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Rural Women Rice Farmers' Perceptions of Information and Communication Technologies for Enhancing Agricultural Practices in Nasarawa and Benue

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Abstract:

This study examines the perceptions of rural women rice farmers on the use of Information and Communication Technologies (ICT) in enhancing agricultural practices in Northcentral Nigeria. The study adopted a descriptive research design. A purposive sampling technique was employed to select the farming communities for the study. Three L.G.A. were selected from each state based on the volume of rice production and the number of women involved in farming. The sample size of the study was 450 women rice farmers from 45 communities made up of 50 farmers from each of the L.G.A. The most commonly used ICT tools were public address systems, radios, and mobile phones. The results showed that more than 50% of the respondents attest to ICT playing a significant role in decision-making, access to financial services, and knowledge sharing all of which positively impact agricultural practices. Regression analysis revealed that socio-economic factors such as marital status, education, farming experience, household size, and cooperative membership influence the use of ICT, accounting for 15.52% of the variation in use. However, barriers such as poor network connectivity (mean = 0.803) and high costs (mean = 0.795) limit broader ICT adoption. Addressing these challenges could empower rural women farmers and increase agricultural productivity. The study recommends that government and agricultural agencies improve the accuracy, relevance, and timeliness of information shared via ICT platforms, particularly focusing on climate data, market trends, and best farming practices that are easily accessible to rural women. In addition, Policymakers should consider creating specific policies that support the digital inclusion of rural women in agriculture.

Keywords:

ICT, Use, Perception, Women, Rice and Agricultural Practices

Introduction

Information and Communication Technology (ICT) has emerged as a transformative tool in agriculture, addressing long-standing challenges and revolutionizing farming practices globally. ICT solutions offer real-time access to critical agricultural information, such as weather patterns, market prices, and best practices in farming, significantly improving decision-making and boosting productivity (Benyam*et al.,* 2021; Fuentes-Peñailillo*et al.,* 2024). Since the late 1980s, the ICT sector has experienced rapid growth, with its application in agriculture expanding notably in the 1990s (Jain *et al.,* 2012). This evolution has been particularly impactful in developing regions like sub-Saharan Africa, where agriculture remains the backbone of many economies, including Nigeria (Oyelami*et al*, 2020; Oyediji*et al,*2024). Within this context, women play a crucial role in food production, especially in staple crops like rice.

In sub-Saharan Africa, agriculture has become increasingly feminized, with women assuming a more prominent role in both agricultural production and development. Women contribute between 60-80% of Africa's food production, particularly in smallholder farming systems focused on staple crops (Bryceson, 2018; Idu*et al.,* 2023). Despite this significant contribution, women are often 20-30% less productive than their male counterparts, a disparity largely attributed to unequal access to critical resources such as land, agricultural inputs, and technology (Muzari, 2016). In Nigeria, rice farming is a vital aspect of the country's agricultural production and food security, and the role of women in this sector is critical for both local and national food systems (Ajah*et al.,* 2023).

The integration of ICT into agricultural practices offers a promising avenue for overcoming the productivity gap between men and women in farming. The use of digital tools for the agricultural education of farmers and the dissemination of agricultural information and advisory services is gradually gaining popularity (Peng*et al.*, 2024). The increasing penetration of mobile phones, the use of radio, televisions, audiovisuals, satellite systems, internet-enabled devices, and other information delivery channels have provided important pathways for improving food security, delivering and enabling farmers to gather, process, and sharing agricultural information more efficiently, facilitating informed decision-making and enhancing farming practices accessing agricultural information; and sustaining successful agricultural supply (Dinesh *et al,*2016; Das and Ganesh, 2022; Adeyemi*et al.,* 2023).

For rural women rice farmers in particular, ICT can serve as a powerful tool for overcoming barriers related to access to information and resources. Through ICT, women can gain timely access to information about climate conditions, pest control, and optimal planting techniques, thereby improving their farming practices (Zougmoré and Partey,2022). Mobile phones, in particular, have become a crucial tool for women farmers, providing them with access to market prices, agricultural inputs, and financial services (Wamae,2023).Furthermore, ICT facilitates the dissemination of best practices in farming, promoting sustainable agricultural techniques that can enhance rice yields and contribute to greater food security in Nigeria (RambodAbiri*et al.,* 2023).

Despite the potential benefits of ICT in agriculture, rural women farmers in Nigeria face significant socio-economic, cultural, and infrastructural challenges that limit their access to and use of these technologies (Sennuga*et al.,* 2023). One of the primary barriers is low digital literacy, particularly among women with limited formal education. (Anyoha*et al*, 2018). Many women in rural areas are unfamiliar with the use of digital tools such as smartphones, computers, and internet-based applications, which limits their ability to take full advantage of the available ICT solutions).

Additionally, the high costs of ICT devices and services further hinder access, particularly for women farmers who often have limited financial resources. (Nayyar*et al,*2019;Mapiye*et al*, 2023).

Cultural norms and gender roles also play a significant role in limiting women's access to ICT. In many rural communities in Nigeria, women's use of technology is often restricted by societal expectations that prioritize men's control over resources, including technology (Achukwu*et al.,* 2023). This gendered divide in technology use exacerbates the marginalization of women farmers, preventing them from accessing the information and resources they need to improve their agricultural productivity. Moreover, women's access to ICT is often mediated through male family members, limiting their autonomy and ability to make independent decisions regarding their farming practices (Okeke, Nwoye and Kadiri, 2020).

The infrastructure necessary to support widespread ICT use in rural areas also presents a significant challenge. Many rural regions in Nigeria lack reliable electricity, internet connectivity, and mobile network coverage, all of which are critical for the effective use of ICT tools (Marvelous, 2023). Poor network connectivity can make it difficult for rural farmers to access real-time agricultural information, while high data costs further limit their ability to engage with digital platforms. As a result, many women farmers continue to rely on traditional, less efficient methods of accessing agricultural information, such as word of mouth or local radio broadcasts.

Perception plays a key role in determining whether ICT solutions are embraced or rejected. For many rural women rice farmers, their willingness to adopt ICT depends not only on the availability of technology but also on their perception of its relevance, usability, and potential benefits (Kante, Oboko and Chepken, 2019). For example, women who perceive ICT as too complex or irrelevant to their farming needs may be less likely to adopt it, even if they have access to the necessary tools (Sing., Tewari andVerma, 2018). Conversely, women who view ICT as a valuable resource for improving their farming practices may be more inclined to invest in digital tools, despite potential barriers such as cost or network connectivity (Dinesh *et al,*2016).

While ICT is widely recognized for its potential to enhance agricultural productivity and resilience, there is a notable gap in research regarding how women rice farmers perceive and interact with these technologies. Most studies on ICT in agriculture have focused on its general impact, with little attention paid to the specific barriers women face in adopting these tools. However, understanding rural women's perceptions of ICT is crucial for developing effective strategies to promote digital inclusion. Therefore, the main objective of this study is to Examine Rural Women Rice Farmers' Perceptions of Information and Communication Technologies for Enhancing Agricultural Practices. The specific objectives of this study are to:

1. describe the socio-economic factor influencing the use of ICTs in the study area;

2. investigate the ICTs Use and preference among women rice farmers in the study area;

3. evaluate the perceived effects of ICT tools among women rice farmers in the study area;

4. identify the factor Limiting the Use of ICTs by women rice farmers.

LITERATURE REVIEW

Theoretical Framework

The theory of Technology Acceptance Model guided this studied

Technology Acceptance Model (TAM) by Fred Davis (1989) is one of the most widely used theories for studying users' acceptance of technology. The model explains how users come to accept and use technology. The theory is based on two main factors that determine whether individuals will adopt a new technology: *Perceived Usefulness* (PU) and *Perceived Ease of Use* (PEOU).

Perceived Usefulness (PU): This refers to the degree to which a person or individual believes that using a particular technology will enhance their job performance or productivity (David,1989). Within the framework of rural women's ICT utilization, this would involve how much women believe that ICT tools will help them improve their agricultural practices, increase crop yields, or boost income

Perceived Ease of Use (PEOU): This relates to the extent to which a person believes that using a technology will be free of effort. If rural women find ICT tools complicated or difficult to navigate, they may perceive them as burdensome, hindering their use.

PU and PEU determine the attitude (A) of a person towards using the system. Finally with the influence of PU and Attitude, Behavioural Intention (BI) influences the actual use of the system (Islam and Grönlund, 2011).

TAM is particularly relevant for understanding rural women's ICT use because it directly addresses how their perceptions of technology's usefulness and ease of use influence adoption. Women who perceive ICT as beneficial for agricultural tasks, yet too complex to use, may be hesitant to adopt it unless these challenges are addressed through training or simplified interfaces. TAM also highlights the importance of digital literacy in bridging the gap between access to technology and actual usage (Abdullah, Ward and Ahmed, 2016).

However, the theories suffer limitations and critics based on the assumption that individuals have relatively equal access to technology, which is often not the case in rural settings. Barriers such as lack of electricity, poor internet connectivity, or the high cost of ICT tools are significant limitations to adoption that the theories do not address (Kalba, 2008). As a result, TAM may not fully capture the perceptions of rural women who view ICT positively but cannot adopt it due to these external limitations. Additionally, the aspect of TAM focuses on individual perceptions, it overlooks important external factors such as community influences, social structures, and cultural norms, which play a critical role in shaping rural women's technology adoption. (Bagozzi,2007). In many rural contexts, women's decision-making is highly influenced by family members, community leaders, and peers, as well as the broader socio-economic environment. In light of this women may perceive ICT as useful but may still not adopt it due to societal pressures or lack of support.

Materials and methods

Description of the study area

The study was conducted in three selected states within Nigeria's North Central region. This region includes the states of Plateau, Kogi, Niger, Kwara, Nasarawa, and the Federal Capital Territory. Geographically, it lies between latitudes 7°00' and 11°30' North of the equator and longitudes 4°00' and 11°00' East of the Greenwich meridian (National Geospatial-Intelligence Agency, 1995). The

region spans the full width of the country, sharing borders with Cameroon on the Benue Stateand with the Benin Republic along the Niger and Kwara State axis.

Characterized by distinct wet and dry seasons, the region has a tropical climate. Agricultural activities are largely dependent on rainfall. The average annual rainfall ranges from 1,200mm to 1,500mm, while the minimum and maximum annual mean temperatures are 22.5°C and 33.5°C, respectively (Olayemi et al., 2014; World Bank, 2021). According to the 2006 Census, the region had a population of 20,369,956, which was projected to reach 29,369,956 by 2022, growing at an annual rate of 3.5% (NBS, 2019). Women constitute 43% of the agricultural population (IFAD, 2019).

The region's fertile soil supports a wide range of agricultural activities, including fishing, animal husbandry, and crop production. Notably, rice cultivation accounts for 43% of the region's agriculturalproduction (NBC,2012).For this study, Benue, Nasarawa, and Niger States were selected due to their prominence in rice production.
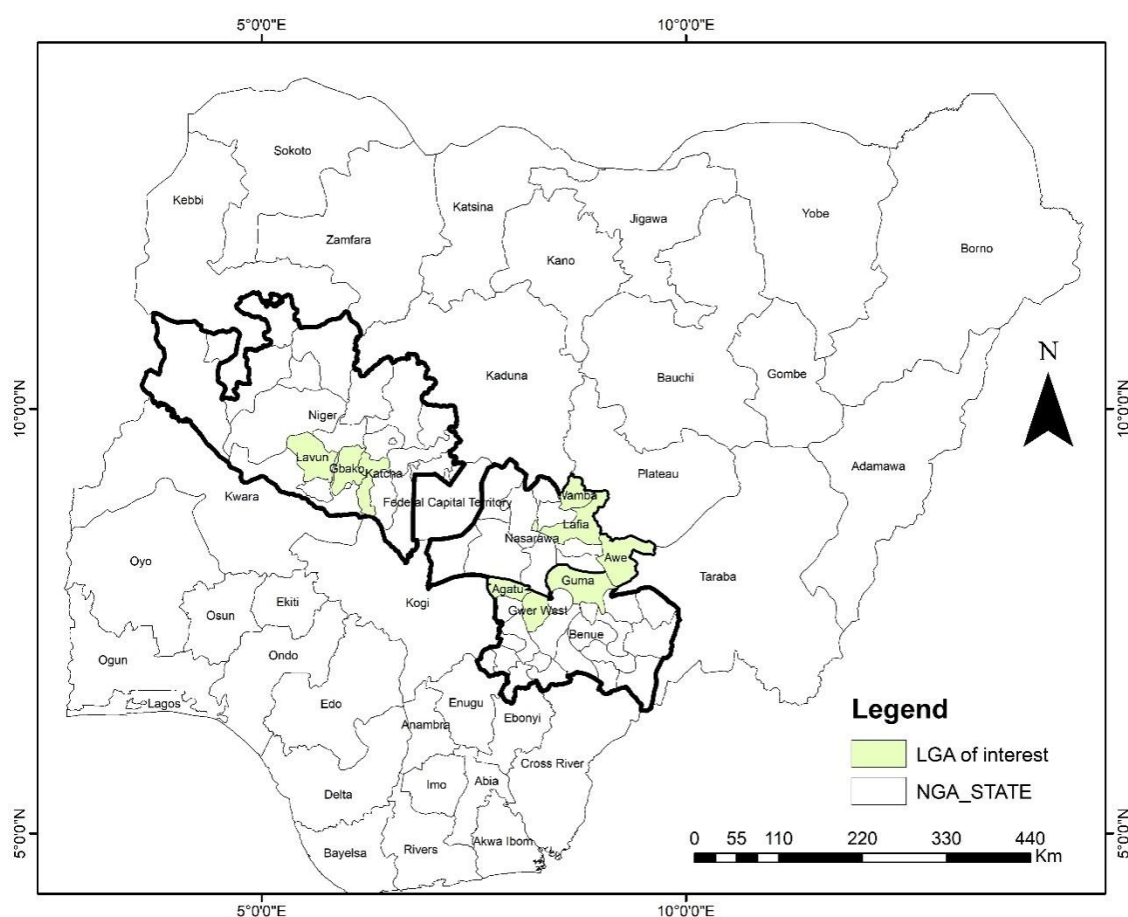
Sampling Technique and Sampling Size

A multistage cluster sampling technique was used to generate data for this study. The first stage was a purposive selection of 3 states out of six states in the North Central, namely Benue, Nasarawa, and Niger. These states were chosen based on the volume of rice produced in each state (Nigeria Bureau of Statistics, 2019). The second stage was also a purposive selection of three (3) local governments based on the dominance of female involvement in rice farming activities to give a total of 9

L.G.A.After that, five (5) communities from each of the local government areas were randomly selected to give a total of 45 communities in the study area. The final stage was also a random selection of 10 women rice farmers in the community to form a cluster in each community to give a total of 450 rice farmers for the study.

Data Collection

Cross-sectional data were collected from primary sources using a structured questionnaire that included both open-ended and closed-ended questions. The data focused on women rice farmers within the communities in the study area. During the field survey, the Open Data Kit (ODK) was used to gather information on socio-economic characteristics,Perceived effects of ICTs,preferred ICTs, and as well as constraints limiting the use of ICTs. To ensure the survey's validity and reliability, a pre-test was conducted with women rice farmers in Kogi and Plateu state. This pre-test helped to identify and clarify any ambiguities in the questions, refining the survey tool for the main study. Additionally, trained personnel with expertise in agricultural extension services and ICT were employed to assist with data collection. Their expertise ensured that respondents fully understood the questions, particularly those related to technology adoption, leading to more accurate and reliable data for the study.

Data analysis

Data were analyzed using a combination of descriptive and inferential statistics. Descriptive statistics, including frequency distributions and percentages, were employed to summarize the data. Principal component analysis was used to identify and analyze the constraints limiting ICT usage. Additionally, an inferential statistical method, specifically regression analysis, was applied to examine the significant influence of socio-economic variables on ICT usage among respondents. All analyses were conducted using the IBM Statistical Package for Social Sciences (IBM SPSS) software to ensure accuracy and consistency in the results.

Results and Discussion

Socioeconomic Profile of women rice farmers in the study area

Table 1 presents the socio-economic characteristics of women rice farmers in Benue, Nasarawa, and Niger States, revealing distinct patterns across the regions. The marital status of respondents shows that the majority (72%) are married, with Benue (78.7%) and Niger (76.7%) having the highest proportions. A smaller percentage of respondents are widowed (10.4%) or divorced (6%), while single women account for 11.6% of the sample.The age of respondents falls within the age range of 31 to 50 years. The average age across the states is 42 years, indicating that the majority of women farmers are middle-aged, contradicting the common perception that most farmers in sub-Saharan Africa are over 60 years old (Jöhr, 2012). Also, the result for education, reveals a significant number (42.9%) of the respondents have no formal education, particularly in Benue (48.7%) and Niger (45.3%). Primary education is the most common, with 43.3% of respondents, while secondary and tertiary education are less prevalent, with only 9.3% and 4.4% of women reaching these levels, respectively. Thetable also shows that most respondents have a household size of 4 to 6 members (40%), and 25.3% in larger households (7–9 members). In terms of farm size, 65.3% of respondents in Benue and 66.7% in Nasarawa has a farm size of 1.0–2.0 hectares, while 67.3% of women in Niger have slightly larger farms of 2.1–3.0 hectares. This aligns with the findings of Nkechi, Sennuga, and

Franklin (2022), who also noted the dominance of small-scale farming among women farmers in Northcentral Nigeria.

The table further reveals that the majority (78.2%) of respondents rely solely on farm income, while 21.8% combine both farming and non-farming activities as sources of livelihood. In terms of farming experience, most women (45.1%) have between 5 and 10 years of experience, with 28.9% having 11 to 15 years. A smaller percentage (14%) have less than 5 years of experience, indicating a generally experienced farming population. 77.8% of theThe table further reveals that the majority (78.2%) of respondents rely solely on farm income, while 21.8% combine both farming and non-farming activities as sources of livelihood. In terms of farming experience, most women (45.1%) have between 5 and 10 years of experience, with 28.9% having 11 to 15 years. A smaller percentage (14%) have less than 5 years of experience, indicating a generally experienced farming population. 77.8% of the respondents are members of farmer organizations, which likely enhance their access to resources and information. Membership is particularly high in Benue (85.3%) and Niger (93.3%), while Nasarawa has a lower membership rate of 54.7%. This reflects the importance of collective participation in improving agricultural activities.

Table 2: Socio-Economic Characteristics of Women Farmers in the Study Area

Variables	Benue		Nasarawa		Niger		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Marital Status								
Single	8	5.3	28	18.7	16	10.7	52	11.6
Married	118	78.7	91	60.7	115	76.7	324	72.0
Divorce	2	1.3	15	10.0	10	6.7	27	6.0
Widow	22	14.7	16	10.7	9	6.0	47	10.4
Age (years)								
< 21	10	6.7	8	5.3	13	8.7	31	6.9
21 – 30	15	10.0	27	18.0	29	19.3	71	15.7
31 – 40	41	27.3	50	33.3	35	23.3	126	28.0
41 – 50	55	36.7	35	23.3	43	28.7	133	29.6.
> 50	29	19.3	30	20.0	30	20.0	89	19.8
Mean		43.0		42.30		41.49		42.0
Education Level								
No formal education	73	48.7	52	34.7	68	45.3	193	42.9
Primary	34	22.7	83	55.3	78	52.0	195	43.3
Secondary	30	20.0	10	24.6	2	1.3	42	9.3
Tertiary	13	8.7	5	6.7	2	1.3	20	4.4
Household Size								
1-3	33	22.0	34	22.7	19	12.7	86	19.1
4- 6	75	50.0	64	42.7	41	27.3	180	40.0
7 – 9	26	17.3	27	18.0	61	40.7	114	25.3
10-12	11	7.3	23	15.3	25	16.7	59	13.1
> 13	5	3.3	2	1.3	4	2.7	11	2.4
Farm Size (Ha)								
< 1	39	26.0	42	28.0	20	13.3	101	22.4
1.0 – 2.0	98	65.3	100	66.7	28	18.7	226	50.2
2.1 – 3.0	11	7.3	5	3.3	101	67.3	117	26.0
3.1 – 4.0	2	1.3	3	2.0	1	0.7	6	1.3
Source of Income								
Farm income	138	92	118	78.7	96	64.0	352	78.2
Farm and non-farm income	12	8	32	21.3	54	36.0	98	21.8
Years of Farming Experience								

< 5	22	14.6	16	10.7	25	16.7.	63	14
5 - 10	63	42.0	70	46.7	70	46.7	203	45.1
11 – 15	38	25.3	47	31.3	45	30.0	130	28.9
16 – 20	19	12.7	10	6.7	7	4.7	36	8.0
> 21	8	5.3.	7	4.6	3	2	18	4.0
Membership							
No	22	14.7	68	45.3	10	6.7	100	22.2
Yes	128	85.3	82	54.7	140	93.3	350	77.8

Sources: Field survey, 2024

Socio-economic Factors Influencing the Use of ICTs in Northcentral Nigeria

The regression analysis on socio-economic factors influencing ICT by rural women in Northcentral revealed a Pseudo R² value of 0.1552, indicating that the factors studied can explain 15.52% of the variation in ICT use. Significant factors included marital status, education, farming experience, household size, and cooperative membership. Marital status (0.293) had a positive, significant influence at 1%, showing that married women were more likely to use ICT. Educational qualification (0.249), also positive and significant at 1%, indicated that formal education increased ICT adoption. Farming experience (-0.013) was significant at 5% but negatively related to ICT use, implying that more experienced farmers tend to use ICT less. Household size (0.031) was positively associated with ICT use, with larger households adopting more. However, cooperative membership (-0.707) had a negative impact, suggesting that women in cooperatives rely more on information from their group, reducing their need for ICT. This means that, on average, member of a cooperative is associated with lower use of ICT compared to not being a member. This could result from the fact that women who are members of cooperative societies have access to information on agricultural practices through their association, hence, their use of ICT is limited. This is in line with Ojoko, Akinwunmi, Yusuf, & Oni (2017) who found that membership in social societies influences the use of CSAP by farmers.

Table 3: Logit regression resultsofSocio-Economics Factors Influencing the Use of ICT by Women Farmers In North central state

Variable	Coef.	Std.Err.	t-value	P>|t|
Marital status	0.293	0.038	7.710 ***	0.000
Age	0.005	0.005	1.100	0.271
Educational Qualification	0.249	0.045	5.533***	0.000
Farmers' experience	-0.013	0.006	-1.970**	0.049
Household size	0.031	0.009	3.260***	0.001
Farm size	-0.139	0.222	-0.630	0.530
Farm income per anum	0.000	0.000	0.670	0.503
Nonfarming income per annum	0.000	0.000	0.530	0.596
Membership of cooperatives	-0.707	0.098	-7.210 ***	0.000
Amount	0.000	0.000	0.420	0.678
Constant	2.608	0.246	10.610	0.000
Number of obs			**450**	
LR chi2(11)			**197.76**	

Prob> chi2	**1%0.000**
Pseudo R2	**0.1552**
Log likelihood	**-538.177**

Source: Field survey, 2024

ICT Preference among Women Rice Farmers in Northcentral

The study reveals that mobile phones,Public address sytem and radio are the most preferred ICT tools among women rice farmers in Benue, Nasarawa, and Niger States. In Benue, mobile phones scored the highest preference (2.86) and Radio (2.6). Nasarawa farmers primarily used public address systems (2.9), followed by radio (2.7) and mobile phones (2.5), Similarly, in Niger, mobile phones (2.7) and radio (2.6) were most used, while tools like televisions (0.7), projectors (0.6), and laptops (0.04) were less common across the state .The widespread use of mobile phones and radio reflects their effectiveness in delivering information, this is consistent with Aker and Mbiti (2010), who noted the rapid growth of mobile phone use in Africa. This also supports findings by Waverman*et al.* 2015) and Oyelaran-Oyeyinka and (Adeya, 2004), who highlighted the importance of these tools in rural information dissemination and economic development.

Table 4.23: ICT Preference among Women Rice Farmers in the Study Area

ICT Types (Benue)	Very Rare (%)	Rare (%)	Often (%)	Always (%)	Mean Score	Not in Use	Decision
MOBILE	4(3)	31(21)	69(46)	39(26)	2.86	15(10.0)	High
Radio	11(7)	1(1)	47(31)	60(40)	2.6	27(18.0)	High
Television	80(53)	11(7)	10(7)	9(6)	1.1	39(26.0)	Low
lab top	32(21)	14(9)	0(0)	0(0)	0.4	104(69.3)	Low
Projector	40(27)	45(30)	10(7)	10(7)	1.3	45(30.0)	Low
Public Address System	40(27)	5(3)	25(17)	10(7)	1.1	70(46.7)	Low
Decision: Weighted average = 1.56							
ICT Types (Nasarawa)							
MOBILE	10(7)	9(6)	35(23)	61(41_	2.5	17(11.3)	High
Radio	5(3)	6(4)	8(5)	92(61)	2.7	38(25.3)	High
Television	67(45)	20(13)	11(7)	9(6)	1.2	46(30.7)	Low
lab top	37(25)	2(1)	8(5)	0(0)	0.4	81(54.0)	Low
Projector	17(11)	16(11)	17(11)	20(13)	1.2	80(53.3)	Low
Public Address System	11(7)	17(11)	42(28)	68(45)	2.9	37(24.7)	High
Decision: Weighted average = 1.81							
ICT Types (Niger)							
MOBILE	6(4)	10(7)	44(29)	60(40)	2.7	30(20.0)	High
Radio	5(3)	20(13)	99(66)	12(8)	2.6	14(9.3)	High
Television	10(7)	4(3)	6(4)	18(12)	0.7	105(70)	Low
lab top	4(3)	1(1)	0(0)	0(0)	0.04	145(96.4)	Low
Projector	58(39)	0(0)	9(6)	0(0)	0.6	62(41.3)	Low

Public Address System	18(12)	18(12)	25(17)	40(27)	1.93	49(32.7)	High

Decision: Weighted average = 1.42

ICT TYPE (Northcentral)

Mobile	20(4)	50(11)	148(33)	160(36)	2.7	62(13.8)	High
Radio	21(5)	27(6)	154(34)	164(36)	2.7	79(17.6)	High
Television	304(68)	35(8)	27(6)	36(8)	1.0	190(42.2)	Low
Laptop/tablets	73916)	17(4)	8(2)	0(0)	0.3	330(73.3)	Low
Projector	115(26)	61(14)	36(8)	30(7)	1.0	175(38.9)	Low
Public Address System	69(15)	40(9)	92(20)	118(26)	1.99	156(34.7)	High

Decision: Weighted average = 1.62

Source: Field survey, 2024.Where 1=Very Rare,2= Rare,3 =often, 4 =Always

Perceived Effects of ICTs among women farmers in North central Nigeria

The findings in Table 4 reveal that over 50% of respondents across Benue, Nasarawa, and Niger states affirmed the positive impact of ICT in various areas. Women rice farmers perceive ICT as significantly enhancing decision-making, providing real-time access to information, improving knowledge sharing, facilitating access to agricultural inputs, supporting government and extension services, reducing the male-female digital divide, and increasing awareness of agricultural events and news. However, certain benefits, such as increased market access, improved record-keeping, and access to financial services, were less frequently acknowledged, with rates below 50%. This suggests that these ICT benefits may be less impactful for the women farmers in these states. Overall, the study concludes that rural women rice farmers have embraced ICT positively, consistent with findings from other studies, such as Singh, Tewari, and Verma (2018), which also reported that rural women have positively adopted ICTs.

Table 4 Perceived Effects of ICTs in Northcentral

Perceived Effects of ICTs	Benue Frequency	%	Nasarawa Frequency	%	Niger Frequency	%
Improved Decision-Making	139	92.7	123	82.0	78	52.0
Real-Time Access to Information	89	59.3	111	74.0	88	58.8
Enhanced Knowledge Sharing	87	58.0	97	64.7	102	68.0
Increased Market Access	57	38.0	71	47.3	45	30.0
Improves access to agricultural inputs	133	88.7	145	96.7	100	66.7
Access to Financial Services	55	36.7	99	66.0	58	38.7
Facilitation of Government and Extension Services	89	59.3	120	80.0	77	51.3
Reduced male-female digital divide	124	82.7	146	97.3	86	57.3
Improves awareness of agricultural events and news	136	90.7	117	78.0	102	68.0
Improves record-keeping	47	31.3	69	46.0	55	36.7

Source: Field survey, 2024

Constraints limiting the use of ICTs among women rice farmers

Table 5, presents the results of a principal component analysis (PCA) examining the constraints faced by women rice farmers in using ICT for agricultural practices. The analysis grouped the most significant constraints across the three states. The results show that components 1, 2, 3, and 4 have eigenvalues greater than 1, indicating that the thirteen variables analyzed are primarily explained by two key components. These two components account for 63.345% of the variance, effectively capturing the relationships among the variables.

Table 6 provides further insights through the rotated component matrix, where variables with a coefficient $\geq$ 0.50 were considered significant, as suggested by Akintobi and Aimienoho (2020). Component 1 constraints are quality and relevance of information (-0.759), limited expertise on agricultural practices (-0.758), gender and social disparities (0.717), language barriers (0.668), and socio-economic disparities (-0.083). While Component 2 is defined by poor network connectivity (0.803), high costs of ICT tools and data (0.795), and limited training and supervision (0.795).These findings align with previous studies, such as Fadiji (2017), Ekwe, Uche-Mba, and Akinnagbe (2018), and Mamun-ur-Rashid (2020), which also identified high costs of ICT tools, data, and language barriers as major challenges faced by smallholder farmers in accessing climate-smart agricultural information, particularly in Bangladesh's coastal regions.

Table 6 Principal Component Analysis of the Constraints to women Rice Farmer's use of ICTs

Component	Total	% Of Variance	Initial Eigenvalues Cumulative %	Extraction total	The sum of square% Variance
1	2.459	18.915	18.915	2.459	18.915
2	1.991	15.312	34.227	1.991	15.312
3	1.547	11.896	46.124	1.547	11.896
4	1.231	9.466	55.590	1.231	9.466
5	1.008	7.755	63.345	1.008	7.775
6	0.917	6.335	70.402	-	
7	0.824	6.158	76.737		
8	0.801	5.395	82.895		
9	0.701	4.039	88.290		
10	0.525	3.269	92.329		
11	0.425	2.381	95.598		
12	0.309	2.021	97.979		
13	0.263	2.021	100.00		

Approx.Chi-Square =1166.0
Berletts Test of sphericity significance at 1 %

Source: Field survey, 2024

Table 6 Rotated Component Matrix

Constraints	1	2
Limited Access to Technology	0.258	0.192
Insufficient/ reliable electricity supply to power ICT devices	0.252	0.192
Poor network Connectivity	0.246	0.803
High costs associated with accessing ICT tool data buying	-0.017	0.795
Inadequate information on climate change	0.023	0.37
Quality and relevance of information	-0.759	0.395
Lack of ICT Skills	0.135	0.098
Limited expert on CSAP	-0.758	0.323
Limited training support and supervision	0.048	0.271
Gender and social disparities	0.717	0.288
Language Barriers	0.668	0.354
Data Privacy and Security Concerns	-0.207	0.081
Socio Economic Disparities	-0.083	0.18

Source: Field survey, 2024

Conclusion

The study provides critical insights into the use of ICT in transforming agricultural practices among rural women rice farmers in Northcentral, Nigeria. The findings affirm the significant influence of ICT in enhancing productivity, decision-making, and access to essential resources. Socio-economic factors such as marital status, education, household size, and educational attainment emerged as significant drivers of ICT utilization. The research outcome revealed that socio-economic factors such as marital status, education, household size, and educational qualification positively influence the use of ICT. However, cooperative membership was found to have a negative effect on ICT use, suggesting that women in cooperatives may rely more on traditional information sources, reducing their need for digital tools. ICT use among rural farmers has been shown to deliver tangible benefits across the states. With more than50% of respondents reported improved decision-making and access to financial services, enhanced knowledge sharing, and experienced better access to agricultural inputs. which are key factors in optimizing farm outputs. The study also outlines that, public address systems, mobile phones, and radios remain the dominant ICT tools, with a notable underutilization of more advanced technologies, highlighting existing gaps. The study ascertained factors limiting women's rice farmers' use of ICTs with Key constraints including poor information quality and limited access, suggesting a need for improved climate information dissemination and ICT infrastructure.

Recommendations

The following recommendations were made based on the findings and the conclusions of the study:

1. Policymakers should consider creating specific policies that support the digital inclusion of rural women in agriculture. These policies should focus on reducing barriers to ICT adoption, ensuring that women farmers are at the center of digital agricultural initiatives, and promoting gender-sensitive approaches to ICT development.

2. Government and relevant Agricultural agencies should focus on improving the accuracy, relevance, and timeliness of agricultural information shared through ICT channels. This includes disseminating up-to-date climate information, market trends, and best farming practices through platforms that rural women can access easily.

3. Government should Improve Digital Literacy and Training Programs**.** Given the influence of education on ICT adoption, targeted digital literacy training should be developed for rural women farmers, particularly for those with lower education levels. These programs should focus on practical skills, helping farmers understand and effectively use more advanced ICT tools for agricultural practices, financial services, and information access.

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