile phones are growing in number and sophistication. Recent figures suggest that although only 81 million Indians (7 percent of the population) regularly use the Internet, price wars mean that 507 million own mobile phones. Calls cost as little as US$0.006 per minute, and Indian operators are said to sign up 20 million new subscribers per month (*The Economist* 2010). Figures for access to mobile phones are higher than ownership figures. Hinduja *et al*. (2017) carried out a research in Thiruvananthapuram District of Kerala in India and reported that the attitude of farmers in the region does not have any significant effect on their use of information kiosks and other

ICTs.

According to Adeniyi and Yekinni (2015) and Ogbonna and Agwu (2013) ICTs like radio, television and mobile phone are the most available, accessible and utilized in the rural communities. These ICTs are capable of capturing, coordinating, processing and disseminate developmental information to a larger percentage of population at a given period of time. ICTs have been a great companion in sustainable developmental issues in remote areas as it enhances production capacity of the rural dwellers. Similarly, they can be used to breakdown both national and international barriers and turned the world into a universal village, through the available information to everyone, everywhere and at the needed time (Ogbonna and Agwu, 2013). The telephone system is not only a fundamental communication infrastructure but also a basic facility which supports the use of other technologies. Other research studies have reported that farmers and agricultural experts are sending information as images via mobile phones with a built-in digital camera and internet access (Musingafi and Zebron, 2014). This approach saved time and money in addition to providing more support by a limited number of aquaculture experts to a greater number of farmers over a larger area.

Improved Fish Farming Systems and Technologies

Different breeds of fish were farmed. Catfish was farmed by most of the respondents (40%), followed by Tilapia (23%) and Heterobrancus species (20%) (Enioluwa *et al.* 2016). This finding shows that fish farmers in the area under study follow the trend reported in Mississippi Agricultural and Forestry Experiment Station (2015) about catfish farming leading aquaculture industry in United States of America and has reached a scale of $660 million sales in recent decades therefore becoming one of the most important agricultural activities. The type of fish culture practiced by the respondents were asked by Enioluwa *et al.* (2016). The respondent's answers showed that monoculture (42.5%) was predominant among them followed by polyculture (28.8%), and integrated culture (25%). This finding is similar to the study by Ibemere and Ezeano (2014) and Olaoye *et al.* (2014) that monoculture was the major fish culture practiced.

Fish feed comes in forms of improved feed, locally formulated feed and animal wastes. Different types of feeds were used in respondents' respective fish farming activities. These include locally formulated feed (34.0%), animal waste (31.3%) and improved feed (30%) (Enioluwa *et al.,* 2016). This contradicts the findings of Ogunleye *et al.* (2015) which shows most of the fish farmers use imported feed for fish farming. There is a need to ask for the type of pond used for farming purposes. Enioluwa *et al.* (2016) reported that thirty percent used homestead concrete and earthen pond, twenty percent used plastic pond but only fourteen percent used tarpaulin as a pond. This result shows that fish farming is no longer limited to the naturally created waters only, but it now extends to artificially created environments of raising fish which is supported by Ogboma (2010). Furthermore, Olaoye *et al.* (2014) highlighted that fish farmers practiced fish farming more through an earthen pond in a similar study.

Roles of ICT in Adoption of Innovations

Electronic communication (radio, television) can play a vital role in adoption of improved fish farming technologies by informing farmers timely in the situations of urgency and emergency. Farmers can be informed promptly and swiftly about diseases and pest control, flood, and changing weather. For example, a study conducted in Kenya showed that ICT-based market information system (MIS) project had a positive and significant effect on the usage of purchased seed, fertilizer, labour productivity, and land productivity (Ogutua, *et al.*, 2014).

In the context of globalizing agriculture where the need for information becomes most vivid, smallholders who still provide a significant portion of the world's food, need information to advance their work just as much as industrial-scale producers. Comparing the two types of farmers—industrial and small-scale, exemplifies the latter's disadvantages. Wealthy industrial producers can use the Internet, phone, weather forecasts, other digital tools, and technologies as simple as vehicles and infrastructure as basic as electricity to glean information on prices, markets, varieties, production techniques, technologies, services, storage, or processing; but smallholders remain dependent primarily on word of mouth, previous experience, and local leadership (World Bank, 2017). Mihaly (2017) reported that farmers in Hadju-Bihar County, eastern Hungary have a low level of use of ICTs, and most of the farmers use their smart phones for buying and selling on the internet and searching for information on government policies. Ndati *et al*. (2014) found aquaculture farmers in Kenya to have a moderate use of ICTs for communication. Lowrey (2014) presents the role of Information and Communication Technologies in rescuing a small fishermen community on Guinea, in the form of global positioning system (GPS) to combat foreign trawlers poaching in their fishing grounds. But he is not making an assessment of information and communication technologies on their livelihood activities.

Amadu and Amin (2016) points out the usefulness of community radio in providing vital information like weather conditions, availability of catch along with other entertainment programmes. By taking Kerala"s, Alakal FM, he also notices the obstacles like Government's indifference in sanctioning initiatives like this in enlarging its scope among fish farmer community in Kerala. But his analysis is limited since his focus is only on community radio.

Constraints of ICTs to Fish Growers

In developing countries, agricultural extension system is facing many problems. The main hurdles which are being faced by agricultural extension system are; less use of ICTs, non-availability of funds, improper transportation facility, lack of training and interaction among different agricultural departments. Such problems decrease the dissemination of agricultural information (Yaseen *et al.*, 2015). The physical distance and logistic problems are the major impediments in personal contacts between farmers and extension field staff (EFS). Also, Aphunu and Atoma (2011) found that lack of government enabling policy is one of the main pressing constraints against effective utilization of ICTs in Nigeria. Maintenance problems, low scale of fish production and rural poverty were also identified as serious

constraints to ICTs use by fish farmers. There are many challenges in the use of ICTs for communication. While facilities and infrastructure could support the use of ICTs in some locations, it may not be so in other locations. It is important to identify the constraints faced by farmers in the use of ICTs. These includes; low level ICT readiness, very low level capacities of gateways and portals to international network/satellite systems, erratic and unstable power supply and high cost of alternative power through standby generators, limited and very high cost of ICT, limited access to computers and even worse access to the internet, high level rural poverty, high illiteracy of farmers and computer illiteracy among researchers and irrelevant message contents on the internet (Haruna, 2014, Rajoria *et al*., 2016; Fangohoi *et al*., 2018).

Theory of Technology Acceptance Model (TAM)

The TAM states that an individual's behavioral intention regarding the use of **a** technology is determined by the perceived usefulness and perceived ease of use, both of which may be impacted by end users' first impressions of **a** technology and trust in that technology over time. Technology acceptance model (TAM) is one of the popular models, which helps to model show how peoples come to admit and utilize new technologies. The model focuses on factors determining behavioral intention to use new technologies from the end user's perspective (Becker, 2016, Wu and Zhang, 2014, Tarhini *et al*., 2014 and Hsieh *et al*., 2015). TAM comprises core variables of user motivation: perceived ease of use, perceived usefulness, and attitudes toward technology. The TAM, as pioneered by Davis (1989), is a well-validated model designed to predict individual technology adoption decisions. In it, two main components, Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), are considered as a principal determinant that directly or indirectly explains the behavioral intention to use ("acceptance") new technology. It is an information technology framework for understanding users' adoption and use of emerging technologies particularly in the workplace environment. Literature has distinguished TAM as the most influential theories used in ICT implementation and adoption studies. TAM extensions added individuals' characteristics (motivation, experience, age, gender) organizational characteristics or innovation characteristics (triability, compatibility, and fit to the task) into the model (Jiriko *et al*., 2015). Users' beliefs and attitudes change when they use ICT systems potential.

Methodology

The study was carried out in Enugu State. The state comprised seventeen Local Government Areas namely; Aninri, Awgu, Enugu East, Enugu North, Enugu South, Ezeagu, Igbo-Etiti, Igboeze North, Igboeze South, Isi-Uzo, Nkanu East, Nkanu West, Nsukka, Oji River, Udenu, Udi and Uzo-Uwani, (Wikipedia *2023).* Enugu State Nigeria is located between latitude 6° 56"N and 7°06"N and longitude 6°53"E and 7°55"E (Wikipedia, 2023). It lies in the freshwater and rain forest belts. The climatic and soil physical and chemical conditions encourage fish farming.

A multi stage sampling technique was used to select a total sample size of 253 respondents for this study. Enugu State has six agricultural zones namely; Agbani, Awgu, Enugu, Enugu Ezike, Nsukka and Udi. In the first stage, the population of the study was stratified into 6 agricultural zones. In the second stage, one Local Government Area was purposively selected, making it a total of six Local Government Areas. In the third stage two communities from each of the selected Local Government Areas were purposively selected with regards to their fishpond management technologies activities. Twenty percent of fish growers were selected through random sampling procedure from each of the twelve communities to give a total of 253 respondents from a sample frame of 1,277 fish farmers. Data for this study were collected from primary sources using a structured questionnaire. The questionnaire consists of 4 sections; A, B, C and D. Section A deals on the levels of ICT usage. Section B focuses on the improved fishpond management technologies used by the respondents. Section C deals with the roles of ICTs in adoption of fishpond management technologies while section D deals with constraints to use of ICTs in adoption of improved fishpond management technologies.

The interview schedules were personally administered by the researchers. Data were analyzed using descriptive statistics such as percentages and mean. Factor analysis was used to analyze the constraints and H_{01} was tested with Kruskal Waliss (H) test.

Result and Discussions

Level of Utilization of ICTs among the Fish Growers in Enugu State

The Research result in Table 1 revealed that fish farmers utilized the ICTs in their dispositions. Mobile phone was high at (99.21%) and a mean of (3.98419) followed by internet (52.96%) and a mean of (3.382055), e-mail and television was high at (35.57%) respectively and a mean of (2.932806) and (3.320158) respectively. Also, ICTs that are utilized at low level includes video CD (58.50%) and home video (41.90%). At moderate level utilization, radio had (69.17%), television (61.26%), Satellite television (52.17%), Home video (49.80%) and Web Casting/video television (41.11%). ICTs that are not used (GIS 64.43%), GPS (63.24%), cable media (36.76%) and web casting/video television (33.20%). New technological applications are being used across the fisheries value chains (maritime, inland and aquaculture). Some are specialist applications with a particular role in fishing such as sonar for locating fish. Others are general purpose applications such as Global Positioning System applications (GPS) used for navigation and location finding, mobile phones for trading and emergencies, radio programming targeted at – and in many cases compiled by – fishing communities and Web-based fisheries-specific information and networking resources (Ejiogu-Okeke *et al.,* 2016). Nwobodo and Nwabugwu (2016) reported a high usage of ICTs by farmers in Anambra State, Nigeria, while Wole-Alo and Oluwagbemi (2020) reported a high level of utilization of ICTs by farmers in Ondo State, Nigeria.

Table 1: Levels of Utilization of ICTs among the Fish Growers

ICTs	High	Moderate	Low	Not used	Mean
Mobile phone	251(99.21)	1(0.4)	-	1(0.40)	3.98419
Television	90(35.57)	155(61.26)	7(2.77)	1(0.40)	3.320158
Radio	51(20.16)	175(69.17)	25(9.88)	(0.79)	3.086957
Video CD	8(3.16)	51(20.16	148(58.50)	46(18.18)	2.083004
E-mail	90(35.57)	80(31.62)	59(23.32)	24(9.49)	2.932806
Internet	134(52.96)	46(18.18)	53(20.95)	20(7.91)	3.382055
GIS	- -	48(18.97)	42(16.60)	163(64.43)	1.545455
GPS	40(15.81)	42((16.60)	11(4.35)	160(63.24)	1.849802
Cable media	13(5.14)	98(38.74)	49(19.37)	93(36.76)	2.122553
Satellite TV	15(5.93)	132(52.17)	25(9.88)	81(32.02)	2.320158
Web casting tv	3(1.19)	104(41.11)	62(24.51)	84(33.20)	2.102767
Home video	3(1.19)	126(49.80)	106(41.90)	18(7.11)	2.450593

Figures outside the parentheses are frequency counts while those in the parentheses are percentages

Source: Field survey, 2021.

Fish farming Systems and Pond Management Technologies Used by the Respondents

Pond management technologies are the materials and methods put into practice in raising a fish farm. Table 6 indicates the use of pond management technologies by the respondents. The majority (99.60%) used fishpond construction and repair of broken dykes. Those into replacement of old pond water were (98.81%). Other pond management technologies and their rate of usage were stocking density (98.42%), fingerling production, regular supervision, use of scoop net, and regular feeding (98.02%). Regular aeration and maintenance of fish equipment (96.05%), use of concrete pond (95.26%), spawning (94.07%), use of improved breeds of fish (93.28%), fish feed formulation (89.33%), control of turbidity and liming (75.10%), pH testing and correction (74.70%), fiberglass culture (64.43%), earthen pond (60.87%). This finding means that there is a lot of fish farming systems and pond management technologies in use as far as raising fish in a pond is concerned. The finding is similar to that of Ibemere and Ezeano (2014) and Olaoye *et al.* (2014) that different pond technologies are used in fish growing practised in the present time.

Table 2: Fish Farming Systems and Pond Management Technologies Used by the Respondents (n = 253)

Fish Farming System and Pond Management Tech.	Frequency*	Percentage.
Earthen pond	154	60.87
Concrete pond	241	95.26
Pen culture	8	3.16

Enclosure/fencing	51	20.16
Fibreglass culture	162	64.43
Use of improved breed of fish	236	93.28
pH testing and correction	189	74.70
Regular aeration	243	96.05
Polyculture	89	35.18
Integrated fish/poultry rice farming	75	29.64
Re-circulatory aquaculture system	105	41.50
Drainage system	8	3.16
Spawning	238	94.07
Stocking density	249	98.42
Fingerling production	248	98.02
Maintenance of fish equipment	243	96.05
Fish pond construction	252	99.60
Fish feed formulation	226	89.33
Regular supervision	248	98.02
Use of Scoop net	248	98.02
Control of turbidity	190	75.10
Regular feeding	248	98.02
Replacement of old pond water	250	98.81
Repair of broken dyke	252	99.60
Liming of the pond	190	75.10

**Multiple responses recorded*

Source: Field survey 2021.

Roles of ICTs in the Adoption of improved Fishpond Management Technologies

The roles of ICTs are numerous and important in adoption of improved fishpond management technologies. Table 3 shows that information exchange with a mean value of (2.98) was a major role of ICTs in adoption of fishpond management technologies. Other major roles were promotion of training (2.91), knowledge sharing and promotion of education (2.95), online trading (2.42), sales and marketing (2.57), increasing safety (2.19) and receiving weather reports (2.23). ICT also acts to reduce vulnerability among fisher folk (2.23) and social inclusion (2.01), this makes farmers have right sense of belonging. The result shows that good and timely knowledge is essential for competing in local and global markets. Information about prices and availability can be shared across value chains, increasing the power of smaller or otherwise disadvantaged groups while reducing the volatility of fish prices and wastage of fish. Valuable information that can be made available through ICTs includes production and processing techniques, equipment, sales and marketing advice, financial advice and services and legal issues (Ejiogu-Okeke *et al*., 2016).

Access to and exchange of key information can assist farming communities in making informed decisions on a variety of matters from whether to engage in specific fish farming operations to trading at a local market to participating in a meeting – decisions that can help reduce their vulnerability and improve their opportunities. ICTs can also assist people to be heard, encourage networking and knowledge-sharing and increase access to the governance process and political agency. Food and livelihoods security issues and the lack of extension support for fish farmers can be addressed through information networks. Fishers can have access to up-to-date weather information before setting out, through community radio stations, loudspeakers and telecentres collecting and broadcasting information. ICTs can empower fish farmers in the communities in local and national campaign and advocacy work to facilitate dialogue with policy-makers (FAO, 2007).

Table 3: Roles of ICTs in adoption of improved fishpond management technologies in Enugu State

Roles	Percentage	Mean
Information exchange	100	2.98
Knowledge sharing	99.21	2.95
Promotion of education	99.21	2.72
Market price information	95.26	2.57
Promotion of training	99.60	2.91
Online trading	90.12	2.42
Increasing safety	58.5	2.19
Vulnerability reduction	60.08	2.34
Social inclusion	56.13	2.01
Receiving weather report	86.17	2.23

Source: Field survey 2021.

Constraints to Accessing ICTs by Fish Growers in Enugu State

Table 4 shows that there were three major categories of constraints faced by the fish growers in accessing information and communication technologies (ICTs) namely; Socio-economic cum cultural constraints (Factor1), Administrative constraints (Factor 2) and Environmental – technological constraints (Factor 3).

In factor 1, the significant socio-economic cum cultural constraints to access ICT facilities by fish growers in Enugu State were high low income of fish growers (0.6277), cost of devices (0.5874), lack of skills (0.5450), lack of awareness/ knowledge (0.4913), Unavailability and cost of batteries (0.4280), language barrier (0.4267), lack of interest (0.3997) and low scale fish production (0.3515).

In Factor 2, the significant administrative constraints faced by fish growers in accessing ICTs were erratic electricity power supply (0.8577), time of transmission (0.6549), lack of adequate time to listen to information (0.6097), high call tariff (0.5916), lack of policy

framework (0.5616), fluctuation of services (0.5382) and lack of maintenance of tools (0.4281).

In Factor 3, the significant environmental technological constraints to accessing ICTs by fish farmers were poor connectivity (0.8561), problems of ICTs (0.5920) and complexity of information and communication technologies (0.5514).

These three major categories of constraints have several implications as far as use of ICTs for the adoption of improved fishpond management technologies is concerned. Firstly, socio-economic cum cultural constraints can adversely affect fish grower's access to ICTs facilities and this in turn, can affect the adoption of improved fishpond management technologies. Take for instance, high cost of devices, low income of fish growers and unavailability and cost of batteries can mar fish growers' accessibility to ICT facilities.

Secondly, administrative constraints such as erratic electricity power supply, fluctuation of services and lack of maintenance can adversely affect the accessibility of fish growers to ICTs and this in turn, can slow down the rate of adoption of improved fishpond management technologies in Enugu State.

Thirdly, Environmental cum technological constraints such as poor connectivity and complexity of ICTs can affect both accessibility of fish growers to ICTs and adoption of improved fish pond management technologies in Enugu State. Take for instance, poor connectivity to the internet due to the remoteness of some rural areas to urban centres where ICT facilities are found may hinder fish growers from having access to ICTs in Enugu State.

Besides, some ICT facilities are too complex for rural fish growers to comprehend or understand and put into use. These can definitely affect the adoption of improved fishpond management technologies among fish growers in Enugu State. This result agrees with that of Aphunu and Atoma (2011) who found that lack of government enabling policy is one of the main pressing constraints against effective utilization of ICTs in Nigeria. Maintenance problems, low scale of fish production and rural poverty were also identified as serious constraints to ICTs use by fish farmers. Nkwocha *et al.,* (2009) stated that government's low level of assistance to ICTs infrastructural provision and absence of any policy to encourage farmers gain ICT education pose threat to agricultural development. Ejiogu-Okeke *et al*. (2016) in their work in River State found that; high cost of devices, low income of farmers, low level of education, poor access to ICT device and erratic power supply are major challenges in the use of ICTs by the fish farmers. The result is in line with works of Omar *et al*. (2011) who indicated that fish growers are facing many problems and hindrances in ICT usage including the expensive cost particularly computer and sonar. Yekinni *et al*. (2019) also stated high cost of maintenance, high call tariff, language barrier, maintenance of tools and equipment among others as a constraint to ICTs use by farmers.

Table 4: Factor analysis of constraints to accessing ICTs by fish farmers in Enugu State.

Variables	Factor 1	Factor 2	Factor 3
1. High cost of devises (HCD)	0.5874*	0.0821	0.0550
2. Low income (LI)	0.6277*	0.0774	-0.1073
3. Poor access to ICTs	0.1480	0.0325	0.7484***
4. Erratic power supply (EPS)	0.0085	0.8577**	0.0471
5. Poor connectivity (PC)	0.0264	0.0679	0.8561***
6. Lack of policy framework (LPF)	-0.0511	0.5616**	-0.0412
7. Problems of ICTs (PI)	0.0760	0.1122	0.5920***
8. Low scale of fish production (LSFP)	0.3515*	-0.4111E02	0.0102
9. Lack of skills (LS)	0.5450*	0.1493	0.2178
10. Lack of awareness/knowledge	0.4913*	0.1716	0.2838
11. Language barrier (LB)	0.4267*	0.0271	-0.1271
12. Fluctuation of services (FS)	0.2197	0.5358**	-0.1249
13. Lack of interest (LI)	0.3997*	0.5072E02	-0.3141
14. Time of transmission (TT)	-0.1736	0.6549**	0.0659
15. Lack of adequate time to listen to Information (LATLI)	-0.0011	0.6097**	0.1325
16. High call tariff (HCT)	-0.0050	0.5916**	-0.0224
17. Lack of tools maintenance (LMT)	-0.5637E02	0.4281**	0.1407
18. Non avaib, & cost of battery (LAB)	0.4280*	0.1638	-0.0259
19. Complexity of ICTs (CI)	0.1583	-0.0684	0.5514***

* - Socio-economic cum cultural constraints (Factor 1)

** - Administrative constraints (Factor 2)

*** - Environmental cum technological constraints (Factor 3)

Source: Field survey 2021

Method: Varimax with Kaisar normalization

Kruskal Wallis Test of Utilization of ICTs among Fish Growers across Six Agricultural Zones in Enugu State

Table 5 indicates that there is a significant difference among the fish growers in the use of ICTs in Enugu State ($P < 0.05$). Since H. cal. (27) > X^2 – Tab. (11.1) at 0.05 level of probability, the null hypothesis was rejected and the alternative hypothesis was accepted. This implies that there is a significant difference in the usage of ICTs among fish growers in Enugu State. Each grower uses the ICTs he/she feels like using. Hence, ΣR_1 297, ΣR_2 842.5, ΣR_3 546, ΣR_4 549, ΣR_5 639.5 and ΣR_6 1,004 are different. This result agrees with the works of Anoop *et al.* (2015) that farmers use ICTs to plan and obtain better prices for produce and save them the exploitation from the middlemen. Otter and Theuvsen (2014) stated that mobile phones and e-mail had positive impact on farm production of small farmers.

Table 5: Kruskal Wallis analysis of usage of ICTs among fish farmers across the six agricultural zones of Enugu State

ICTs	Agbani	R_1	Awgu	R_2	Enugu	R_3	Enugu-Ezike	R_4	Nsukka	R_5	Udi	R_6
Mobile phone	128	62	184	86	136	69	180	85	172	84	208	90
Television	96	52.5	170	83	98	54	162	80	134	67	203	89
Radio	96	52.5	143	72	101	55	124	61	141	71	151	77
Video CD	34	8.5	75	43	34	8.5	47	21.5	49	26.5	140	70
E-Mail	56	35	148	74	116	60	57	6	115	59	191	88
Internet	58	3.5	150	75.5	135	68	51	29	164	81	189	87
GIS	32	3.5	63	40	34	8.5	45	17	43	13	132	65
GIS	32	3.5	132	65	34	8.5	45	17	45	17	169	81
Journals	40	11	4	21.5	42	12	51	29	48	24	58	37.5
Cable media	32	3.5	132	64	74	42	45	17	49	26.5	156	79
Satellite Television	32	3.5	144	73	102	56	45	17	87	49	152	78
Webcasting of video/television	32	3.5	110	58	54	34	45	17	79	45	150	75.5
Home video	95	51	80	46.5	48	24	133	66	76	44	82	48
Others	32	3.5	65	41	80	46.5	45	17	53	32.5	60	39

ΣR_1 297 $\Sigma R_2 = 842.5$ $\Sigma R_3 = 546$ $\Sigma R_4 = 549$ $\Sigma R_5 = 639.5$ $\Sigma R_6 = 1004$

H. Cal = 27 **x2 Tab. = 11.1** **Probability = 0.05**

Source: Field survey, 2021.

Hypothesis H_o states that there is no significant difference among fish growers across the six agricultural zones in terms of ICTs usage. However, it was found that there was a significant difference among the fish farmers ($P < 0.05$). Since H. Cal. (27) > X^2- Tab. (11.1) at 0.05 level of probability, the null hypothesis was rejected and the alternative hypothesis was accepted. This implies that there is a significant difference in the use of ICTs among fish farmers across the six agricultural zones in Enugu State.

Conclusion and Recommendation

Mobile phones, internets, e-mail, television and radio are available ICTs in Enugu State. The farmers prefer mobile phones, television, internet, e-mail and radio in this order. The fish farming systems and fishpond management technologies actively in use in the study area were; Fishpond construction, repair of broken dykes, replacement of old pond water, stocking density etc. The study concludes that the roles of ICTs in adoption of fishpond management technologies as it affects increasing safety, vulnerability reduction and social inclusion are to be enhanced. The study also established that there is a significant difference in the use of ICTs across the six agricultural zones in the State. Training should be given to

the fish farmers by the extension agents to help lift safety, reduce vulnerability and increase social inclusion and reduce constraints as identified in the research results.

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