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Oluremi Atinuke Elusoji
Department of Agricultural Extension and Rural Sociology, Faculty of Agriculture, University of Abuja, FCT, P.M.B. 117, Abuja, Nigeria

EE Idu
Department of Agricultural Extension and Rural Sociology, Faculty of Agriculture, University of Abuja, FCT, P.M.B. 117, Abuja, Nigeria

Julius Ajah
Department of Agricultural Extension and Rural Sociology, Faculty of Agriculture, University of Abuja, FCT, P.M.B. 117, Abuja, Nigeria

Corresponding Author:
Oluremi Atinuke Elusoji
Department of Agricultural Extension and Rural Sociology, Faculty of Agriculture, University of Abuja, FCT, P.M.B. 117, Abuja, Nigeria

Exploring the factors influencing the adoption of ICT tools among rice farmers in southwest and north Central Nigeria

Oluremi Atinuke Elusoji, EE Idu and Julius Ajah

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Abstract
This study delves into the multifaceted factors that shape the integration of Information and Communication Technology (ICT) tools within the agricultural landscape, focusing on rice farmers in Southwest and North Central Nigeria. The adoption of ICT tools in agriculture holds immense potential for enhancing productivity, sustainability, and overall socio-economic development. However, understanding the determinants of this adoption is crucial for effective implementation. The research employs a comprehensive approach, combining surveys, interviews, and statistical analyses to unravel the intricate web of factors influencing ICT tool adoption. Socioeconomic variables, such as education and income levels, are scrutinized alongside infrastructural aspects like internet accessibility and power supply. Additionally, the study explores the impact of agricultural extension services, farmer-to-farmer networks, and governmental policies in shaping farmers' attitudes towards ICT adoption. By focusing on the specific context of rice farming in these two regions, the research aims to draw region-specific insights into challenges and opportunities. The findings of this study will not only contribute to the academic discourse surrounding ICT adoption in agriculture but will also offer practical implications for policymakers, extension services, and technology developers. Ultimately, this research endeavours to provide a nuanced understanding of the dynamics at play, offering valuable insights that can inform targeted interventions and strategies to foster the widespread and effective adoption of ICT tools among rice farmers in Southwest and North Central Nigeria.

Keywords: ICT, adoption, rice, farmers, extension, innovation

Introduction
A growing field that focuses on advancing agricultural and rural development through improved information and communication processes is the use of Information and Communication Technologies (ICT) in Agriculture (often referred to as Agro-informatix). ICT-based networking abilities are the universal currency of 21st-century economics, yet there is a serious lack of people with these skills (Oyerinde, 2019) [17]. Idu, Aiyedun and Idu (2012) [9], stated that Information and communication is the scientific, technological and engineering disciplines and the management technologies used in handling information processing and application related to computers. All these technologies used in information processing and electronic communication are referred to as Information Communication Technology (ICT).

Information and communication technology (ICT) was defined by Kumar (2012) [10] as a set of tools used to gather, process, store, retrieve, distribute, and implement data and information using microelectronics, optical, telecommunications, and computers. These include computer features including Internet access, email functionality, web portals, online chat, video conferencing, and multimedia technologies. The impact of computer visuals on the brains and psyches of rural, uneducated farmers is significantly larger than that of verbal descriptions of the technology, according to Kumar. He stated that information and communication technologies (ICT) aid in the communication of information to bring scientific knowledge and technology to the end consumers.

Rice is one of the most important sources of calories for humans. It contributes about 27% of per capita calories in the developing countries (Awika *et al.*, 2011) [22]. Rice has grown to become a major staple food in Nigeria such that households consume it in large quantities (Godwin, 2012) [23]. Rice has transformed from being a luxury to a necessity whose consumption will keep increasing with per capita GDP growth, thus outlining its importance as a major food item for food security in the country (Ojogho & Alufohai, 2010) [24].

Rice can provide the country with the required minimum of 2,400 calories per person per day (Olagunju, 2014) [25].

Rice is one of the most important sources of dietary food energy for majority of Africans; hence, its production and utilization must be given all the required attention. It is an important food and cash crop in Nigeria. Rice serves multipurpose roles: it immensely contributes to internal and external African sub-regional trade as well as food security for the nation (Bello *et al*., 2014) [3]. Nigeria has a history of indigenous rice production and high demand (Johnson *et al.*, 2013) [26]. Thus, it is not surprising that rice has emerged as a major staple food crop in Nigeria, given its demand all over the country and across all socio-demographic groups (Gyimah-Brempong *et al.,* 2016) [27]. Rice is mainly grown in four major production ecosystems which are broadly defined on the basis of water regions; irrigated rice, rainfed lowland rice, upland rice and deep water rice. In Nigeria, farmers cultivate in a variety of production ecologies throughout the country due to the immense potentials of the nation for rice production (Federal Ministry of Agriculture and Rural Development (FMARD), 2011). According to Idu *et al.* (2016), increase in local production in commercial quantity will bridge the apparent demand-supply gap in the rice subsector.

A variety of ICTs have significant impact on agricultural production and postharvest activities. Helping in mitigating effects of poverty and e-literacy and impact in agriculture, e-governance in rural districts. ICTs focused on extension of various financial services, provision of basic telephone access and improved multi-stakeholder dialogue and louder rural/ agricultural voices in the national policy and programme context may exert an even greater impact. Successful adoption of ICTs helped in transforming agriculture among young farmers in Luwero district in Uganda. Most of them either had or regularly accesses several ICTs such as radios, mobile phones and commercial internet services. About 75% of them have access to the internet, they visit agro-based websites on their mobile phones and at internet cafes in Luwero town. In addition, they also use their mobile phones to access and use agro-based information through SMS messages to enable them procure quality planting/stocking materials, pesticides, markets and prices for their agro-produce as well as accessing weather information.

Research demonstrates that a common factor influencing the use of information technology is land ownership. It is well known that the rate at which small and large farm owners adopt and use technology to acquire information varies. According to Mittal *et al*. (2010) [11], large-scale farmers have greater rates of using ICTs to acquire agricultural information than small-scale farmers since they have a higher socioeconomic standing. In other words, for enhanced output, farmers with larger farms are more likely to seek information through the use of various ICT tools, including mobile phones (Mwombe *et al*., 2014) [12]. For instance, research by Mittal *et al*. (2010) [11] in India revealed that farmers with big farms were more likely to adopt and use ICTs for accessing agricultural productivity.

Age of the farmer is another factor that influences how much they employ technology. Compared to the young, older adults are less interested in using information and communication technologies. According to a study by Nyamba and Mlozi (2012) [13], younger respondents in Tanzania were more likely than older respondents to use mobile phones to acquire information. Another element that may affect the utilisation of information technology is household size. According to Vosough *et al*. (2015) [20], ICT usage is more likely to occur in households with larger families. To give an example, research by Sekabira *et al*. (2012) [18] in Uganda, India and China indicated that as household sizes increased, ICT usage increased. Exploring Factors Influencing the Adoption of ICT Tools among Rice Farmers in Southwest and North Central Nigeria is yet to be established and this is why this study was conducted. Therefore, the main objective of this study is to ascertain/ Explore Factors Influencing the Adoption of ICT Tools among Rice Farmers in Southwest and North Central Nigeria.while, the specific objectives are to:

1. Examine the socio-economic characteristics of the rice farmers in the Southwest and the North Central Nigeria.
2. To explore the factors influencing the adoption of ICT tools among rice farmers in southwest and north central Nigeria.
3. Determine the level of rice farmers' utilization of ICT tools in the Southwest and the North Central Nigeria.

Methodology

Study Area

North Central: North Central Nigeria consists of the Federal Capital Territory and six states situated geographically spanning from the west, around the confluence of the River Niger and the River Benue. The region itself is rich in natural land features and boasts some of Nigeria's most exciting scenery. The region is also home to many historical and colonial relics. The North Central States of Nigeria are Kwara, Kogi, Niger, Nasarawa, Benue, Plateau and the Federal Capital Territory (FCT). The Nigeria Artisanal fisheries production is much favoured in this North Central part of Nigeria as a result of numerous tentacles of inland water and streams as well as flood plains of the River Niger that stretch from Niger State (Borgu Local Government Area), through Kwara State (Edu LGA) to Lokoja in Kogi State. River Benue also cuts across Benue State with prominence in Makurdi and adjacent towns in the State. Rice is predominately cultivated in this zone.

South West

The South-West region of Nigeria is one of the geopolitical zones of Nigeria, the zone consist of six states which are Ekiti, Lagos, Ogun, Ondo, Osun and Oyo. The region offers a wide range of sights and experiences; from the beaches in Lagos to the natural springs in Osun state and from the historic city of Ibadan to the mountain caves of Ogun state. The area lies between longitude 2 0 3 1 and 6 0 00 1 East and latitude 6 0 2 1 and 8 0 37 1 N with a total land area of 77, 818 km 2. It has a period of rain from March to November and a dry season from November to February. Rice is one of the staple food widely grown in the region.

Table 1: Distribution of rice production systems by states in Nigeria

Production Systems	States
Upland Rice	Abia, Bauchi, Benue, Borno, Delta, Ebonyi, Edo, Ekiti, Enugu, Gombe, Jigawa, Imo, Kaduna, Kastina, Kebbi, Kwara, Kogi, Nassarawa, Niger, Ogun, Ondo, Oyo, Osun, Sokoto, Plateau, Yobe, Zamfara, Taraba and FCT.
Lowland Rice	Adamawa, Anambra, Akwa-Ibom, Bayelsa, Borno, Delta,Ebonyi, Edo, Enugu, Kaduna, Katsina, Kebbi, Kwara, Lagos, Nassarawa, Ondo, Osun and Rivers.
Mangrove or Deepwater	Flooded Rima River Valley areas-Kebbi State and deep flood areas of Delta State. Other states are: Ondo, Edo, Rivers, Bayelsa, Cross-River and Akwa-Ibom.
Irrigation	Adamawa, Benue, Borno, Cross River, Ebonyi, Enugu, Kano, Kebbi, Kwara, Lagos, Niger, Ogun, Sokoto and Zamfara.

Source: FMARD, Agricultural Transformation Agenda, 2011

Research design

The design was experimental. The research was carried out in three phases. The first phase was a baseline survey of the study area which was carried out at the preliminary stage. This phase had the main objective of describing the socio-economic characteristics of the rice farmers in the study areas, the rice farmers' literacy status in ICT for agricultural activities and to determine the ICT need of rice farmers in the study area. This was done by an interactive visit to the farmers and information were collected through the aid of questionnaires, the visit was to familiarize the researcher with the rice farmers in the study area and to find out if there was the need for more sensitization on the use of ICT as regards rice farming in the study area. The second phase involved a teaching visit to the male and female rice farmers in the study areas, where the farmers were trained with the use of a teaching manual on ICT prepared by the researcher as attached in appendix II and list of villages and farmers trained attached in appendix III. Two years after the training by the researcher, data were collected through the aid of questionnaires from the trained farmers to determine the impact of the training on the use of ICT on rice production among the farmers in the study area.

Instrument and Techniques for Data Collection

Data were collected through the use of questionnaire, which was administered to the Rice Farmers in the study area by the researcher and well-trained enumerators (staff of RMRDC at the State offices) who have constant interaction with the rice farmers in the states. This was to enable the researchers get the required information needed for the study. Also, Focused Group Discussions (FGD) were held to validate the data collected from the respondents. FGD involved gathering Farmers from similar backgrounds / experiences together to discuss a specific topic of interest (Aslam, 2019) [28]. This strategy enabled solicitation of in-depth information to complement the empirical findings. The FGD was held to obtain basic findings on the usage of ICTs in rice farming activities.

Instruments of data collection

The instrument for data collection were the questionnaires designed to capture all the objectives of the study. The arrangement of questions was aimed at addressing specific objectives.

Validation and Pilot-Testing of instrument

The instrument used for the study was subjected to face and content validation. The copies of the proposal and questionnaire were given to lecturers in the Department of Agric Extension and Rural Sociology, University of Abuja and staff of the Agricultural Department of RMRDC Office for review. After the content had been validated, 32, (10%) of the 320 of the questionnaires were administered to group of rice farmers in Kwali Area Council of Federal Capital Territory (FCT) near the study area, on 4th April, 2019 for pilot testing. Pilot testing of the questionnaire was done in order to identify and rectify short comings in the instrument and get them addressed before they are fully used for data collection. Modification of the questionnaire in line with the comments and suggestions of the validators were taken and other improvements were made before printing the final copies of the questionnaire used for carrying out the study.

Population, sampling techniques and sample size

The target population of the study was made up of male and female rice farmers who had a minimum of Primary School Education and the study was basically carried out in 2 states in the North-Central (Niger and Nasarawa) and 2 states in the South-West (Ondo and Ekiti), based on the rice farming activities carried out in the area. The rice farmers in the four states within the two agro-ecological zones were registered with the Agricultural Development Programme (ADP) and the cooperative societies in Nasarawa, Niger, Ekiti and Ondo States.

In order to get a representative sample of the rice farmer's population and achieve, the objective of the study, a multi-stage sampling technique was used to select respondents for the study. The first stage involved purposive selection of two rice-producing agro-ecological zones. The second stage involved the selection of two states each out of the two agro-ecological zones. The third stage involved the selection of rice farmers who belong to each of the selected states chapter of the Rice Farmers Association of Nigeria RIFAN, thereby forming a cluster. This was achieved through the help of the ADPs in each of the selected states, this clusters served as the sample frame. The fourth stage involved the random selection of forty male and female rice farmers from the cluster within each selected states. Thus, a total of three hundred and twenty (320) rice farmers comprising 80 rice farmers from each state were selected for the study.

Data Collection

Primary data used for the study were obtained with the aid of a well-structured questionnaire which was administered to rice farmers with the help of the executive members of the rice farmers' association in the study area. For an effective exercise, the researcher held Focused Group Discussions and training sessions with rice farmers on the use of ICT for rice farming activities. The questionnaires consisted of seven sections. Section A dealt with the socioeconomic characteristics of the rice farmers in the study area. This includes age, gender, educational level, marital status, etc. Section B contained questions on factors influencing the adoption of ICT tools among rice farmers in southwest and north central Nigeria. Section C consisted of questions the level of rice farmers' utilization of ICT tools

in the Southwest and the North Central Nigeria.

Method of data analysis

Different models were used to realize the specific objectives of the study. Descriptive and inferential statistics were used.

Model Specification

The Multinomial Logit Model

Multinomial logit model was used to estimate the relationship between farmers' socio-economic factors and the level of information and communication technologies (ICTs) usage on rice production activities in the study area. This determines the likelihood of a household to fall into one of the four level categories (low level, moderate level, high level, and very high level) of ICTs usage in rice production activities in the Southwest and the North Central Nigeria. The Multinomial logit (MNL) model specifies the following relationship between the probability of choosing option A_i and the set of explanatory variables x_i as (Greene, 2003).

$$\Pr(Y_i = j) = \frac{e\beta_j^{'} x_{ij}}{1 + \sum_{m=1}^{4} e^{\beta_m x_{ij}}}, \; j = 1, 2, 3, 4 \ldots, k \quad (1)$$

Where β_j is a vector parameter that relates the socio-economic factors or characteristics x_i to the probability that Y_i= j. Because the probabilities of k level of ICTs usage of rice farmers must sum to one, a convenient normalization rule is to set one of the parameter vectors, say β_0, equal to zero (β_0=0). The probabilities for the k alternatives then become (Greene, 2000):

$$P_j \equiv \Pr(Y_i = j) = \frac{e^{\beta_j^{'} x_{ij}}}{1 + \sum_{m=1}^{k} e^{\beta_m x_{ij}}}, \; j = 1, 2, 3, 4 \ldots, k \quad (2)$$

$$P_0 \equiv \Pr(Y_i = 0) = \frac{1}{1 + \sum_{m=1}^{k} e^{\beta^{'} m x_{ij}}} \quad (3)$$

The dependent variable (Y_i) is the probability of belonging to a category of the level of ICTs usage. This is quantified numerically as follows: 1 for low level of ICT usage, 2 for moderate level of ICT usage, 3 for high level of ICT usage, and 4 for very high ICT usage. The multinomial logit model is a polytomous models used for addressing dependent variable that has more than two response outcomes (Gujarati, Porter & Gunasekar, 2012) [8]. To effectively apply this model, one of the levels of information and communication technologies (ICTs) was set to be the reference category, which is assumed to be zero (0). In other words, we compare the case of no/low level of ICT usage (1) with other possible levels of ICT usage (2, 3 and 4).

The explicit form of the Multinomial model is stated as:

$$Y_i^* = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon_i \quad (4)$$

Findings and Discussion

Socio-economic characteristics of the rice farmers

Gender of the Rice Farmers

Table 2 shows that 68.8% and 71.7% of the farmers in the South-Western and North Central Nigeria, respectively were male. This portends that the rice farmers were mostly male. The male dominance in rice farming activities in the study areas may be attributed to the crude implements and strenuous activities involved in rice farming in the study area. Male farmers in a developing country such as Nigeria are usually saddled with great responsibility in their families as heads. Thus, engage in rice farming to supply food and other household basic needs. This supports the findings of Tijani *et al*., (2010) [19] who made similar discovery in Jere Local Government Area of Borno State, Nigeria.

Age of the Farmers

The findings on the age of the farmers are presented in Table 2. The mean age of the farmers was 41.49 and 40.63 years in the Southwest and North Central, Nigeria respectively. About 35% of the farmers fell within the age range of 31-40 years, 26.3% of the farmers fell within the age range of 41-50 years in both Southwest and North Central, Nigeria. More so, about 18% of the farmers fell within the age range of 21-30 years in both Southwest and North Central, Nigeria. Again, 17.5% and 15.8% of the farmers fell within the age bracket of 51-60 years in the Southwest and North Central Nigeria. This implies that rice production in Southwest and North Central Nigeria was in the hands of young farmers, who were supposed to be very productive. These findings disagree with the study that showed out that the age of Thailand rice farmers were 51 years which means they were quite older than the rice farmers in the South-western and North Central zones of Nigeria.

Table 2: Socio-economic characteristics of the rice farmers in the study

Variable	Southwest		North Central	
Gender	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Male	110	68.8	109	71.7
Female	50	31.1	43	28.3
Marital Status				
Single	19	11.9	32	21.1
Married	141	88.1	120	78.9
Household Size	Mean = 5		Mean = 10	
1-5	77	48.1	11	7.2
6-10	83	51.9	75	49.3
11-15	0.0	0.0	65	42.8
Above 15	0.0	0.0	1	0.7
Age	Mean = 41		Mean = 40	
Less than equal to 20	0.0	0.0	4	2.6

21-30	29	18.1	28	18.4
31-40	57	35.6	53	34.9
41-50	42	26.3	40	26.3
>50	32	20.0	27	17.8
Level of education	Mean = 14		Mean = 10	
Primary Education	6	3.8	65	42.8
Secondary Education	58	36.3	55	36.2
Tertiary Education	96	60.0	32	21.1
Farming Experience	Mean = 3.78		Mean = 13.76	
1-5	22	13.8	26	17.1
6-10	57	35.6	35	23.0
11-15	28	17.5	40	26.3
16-20	25	15.6	28	18.4
>20	25	15.6	23	15.1
Farm size	Mean = 1.76		Mean = 1.23	
Less than or equal to 1.00	93	58.1	110	72.4
1.01-3.00	42	26.3	34	22.4
3.01-6.00	19	1.9	8	5.3
6.01-9.00	6	3.8	0	0.0

***Source*:** Computed from field data, 2021.

Marital Status of the Farmers

The result on marital status shows that 88.1% and 78.9% of the farmers in the South-western and North Central zones of Nigeria, respectively were married, while 11.9% and 21.1% of them in the South-western and North Central zones of Nigeria, respectively were single as indicated in Table 2. This agrees with the findings of Onumadu and Osahon (2014) [16] where the majority of rice farmers were married. This implied that married people were more in rice farming, this according to WARDA (2003) [21] implies that majority of the farmers are stable and could command societal respect. Being married could mean that the farmers are responsible. Marriage could also imply an active family support for farm work through the supply of family labour which is an alternative cheap source of labour for farming activities.

In response to the Focused group question on the socio-economic characteristics of rice Farmers, here are responses from some of the farmers.

"Majority of us rice farmers are male and we are married and have children to feed, our women work with us but mostly they process the rice and take them to the market to sell.''

"Many graduates do not like farming because they feel is very difficult and will not get much money, rather they want government job or what you call white collar job''

"There are more male rice farmers here because the women are busy either with domestic work or selling their rice in the market, they have little time to use the ICT tools."

(Inferred from a Focus Group Discussion)

Household Size

The results in Table2 show that 51.9% and 49.3% of the farmers fell within the age bracket of 6 -10 persons in the Southwest and North Central Nigeria respectively. Furthermore, 48.1% of the farmers fell within the age range of 1-5 household size in the Southwest Nigeria, while 42.8% of them fell within the household size range of 11-15 in the North Central Nigeria. The result further shows that the average household size of the farmers was 5 and 10 in the Southwest and North Central Nigeria respectively. This implies that there is tendency of family labour availability for rice farming in the North Central than in the Southwest zone of Nigeria.

Level of education of the Farmers

The result in Table 2 shows that the farmers spent an average of 14 years and 10 years in formal schooling in the Southwest and North Central zones of Nigeria, respectively. Moreso, 60% and 21.1% of the farmers had tertiary education in the South-western and North Central zones of Nigeria, respectively. Again about 36% of the farmers both in the Southwest and North Central zones of Nigeria had secondary education. About 3.8% and 42.8% of the farmers had primary education in the South-western and North Central zones of Nigeria, respectively. This implies that majority of the farmers in the Southwestern zone had at least secondary education unlike their counterpart in the North Central Nigeria.

Farming experience of the Farmers

Farming experience counts in the use and adoption of technologies. Table 2 shows that 35.6% and 23% of the farmers had farming experience within the range of 6 -10 years in the Southwest and the North Central Nigeria, respectively; while 26.3% of them had farming experience between 11-15 years in the North Central Nigeria. Also, 13.8% and 17.1% of the farmers had farming experience within 1-5 years in the Southwest and the North Central regions of Nigeria, respectively. Moreso, 15.6% and 18.4% of the farmers in the Southwest and the North Central Nigeria, respectively had farming experience within the range of 16-20 years. The farmers had an average experience of 13.78 and 13.76 years of farming in the Southwest and the North Central Nigeria, respectively as seen in Table 2. This indicates that majority of the rice farmers are well experienced in rice farming and according to Nwoye (2007) [29] this has some positive implications for increased production. The higher the number of years spent in farming by a farmer, the more he becomes aware of new production technologies (Amaza & Olayemi, 2002) [2]. Experience farmers are more likely to be receptive to use technologies which they perceived beneficial to their farming activities.

Farm size of the Farmers

The result also revealed that most (58.1%) and (72.4%) of the farmers operate farms that were less than one hectare in the Southwest and the North Central Nigeria, respectively as seen in Table 2. The average farm size of the farmers is

1.76ha and 1.23ha in Southwest and North Central respectively. This finding implies that majority of the rice farmers in the study area can therefore, be categorized as small-scale farmers. This is consistent with the assertion by F.A.O, (1998) that most of the farmers in Nigeria were small-scale farmers who cultivate less than 5 hectares of land. Similarly, Tijjani (2007) reported that majority (72.0%) of the farmers in Borno state, Nigeria are small-scale farmers who had farm sizes between 3-4 hectares.

Factors affecting the level of usage of information and communication technologies (ICTS) In South-West and The North Central Nigeria

Factor analysis was employed to analyse the factors affecting the level of usage of ICTs in southwest and the North Central Nigeria. The extracted variables with coefficient of ≥ 0.50 and above were used in identify the variables which defined each of the factors and this is in line with Nwaogwugwu and Obele (2017) [30]. The result shows that in the Southwest, the specific variables that defined factor 1 include environmental awareness (0.898), difficulty in operating ICT (0.871), awareness (0.861), government policies (0.841), location proximity (0.811), cost of data (0.810), access to credit (0.701), and access to ICT (0.660). This implies that these variables are related and therefore they have similar effects on the level of usage of ICTs in the southwest.

However, the result in North central revealed that factor 1 was defined by the following specific variables: difficulty in operating ICT (0.900), government policies (0.867), location proximity (0.808), environmental awareness (0.783), awareness (0.761), cost of data (0.649) and access to credit (0.630). Also, the second factor loading showed that knowledge of ICT usage (0.789), training on ICT usage (0.785), availability of ICT (0.762), access to ICT (0.606), access to information (0.599) and cost of data (0.566) were the variables that defined factor 2. This implies that these variables are related and therefore they have similar effects on the level of usage of ICTs in the southwest.

Table 3: Factors affecting the level of usage of ICTs in southwest and the North Central Nigeria

Variables	South-West		North Central	
	Factor 1	Factor 2	Factor 3	Factor 4
Availability of ICT	.371	.714	.175	.762
Access to ICT	.660	.355	.459	.606
Training on ICT usage	.198	.908	.265	.785
Cost of Data	.810	.297	.649	.566
Knowledge of ICT usage	.181	.871	.246	.789
Difficulty in operating ICT	.870	.109	.900	.159
Environmental awareness	.898	.271	.783	.489
Access to credit	.701	.196	.630	.352
Access to information	.204	.849	.388	.599
Awareness	.861	.201	.761	.452
Location proximity	.811	.225	.808	.301
Government Policies	.840	.221	.867	.236

Source: Computed from field data, 2021.

Impact of training on the use of ICT among rice farmers in the North-Central and South-West, Nigeria using Kirkpatrick's Evaluation Model

Presented in Table 3 is the ANOVA result on the impact of training on usage of ICT by rice farmers in the study area. The result shows that location of the respondents had a significant influence on the use of ICT among the rice farmers. This implies that the location of the farmers will determine if the farmers use information and communication technologies, as well as the level of their usage of the technology. Also, the result reveals that ICT type was significant in influencing the usage of ICT among the farmers. This implies that the usage of ICT by the farmers depends on which the type of ICT tools involved. This is in line with the findings of Adegbidi *et al.* (2012) [31] who found that there were differences in the level of usage of ICT tools based on the type of ICT. Furthermore, the result shows that there was a significant interaction between the location of the farmers and the ICT type in determining the usage of ICT by the respondents. Based on this result, mean separation was done and presented in figures.

Table 4: ANOVA results of the impact of training on usage of ICT on rice farmers

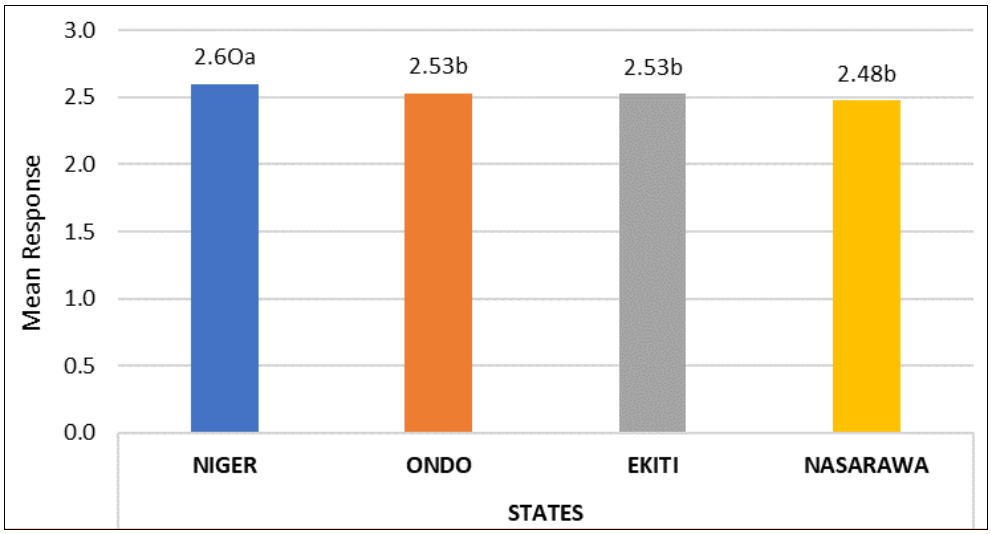
Sources of variation	DF	SS	MS	F-cal	*P*-value
Indicator-type	11	365.819	33.256	180.40	.00
Indicator-type∗location	33	17.775	.539	2.922	.00
Indicator-type∗ICT-Type	55	73.141	1.330	7.214	.00
Indicator-type∗Location∗ICT-Type	165	57.258	0.347	1.882	.00
Error (within subjects)	12925	2382.67	0.184		
Location	3	22.112	7.37	6.956	.00
ICT-Type	6	213.886	42.78	40.37	.00
Location∗ICT-Type	15	63.098	4.207	3.97	.00
Error (between subjects)	1175	1245.15	1.06		

Note * = means interaction

***Source*:** Computed from field data, 2021.

Locational differences in the impact of training on usage of ICT

The result showing the locational differences in the impact of training on the usage of ICT is shown in Figure 1. Here the emphasis is not on the type of ICT but on the location of the farmers. The result reveals that there is significantly higher usage of ICT in Niger State (2.60) than in Ondo (2.53), Ekiti (2.53) and Nasarawa States (2.48). Ondo and Ekiti States had same mean score which implies that they had equal level of usage of ICT among rice farmers. Even though there was no significant difference in the usage of ICT between rice farmers in Ondo, Ekiti and Nasarawa States, Nasarawa State recorded a relatively lower usage than in Ondo and Ekiti States. This implies that there is locational difference in the impact of training on the usage of ICT in the study area. Niger State recorded the highest impact on usage while Nasarawa State had the least impact on usage of ICT by rice farmers.



Note: Mean with the same alphabet did not significantly differ

Fig 1: Locational differences in the impact of training on usage of ICT

Conclusion

Rice being a major staple food widely consumed across the Nigeria and stands out as an important crop; hence, the production must be increased drastically. Rice production activities along the value chain (Farming to Market) should be made more attractive and easier for the rice farmers, as such, the imperative need for the application of ICTs to the rice production activities to improve yield. Results showed there is positive impact on the rice farmers, as such more awareness must be created and capacity building of the farmers on the usage of ICT has become very necessary to achieve increase in production. This will also make it attractive and profitable for more farmers to engage in the usage of ICT in rice production.

The outcome shows that

a) WhatsApp is a widely used ICT tools among the rice farmers in both zones.
b) There are more educated rice farmers in the south-West Zone than the North-Central who are involved in the rice production in ICT usage.
c) The notable benefits derived from ICT usage by rice farmers are lower cost of production, saves time, better linkages to both raw materials, best practices information and market.
d) Age, Education, Farming Experience, Farm Size and gender of rice farmers significantly influence usage of ICT among the rice farmers in the study area.
e) Poor connectivity, electricity, record keeping, more ICT literacy were the major constraints to ICT usage by rice farmers in the study area. Efforts must be made to address these constraints identified in this study.

This proves that ICT usage among rice farmers if given adequate attention, will serve as a veritable and indispensable tool to promote the increase in the production of rice and improve the farmers' standard of living. Hence the usage of ICTs tool among rice farmers in the study area should be encouraged and promoted. We hereby conclude that the usage of ICT by rice farmers is highly imperative for economic development.

Recommendations

From the findings of the study, the following recommendations were made. Implementing these recommendations will ensure that farmers are equipped with valuable digital skills and tools, ultimately leading to increased agricultural productivity and improved livelihoods.

1. Agricultural extension organizations should develop comprehensive training programs that cover various aspects of ICT in rice production, including the use of smartphones, tablets, and specialized agricultural apps. Customize training modules to cater to the specific needs and skill levels of farmers
2. Governments at all levels should ensure that farmers have access to the necessary devices (smartphones, computers) and a reliable internet connection to fully utilize ICT tools. This can be achieved making these devices available at subsidized rates for farmers.
3. Hands-On training programs including practical, hands-on sessions where participants can practice using ICT tools for tasks like data collection, weather forecasting, and market information retrieval should be conducted for farmers. Provide training materials and resources in local languages to ensure maximum understanding and

adoption among the farming community.
4. Government should support the use of ICT in agriculture in terms of infrastructure development and policy incentives for the integration of ICT in agriculture

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