



Utilization of Information and Communication Technologies (ICTs) among Women Farmers in North-Eastern Nigeria

Mudashir Adeola Olaitan^{1*}, Joseph Bamidele², Oluwamayowa Joseph Joel³, Blessing Anthonia Akor⁴ and Ayoola Faith Joel³

¹Department of Agricultural Extension and Rural Sociology, Faculty of Agriculture, University of Abuja, FCT, P.M.B. 117, Abuja, Nigeria.

²Faculty of Business and Law, University of Northampton, Waterside Campus, University Drive, Northampton NN1 5PH, United Kingdom.

³Communication for Development Centre, AMAC Estate, Airport Road, Abuja, Nigeria.

⁴National Biotechnology Research and Development Agency, Umaru Musa Ya'adua Way, Lugbe, Airport Road, Abuja. Corresponding author email: adeolaitan2000@yahoo.com

ABSTRACT

This research focused on evaluating the utilization of ICTs by women farmers in North-Eastern Nigeria. A multi-stage sampling method, which included both purposive and simple random sampling techniques, was used to select 359 women farmers for the study. Primary data were gathered and analysed using descriptive and inferential statistics to meet the study's objectives. The majority of respondents (78.0%) were married, with a mean age of 41 years. Most of the respondents (52.5%) were involved in trading, and the average farm size was 3.4 hectares. Additionally, 88.3% had a high social participation score, and 51.7% and 58.9% were aware of old and new ICTs, respectively. Majority of the participants benefited from access to information on fertilizer sources and application (74.9%), credits, grants, and loans (70.8%), market rates and locations (63.1%), and crop pests, diseases, and control (62.1%) through the use of ICTs. Most of the respondents faced several constraints: high cost of gadgets (73.5%), insufficient time allotted to agricultural programmes (73.5%), lack of or inadequate ICT infrastructure (62.3%), expensive power/electricity prices (61.3%), defective equipment (57.8%), and multiple responsibilities of women farmers (54.3%). The regression analysis showed that age, marital status, religion, farm size, household size, and occupations did not significantly affect ICT utilization. However, educational attainment, participation in social organizations, and awareness were significant factors influencing the use of ICTs among women farmers. Based on these findings, it was recommended that the Federal Government of Nigeria should prioritize the establishment of essential infrastructure aimed at promoting and facilitating the utilization of ICTs among women farmers.

Keywords: Women farmers, Information and Communication Technologies (ICTs)

Article information

Received 2 July 2024;

Accepted 1 August 2024;

Published 14 August 2024

DOI: <https://doi.org/10.26765/DRJAFS072693541>

Citation: Olaitan, M. A., Bamidele, J., Joel, O. J., Akor, B. A. & Joel A. F. (2024). Utilization of Information and Communication Technologies (ICTs) Among Women Farmers in North-Eastern Nigeria. *Direct Research Journal of Agriculture and Food Science*. Vol. 12(2), Pp. 253 -262.

<https://doi.org/10.26765/DRJAFS072693541>. This article is published under the terms of the Creative Commons Attribution License 4.0.

INTRODUCTION

Globally, women in agriculture are playing a significant role in food production. According to the United Nations Report on the status of the world's women (2019), women are twice as likely as men to be involved in agricultural activities. In sub-Saharan Africa, about 90% of rural women participate in farming. They undertake over 70% of agricultural production tasks, manage all aspects of food processing and utilization, and handle half of the storage and marketing activities (Nwosu and Akintola, 2021). Women farmers are active in both rural and urban areas, engaging in diverse income-generating activities such as food processing, marketing, collecting and selling non-timber forest products, and crafting, all aimed at supporting their families and improving their living standards (Abdulahi *et al.*, 2023; Olaitan *et al.*, 2024).

The scenario in Nigeria mirrors this global trend. According to National Bureau of Statistics (2020), women make up roughly 60% of the farming population and perform up to 70% of the actual agricultural labour. In the ten stages of the food production chain—land clearing, harrowing, planting, weeding, harvesting, transportation, processing, distribution, marketing, storing, and cooking—only the initial two stages are predominantly managed by men. Women take charge of the subsequent stages and oversee approximately 70% of the remaining activities, all while balancing their regular domestic responsibilities. This highlights the indispensable role of women farmers in Nigeria in advancing agricultural development and ensuring food production (Ameh *et al.*, 2023; Adeyemi *et al.*, 2023).

Despite their significant contributions to food production across both rural and urban areas of Nigeria, women farmers historically have not been recognized as productive. Adeboye (2022) explains that this perception stemmed from women typically working as unpaid family labour, with their contributions not economically quantified. Consequently, women farmers have faced marginalization and have had limited access to crucial production resources such as fertile land, credit, extension services, and technology. This underscores the importance of leveraging Information and Communication Technologies (ICTs) to empower women farmers by providing them with essential information to enhance their productivity. Globally, there are many stories demonstrating how ICTs have transformed societies and improved the livelihoods of marginalized groups. Therefore, women farmers many of whom reside in rural areas and are responsible for feeding their families (Okoye, 2020), can capitalize on ICT opportunities to access information on improved agricultural practices. This access can help them increase their agricultural output, thereby meeting the growing food demands driven by population growth and urbanization (Iliyasu *et*

al., 2023; Olaitan *et al.*, 2024). Eze and Okeke (2021) characterize Information and Communication Technologies (ICTs) as a diverse range of electronic technologies that, when creatively combined, are adaptable, flexible, and transformative, capable of reshaping social relationships and organizational structures. The spectrum of ICTs continues to expand, with a convergence occurring between new media—such as computers, mobile phones, and the internet—and traditional media, including radio, television, telephone, newspapers, and extension bulletins. Obasi (2022) views ICTs as a collection of technologies, both new and old, that facilitate human and digital communication. They highlight the benefits of merging these media types for women, citing devices like phones with radio capabilities, media centers with computing functions, and digital televisions. In essence, ICTs encompass the use of radio, video, telephone, computer-based technologies, and the internet to deliver information and communication services to users (FAO, 2020). The strength of ICTs lies in their ability to integrate old and new technologies seamlessly. Amadi and Ugwu (2023) observe that even books are now part of ICTs through web publishing or digital formats like dedicated e-readers or e-books. Hence, ICTs represent a growing array of technologies utilized for gathering, storing, and disseminating information across various devices and media platforms (Sennuga *et al.*, 2023; Olaitan *et al.*, 2024).

The effectiveness of Information and Communication Technologies (ICTs) in addressing various developmental challenges hinges significantly on their convergence and the quality of the content they deliver. Convergence is powerful because it recognizes that no single medium is inherently superior; rather, combining multiple media often proves more effective and efficient than relying on any one alone, regardless of its capabilities. The quality of content is equally crucial. When ICTs are equipped with relevant and meaningful messages, they become powerful tools for communication and information dissemination. Therefore, ICTs have the ability to greatly enhance information sharing among small-scale farmers if deployed effectively. In this study, ICTs are defined broadly to GSM-phones, television; encompass radio, newspapers, telephone, video, the internet, extension bulletins and computer-based technologies. Each of these mediums plays a role in facilitating communication among users, highlighting the diverse and interconnected nature of ICTs in supporting development initiatives (Sennuga *et al.*, 2023).

As contributors to farming activities, women play an essential role in providing food for their families. However, their involvement extends beyond farming, as women in the area are also engaged in marketing, gathering non-timber forest products, and crafting.

Despite the significance of women's participation in agricultural production and household management, they often do not have access to dependable and thorough information regarding contemporary agricultural methods that could enhance their efficiency and overall well-being. This information gap is often linked to disparities in access to economic and political resources (Okwu and Obasi, 2022; Olaitan *et al.*, 2024). Therefore, it is imperative to empower women by granting them access to information on advanced agricultural methods. Women farmers require information across various aspects of agricultural production, including marketing crop and animal farming, input procurement, processing, post-harvest management, and storage, among others.

The traditional extension approach for disseminating information on enhanced agricultural practices primarily relies on face-to-face training and instructional methods. However, these traditional approaches frequently do not adequately tackle the difficulties encountered by female farmers. These challenges include their limited uptake of technologies, demanding workloads, insufficient access to education and training, and busy schedules managing multiple tasks (Achukwu *et al.*, 2023). Additionally, the current extension system has limited reach, with a scarcity of female agricultural extension agents available to assist the majority of Nigerian women farmers, many of whom live in remote and hard-to-access rural regions. Consequently, effectively delivering agricultural extension services to most women farmers becomes a significant challenge. Therefore, it is crucial to devise novel methods for conveying information about enhanced agricultural techniques to a broader spectrum of female farmers, irrespective of their geographical settings. This highlights the significance of incorporating Information and Communication Technologies (ICTs) into the distribution of agricultural knowledge to female farmers. ICTs present an opportunity to disseminate extensive information to rural communities and extension service agencies in a more prompt, thorough, and economical fashion (Sennuga, 2023; Olaitan *et al.*, 2024).

However, research conducted by Kwatsha and Okoh (2020), Adeniyi and Arimi (2021), Chukwu and Nwosu, (2023), and Oluwatobi, Adewale and Ifeoma (2022) has indicated notwithstanding the potential of ICTs to gather, process, and distribute information among agricultural stakeholders interactively, women farmers, who bear primary responsibility for agricultural activities, face barriers in accessing ICTs.

Even among those who have access, there is variability in usage patterns. This indicates that women farmers in North-Eastern Nigeria likely encounter challenges in accessing ICTs. Such restricted access and uneven usage exacerbate the disparity in information, leading to a digital division, while ICT use remains marginal. Consequently, to improve access to agricultural information among women farmers, it is imperative to

assess their ICT use by investigating their subjective norms, behavioural control, and past experiences. With this context, the study aims to achieve the following specific objectives, which are to:

- (i) Describe the socio-cultural characteristics of women farmers in the study area.
- (ii) Ascertain the awareness of ICTs among women farmers in the study area.
- (iii) Determine the factors that affect use of ICTs among women farmers in the study area.
- (iv) Assess the benefits and constraints experienced by women farmers in the use of ICTs in the study area.

LITERATURE REVIEW

Theoretical Framework

The study is grounded in behaviour theories, particularly focusing on their predictive capacity and their influence on behaviour towards specific objects, events, or individuals. These theories aim to anticipate the reasons behind individuals' behaviours in particular situations. Specifically, the study draws from the theories of reasoned action and planned behaviour to understand and predict behavioural patterns.

Theory of reasoned action

The theory of reasoned action offers a structure for examining behaviours associated with technology usage. As outlined by Ajzen and Fishbein (1980), the key predictor of an individual's behaviour is their behavioural intention. This intention to engage in a specific behaviour is shaped by two primary factors: the individual's attitude towards engaging in the behaviour and the impact of influential individuals in their lives. The individual's attitude toward the behaviour comprises their behavioural beliefs and the evaluation of the outcomes of that behaviour, while subjective norms encompass normative beliefs and the willingness to adhere with those norms. A person's conduct (in this scenario, engagement with a technology) is influenced by belief regarding the likely outcome and their evaluation of said outcome. If the individual sees the technology's outcome as advantageous, they will harbour a positive outlook on its use; conversely, if they view the outcome as disadvantageous, their attitude toward the technology will be negative.

Theory of planned behaviour

Ajzen (1985) formulated the theory to forecast behaviour in scenarios where individuals have limited control. The theory of planned behaviour introduces a third factor to behaviour prediction: perceived behavioural control. This

encompasses one's proficiency in utilizing the technology, alongside the other factors elucidated in the theory of reasoned action. Perceived behavioural control refers to an individual's sense of capability in executing a specific behaviour. It primarily relates to one's capacity to afford technology usage when needed and their confidence in performing or refraining from the behaviour. This elucidates the level of confidence a woman farmer, for example, has in her capability to utilize the technology.

Conceptual framework

The model depicted that the socioeconomic and institutional traits of women farmers can directly affect their adoption of ICTs. The utilization of ICTs, serving as the dependent variable, gauges the frequency and efficacy of extension agents' use of these technologies in their tasks. Independent variables, including education age, marital status, farm size, religion, household size, occupations and organizational involvement, also considered, directly influencing the level of ICT usage. Intervening variables, such as ICT network coverage, government policies on ICTs, and existing ICT infrastructure, act as mediators in the correlation between the independent variables and the dependent variable.

MATERIALS AND METHODS

Study area

The research was conducted in North-Eastern Nigeria, comprising six states: Adamawa, Borno, Gombe, Bauchi, Taraba, and Yobe. This region experiences an annual rainfall ranging from 750 mm to 1550 mm, with a rainfall duration of three to six months per year. The wettest months are typically August and September, while February and March are the driest, with a relative humidity of around 13% (Adamu and Akinyemi, 2020). Geographically, the area lies between latitude 7° 28'N and 10° 55'N of the Equator and longitude 11° 30'E and 13° 45' E of the Greenwich Meridian. The region's population was estimated to be 23,168,101 people according to the National Population Census (NBS, 2021).

Agriculture serves as the primary source of income for the majority of the population, mainly through traditional subsistence farming practices. As outlined by Ibrahim and Mohammed (2021), the predominant crops cultivated in the region include millet, groundnut, maize, sorghum, rice, yam, cowpea, soybeans, sesame, cassava, cotton, and sweet potato. Furthermore, during the dry season, there is intensive cultivation of vegetables such as carrots, tomatoes, spinach, garden egg, onion, and okra, among others. Alongside crop cultivation, some farmers engage in livestock rearing, including cattle, goats,

sheep, pigs, and poultry.

Population of the study and research design

The study population consists of women farmers residing in North-Eastern Nigeria, spanning across the states of Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe. This diverse population ensures that the research encompasses a broad perspective on the utilization of Information and Communication Technologies (ICTs) among women farmers in the region. The research methodology chosen for this study is a descriptive survey, aimed at systematically collecting data on the utilization of Information and Communication Technologies (ICTs) among women farmers. This method is particularly suitable for capturing the opinions, attitudes, and behaviours of a substantial population, thereby laying a robust foundation for identifying trends and patterns. Through this approach, the study endeavours to offer comprehensive insights into the current state of ICT integration among women farmers in North-East Nigeria.

Sample size and sampling techniques

In the north-eastern region of Nigeria, there are six states, each containing an equal probability of selection. However, for the purpose of this research, two states will be chosen randomly to ensure a thorough representation of the area. This method of selection is designed to encompass diverse geographical regions within the states effectively. To identify women farmers, a multi-stage sampling method will be utilized. Initially, two states were purposefully selected from the North-East region for data collection, chosen due to their significant population of women farmers. This deliberate sampling strategy ensures that the chosen states adequately reflect the various circumstances of extension service provision in both rural and urban settings within the region. The selected primary states are Adamawa and Bauchi, jointly comprising more than 70% of the women farmers in the area.

Once the states are identified, we'll use a simple random sampling technique to choose the women farmers. This approach is crucial for preserving the statistical validity of the sample, ensuring that each woman farmer in the selected communities has an equal opportunity to participate in the study. To accomplish this, we'll employ a random number generator to select a sample of three hundred and fifty-nine (359) respondents.

Data collection

The primary instrument used for data collection in this study was a structured questionnaire. These surveys were conducted to collect data, with each session lasting

around 1 hour and 15 minutes. The primary themes investigated in the questionnaire covered the socio-cultural and institutional attributes of women farmers, their awareness of ICTs, their attitudes toward ICT usage, factors influencing their ICT usage, as well as the perceived benefits and constraints associated with ICT usage. To ensure the validity and reliability of the questionnaire, it underwent a pre-test during a pilot study. This preliminary assessment involved 40 female farmers chosen from Kaltungo Zone in Gombe State, an area not included in the primary main sample. Through this pilot study, any ambiguities or concerns with the questionnaire were identified, allowing for adjustments to improve its effectiveness and clarity.

Data analysis

The gathered data was analyzed utilizing descriptive statistics, encompassing percentages, frequency counts, and means presented in tables. Additionally, inferential techniques, like the logit regression model, were applied. Goals (i), (ii), (iii), and (v) were addressed through descriptive statistics, while objective (iv) was fulfilled via the logit regression model. Data analysis was facilitated by the Statistical Package for the Social Sciences (SPSS) version 24.

Model specification

Logit regression model

A logistic regression model was employed to ascertain the factors influencing the utilization of ICT by women farmers in the study area. The regression equation is represented as:

$$Y = f(X_1, X_2, X_3, X_4, X_6, X_7, X_8, X_9)$$

The Logit model in its explicit form is expressed as:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + e$$

Where;

Y = Women farmers' utilization of ICTs

e = Regression constant

X1 = Age

X2 = Marital status

X3 = Religion

X4 = Household size

X5 = Occupation

X6 = Farm size

X7 = Level of education

X8 = Membership of organizations

X9 = Awareness

RESULTS AND DISCUSSION

Socio-cultural characteristics of respondents

The findings showed in (Table 1) reveal that a significant portion (43.5%) of female farmers fell within the age bracket of 41 to 50 years, with 35.0% falling between 31 and 40 years, and only 11.5% aged above 50 years. This pattern in demographics was consistent across both rural and urban areas, indicating a predominant age range of above 40 but below 50 among women farmers. The average age of respondents was calculated at 41 years. Supporting this observation, Oluwatobi *et al.* (2022) noted the proactive participation of female farmers aged 31 to 50, which presents an advantageous situation for technological awareness and adoption. Adeyemi (2020) further suggests that younger and more active women farmers tend to favor adaptation compared to their older counterparts, who typically prefer maintaining the status quo. Consequently, this underscores the greater participation of younger women in agricultural endeavours compared to their older counterparts.

The findings in (Table 1) indicate that the majority of respondents (78.0%) were married, while 5.0%, 0.5%, and 16.5% were divorced, widowed, and single, respectively. This outcome aligns with the conclusions drawn by other researchers. Okeke (2022), Alabi (2021), and Chukwu and Nwosu (2020) all reported a predominance of married women among farmers. This underscores the significance women farmers attach to marriage, because it is seen as bestow respect and strengthen family bonds. Moreover, women engage in farming because they shoulder responsibility not just for themselves but also for the well-being of other household members. Consequently, these women often depend on their spouses and children for essential farming resources such as labour, land, and knowledge of enhanced agricultural practices.

The information provided in (Table 1) illustrates that over half of the respondents (58.5%) have finished high school, while 11.1%, 9.7%, and 2.8% have tertiary education. Various scholars, including Okeke (2022), Adeyemi, Bello and Salawu, (2021), and Ogunsanya, Bello and Olatunde (2023), have previously reported that the majority of women farmers have limited or no formal education. However, this study's findings contradict these assertions, revealing that most women farmers are educated, albeit predominantly at the primary school level. Similarly, Alabi (2021) discovered that 52.0% of women farmers in southwest Nigeria have received formal education, with 53.2% of them not progressing beyond primary school. This variance may be attributed to the fact that the current generation of women farmers largely benefitted from the Universal Primary Education (UPE) initiative launched in 1978, which is a mandatory primary education for school-age children.

Table 1: Socio-Cultural Characteristics of Respondents (n = 359).

Characteristics	Frequency	Percentage (%)	Mean
Respondents' age (years)			41 years
21-30	36	10.0	
31-40	126	35.0	
41-50	157	43.5	
51-60	20	5.5	
Above 60	20	6.0	
Marital status			
Single	59	16.5	
Married	280	78.0	
Divorced	18	5.0	
Widowed	2	0.5	
Educational Level			
No education	10	2.8	
Adult/Quranic education	18	5.0	
Primary education	36	10.0	
Secondary education	210	58.5	
NCE/OND	35	9.7	
B.Sc/HND	40	11.1	
M.Sc	10	2.8	
Religion			
Christianity	301	96.0	
Islam	57	3.5	
Traditionalist	1	0.5	
Household size			8persons
1-6	111	30.0	
7-12	193	53.8	
13 and above	55	16.2	
Secondary occupation		31.5	
Civil service	117	52.5	
Trading	191	16.0	
Private employed	51	28.9	
Farm size (hectares)		63.2	
0 - 1 ha	104	4.8	
1 - 3 ha	227	3.4	
3.1 - 6 ha	17	hectares	
> 6 ha	11	3.1	
Membership of social organizations			
No	54	11.7	
Yes	305	88.3	

Source: Field survey, 2024

The findings presented in (Table 1) demonstrate that the majority of women farmers (96.0%) identify as Christians, with 3.5% identifying as Muslims and 0.5% as traditionalists. This outcome supports Okwu and Obasi (2022) assertion that religious beliefs and principles often significantly influence people's lifestyles and occupations. Such religious affiliations could potentially impact the attitudes of women farmers towards the adoption of technology, particularly concerning practices related to behavioural change.

Table 1 data indicates that a majority of households (53.8%) consist of 7 to 12 individuals, with 30.0% having 1 to 6 members and 16.2% comprising 13 or more members. On average, households include 8 individuals. These findings correspond with the most frequent household sizes of 6 and 10 identified by Okoro and Adebayo (2021) in their research on women farmers in southwest Nigeria. Household size, alongside income, significantly influences the well-being and access to innovative ideas and technology among its residents. The information provided in (Table 1) reveals that the

predominant occupation among the surveyed population is trading business, accounting for 52.5%, while 31.5% are engaged in civil service and 16.0% in private employment. This aligns with the perspective of that Ogunsanya *et al.* (2023), who noted women farmers are often involved in various activities beyond farming, which enables them to generate additional income and other benefits, thereby supporting their families and enhancing their overall well-being.

The results from (Table 1) demonstrate that a significant portion of women farmers (63.2%) own farms ranging from 1 to 3 hectares. Additionally, 28.9% cultivate plots smaller than one hectare, 4.5% manage farms between 3.1 and 6 hectares, and 3.1% oversee holdings larger than six hectares. The average farm size was calculated at 3.4 hectares. This aligns with Okoro and Olayinka (2020) suggestion that this distribution may stem from intense competition for land in urban areas and the limited access women farmers have to larger land holdings. Another possible explanation could be that women farmers in urban settings are engaged in additional activities that consume much of their time, thereby restricting their capacity to manage larger farm plots.

The findings depicted in (Table 1) indicate that significant proportions (88.3%) of the participants were affiliated with social organizations. These results imply that women farmers engage actively in social group activities. This inference arises from the observed correlation between participation in social groups and various advantageous characteristics, as noted by Adetunji and Onigbinde (2022).

Women farmers' awareness of ICTs

The data showed in (Table 2) indicates that nearly all participants (99.2%) demonstrated awareness of radio, whereas awareness levels for television, video, telephone, newspaper, and extension bulletin were 76.7%, 63.8%, 58.1%, 55.9%, and 53.3% respectively. Moreover, Table 2 highlights that among the emerging ICTs, GSM phones were the most recognized (78.3%), followed by computer (45.2%), internet (34.1%), and CD-ROM (15.2%). This pattern of awareness was consistent across both rural and urban respondents. The observed trend can be attributed to the focus of ICT infrastructure and base stations in urban areas, resulting in higher awareness levels among urban respondents for both traditional and new ICTs. This finding resonates with the conclusion drawn by Adeyemi *et al.* (2021), who noted that a significant percentage of respondents became acquainted with the *Oyinladun* radio program, leading to increased knowledge in agricultural practices. Awareness serves to expose farmers to innovations, stimulate their interest, and encourage the use of new technologies.

The findings presented in (Table 3) reveal that

Table 2. Percentage distribution of the women farmers according to awareness of existing ICT facilities.

Existing ICTs	Frequency (n = 359)	Percentages (%)
OLD ICTS		
Radio	356	99.2
Television	279	76.7
Telephone	205	58.1
Video	247	63.8
Newspaper	208	55.9
Bulletin/posters	191	53.3
NEW ICTS		
Computers	162	45.2
Internet	126	34.1
GSM phone	284	78.3
CD-ROM	51	15.2
Total	2109*	

Source: Field survey, 2024

*Multiple responses

Table 3. Categorisation of women farmers' awareness.

Categories	Frequency (n = 359)	Percentages (%)
OLD ICTS		
Low	178	48.3
High	181	51.7
NEW ICTS		
Low	162	41.1
High	197	58.9
Total	718*	

Source: Field survey, 2024; *Multiple responses

Table 4. Distribution of women farmers by benefits of use ICTs.

Benefits	High	Slight	No
Information on current market prices and location	63.1	20.5	16.3
Weather forecast	14.2	15.3	70.5
Soil management	16.9	18.0	65.1
Improved seeds/seedlings	33.2	23.3	43.5
Crop pests, diseases and control	62.1	31.9	6.0
Fertilizer sources and application	74.9	19.1	6.0
New farming methods	23.8	18.4	57.8
Sources and procedures for credits, grants and loans	70.8	24.6	4.6
Government regulations	20.8	15.3	63.9

Table 5. Distribution of women farmers by constraints to use of ICTs.

Constraints	High	Slight	No
High cost of gadgets	73.5	10.5	16.0
Expensive power/electricity prices	61.3	10.1	28.6
Defective equipment	57.8	20.3	21.9
Interruption of signals from the source during broadcasts	33.6	22.5	43.9
Inappropriate programme schedule	31.1	12.3	56.6
Numerous tasks performed by women farmers	54.3	12.1	33.6
Insufficient time allotted to agricultural programmes	73.5	15.7	10.8
Difficulty in comprehending the language used in the presentation	25.8	16.4	57.8
Difficulty in operating ICTs	30.8	27.4	41.8
Weak reception and lack of signal availability in many rural areas	30.2	28.9	40.9
Lack of or inadequate ICT infrastructure	62.3	16.7	21.0

women require an intermediary such as an extension agent to facilitate a better understanding of these technical messages. The data displayed in (Table 5)

approximately half (51.7%) of the respondents fell into the high awareness category for traditional ICTs. Conversely, for new ICTs, a larger proportion of respondents (58.9%) were classified as having high awareness. This discrepancy is unsurprising, considering the assumed availability of media outlets, cybercafés, newspaper stands, and other urban infrastructure that contribute to heightened awareness of these technologies.

Women farmers' benefits and constraints of ICTs use

The findings in (Table 4) demonstrate that a most of respondents (74.9%, 70.8%, 65.1%, and 62.1%) derived significant benefits from information regarding fertilizer sources and application, sources and procedures for obtaining credits, grants, and loans, current market prices and locations, and crop pests, diseases, and control respectively. Conversely, a notable portion of respondents (70.5%, 65.1%, 63.9%, 57.8%, and 43.5%) showed that they did not benefit from information related to weather forecasts, soil management, government regulations, new farming methods, and information on improved seeds and seedlings. This implies that women farmers tend to benefit more from information concerning their economic interests and agricultural inputs rather than highly technical agricultural practices. Many of these

indicates that most women farmers (73.5%, 73.5%, 62.3%, 61.3%, 57.8%, and 54.3%) reported experiencing significant constraints due to the high cost of ICT

gadgets, insufficient time allotted to agricultural programmes, lack of or inadequate ICT infrastructure, expensive power/electricity prices, defective equipment, and the multitude of tasks faced by women farmers. Conversely, a substantial portion of women farmers (57.8%, 56.6%, 43.9%, 41.8%, and 40.9%) stated that they faced no constraints in using ICTs due to difficulty in comprehending the language used in the presentation, inappropriate program schedules, interruption of signals from the source during broadcasts, operational challenges with ICTs, and Weak reception and lack of signal availability in many rural areas.

Regression results on factors influencing the use of ICTs by women farmers

The results in (Table 6) display the logistic regression analysis of women farmers' utilization of ICTs with various independent variables. These independent variables encompassed (i) age, (ii) marital status, (iii) education, (iv) religion, (v) household size, (vi) occupation, (vii) farm size, (viii) participation in social organizations, and (ix) awareness. The chi-square value for these variables was calculated as 186.521 at a significance level of 0.05. This suggests that: The analysis indicates that awareness of ICTs emerged as the most significant predictor of women farmers' utilization of ICTs, with a regression coefficient (beta) value of 0.864.

Table 6: Logit regression results on factors influencing the use of ICTs by women farmers.

Variables	Coefficients	Std. Error	t-value	p-value
Age	-0.002	0.003	-4.870	0.645 ^{NS}
Marital status	0.015	0.036	0.613	0.667 ^{NS}
Level of education	0.027	0.013	2.432	0.064 [*]
Religion	-0.120	0.062	-0.255	0.855 ^{NS}
Farm size	0.005	0.002	0.643	0.041 ^{NS}
Household size	-0.010	0.003	-1.756	0.062 ^{NS}
Occupations	0.380	0.170	1.439	0.027 ^{NS}
Social organizations	0.015	0.008	3.153	0.001 [*]
Awareness	0.864	0.057	9.267	0.000 [*]
Constant term	-0.723	0.217	-4.589	0.000

No. of observation =359
 Log likelihood = - 157.632
 LR Chi2 (10) = 186.521
 Prob>chi-square = 0.0000
 Degree of freedom = 13
 Pseudo R2 = 0.5367
 Source: Field survey, 2024

This beta value suggests that awareness of ICTs contributed approximately 86% to the use of such technologies. Other predictors included occupation, with a beta value of 0.38, educational attainment with a beta value of 0.027, marital status with a beta value of 0.018, participation in social organizations with a beta value of

0.015, and farm size with a beta value of 0.005, respectively. Conversely, the independent variables age, religion, and household size exhibited beta values of -0.002, -0.120, and -0.010, indicating a negative or inverse relationship between women farmers' use of ICTs and these predictor variables. The importance of the beta coefficients presented in (Table 6) became evident when examining the chi-square values at a significance level of $p=0.0000$. Analysis of the chi-square and significance levels indicated that out of the nine independent variables, only three had a potential impact on the increased utilization of ICTs by women farmers. These variables include education ($\beta=0.027$, $p<0.05$), involvement in social groups ($\beta=0.015$, $p<0.05$), and awareness of ICTs ($\beta=0.864$, $p<0.05$). This discovery suggests that awareness, educational level, and social engagement each hold promise for enhancing women farmers' adoption of ICTs, with awareness potentially leading to an 86% increase, educational attainment to a 2% increase, and social participation to a 1% increase.

Conclusion and Recommendations

The research aimed to explore the current status of ICT utilization, awareness, advantages, limitations, and the key influencers of its usage within the female farming community in the surveyed region. The women farmers predominantly operated on a small scale, and a significant portion of them possessed a notable level of formal education, surpassing primary education. This educational background has led to an increased adoption of digital ICTs, consequently enhancing access to information on enhanced agricultural methodologies among female farmers in North Eastern Nigeria. Many of these female farmers actively participated in various social groups, with religious women's groups being particularly prevalent. These groups played a crucial role in disseminating awareness about ICTs among the respondents. Moreover, a substantial number of women farmers exhibited significant involvement in organizational activities, potentially fuelling their interest in utilizing ICTs. As for ICT usage patterns, radio, television, GSM phones, and video platforms emerged as the most commonly employed tools among women farmers.

Additionally, because of the homogeneity within the female farming community, notable distinctions were not discerned regarding age, farm size, marital status, household size, religion, and occupations concerning ICT adoption among women farmers. Likewise, elements such as educational achievement, engagement in social groups, and awareness were recognized as pivotal in shaping the utilization of contemporary ICT tools by women farmers in the surveyed region. This utilization is expected to improve the efficient and timely dissemination of extension messages, thereby facilitating

the prompt delivery of current and pertinent information. Harnessing ICTs offers substantial potential for improving rural livelihoods and the agricultural sector, which are closely connected with the well-being of numerous women farmers grappling with poverty. To unlock this potential, there is a pressing need for heightened investment in ICT initiatives that are in sync with contemporary technologies, encompassing both human resources and capital. Based on the results of this study, the following suggestions have been proposed:

The Federal Government of Nigeria should prioritize the establishment of essential infrastructure aimed at promoting and facilitating the adoption of emerging ICTs among women farmers. This could involve incentivizing telecommunication service providers to extend their coverage to rural areas by installing masts, base stations, internet services, and other ICT infrastructure to enhance the accessibility of ICTs for women farmers in these regions. In instances where telecommunication operators resist such obligations due to potential profitability concerns, legislative measures should be implemented to mandate compliance as part of their corporate social responsibilities.

Despite women farmers typically cultivating small plots of land, all developmental initiatives should concentrate on enhancing their productivity within these limited areas. Rather than focusing on expanding land size, efforts should be directed towards improving efficiency and yield on existing plots. Attempts to increase farm size may result in allocating additional marginal land to women farmers, as men farmers often prefer to retain fertile lands.

State Agricultural Development Programs (ADPs) should conduct training sessions for various women's social groups on the effective utilization of ICT tools already known to them. These tools can then be employed to disseminate extension messages and agricultural technologies to women farmers, many of whom are inaccessible through traditional extension visits due to a shortage of female extension personnel and limited interaction between male extension agents and female farmers in the surveyed area.

Additionally, it is imperative for various NGOs, government agencies, and other stakeholders in extension communication to introduce women farmers to new ICTs. This proactive strategy will help alleviate the technological apprehension that many of them currently experience and enable them to fully exploit the benefits derived from ICT utilization.

REFERENCES

Abdulahi, R. O., Sennuga, S. O., Bamidele, J., Osho-Lagunju, B. and Ameh, D. A. (2023). Policy issues for Improving Monitoring and Evaluation of Agricultural Extension Programmes in Nigeria: A Critical Review, *Journal of Agricultural Economics, Extension and Rural*

- Development* 11(10), 29-47
- Achukwu, G. A., Sennuga, S. O., Bamidele, J., Alabuja, F. O., Osho-Lagunju, B. and Banarbas, T. M. (2023). Factors affecting the rate of adoption of agricultural technology among small scale rice farmers in Gwagwalada Area Council of FCT, Nigeria, *Journal of Agricultural Science and Practice*, 8(2), 30-37
- Adamu, N. A., and Akinyemi, T. E. (2020). Drought and desertification in North Eastern Nigeria. *Journal of Arid Environments*, 180, 104-126.
- Adeboye, T. (2022). The role of women in Nigerian agriculture. *Women in Agriculture*, 2(1), 33-41.
- Adeniyi, R. T., and Arimi, K. (2021). Determinants of information and communication technologies use by women farmers in Oyo State, Nigeria. *Journal of Agricultural Education and Extension*, 27(2), 141-156.
- Adetunji, M. O., and Onigbinde, O. A. (2022). Membership of social organizations and its effects on empowerment of women farmers in Kwara State, Nigeria. *Women in Agriculture*, 4(2), 65-77.
- Adeyemi, A. A. (2020). Socio-economic characteristics and constraints associated with use of ICTs by farmers in Ilorin East Local Government Area of Kwara State. *International Journal of ICT Research and Development in Africa*, 10(1), 1-18.
- Adeyemi, A. A., Bello, M., and Salawu, M. A. (2021). Factors influencing the use of information and communication technologies among farmers in Kwara State, Nigeria. *Journal of Agricultural Extension*, 25(4), 76-91.
- Adeyemi, S. O., Sennuga, S. O., Alabuja, F. O. and Osho-Lagunju, B. (2023). Technology Usage and Awareness among Smallholder Farmers in Gwagwalada Area Council, Abuja, Nigeria. *Direct Research Journal of Agriculture and Food Science*, 11(3), 54-59.
- Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl and J. Beckmann (Eds.), *Action control: From cognition to behavior* (pp. 11-39). *Springer*.
- Ajzen, I., and Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. *Prentice-Hall*.
- Alabi, O. O. (2021). Socio-economic characteristics of women farmers and their constraints in Southwestern Nigeria. *Journal of Agricultural Education and Extension*, 27(3), 269-284.
- Amadi, N. S., and Ugwu, N. (2023). Analysis of information and communication technology (ICT) use by farmers in Abia State, Nigeria. *International Journal of ICT Research and Development in Africa*, 13(1), 1-15.
- Ameh, D. A., Sennuga, S. O., Bamidele, J., Osho-Lagunju, B. and Abdulahi, R. O. (2023). Linkage Behavior and Practices of Agencies in the Agricultural Innovation Transfer Sub System in Nigeria: Issues for Agricultural Extension policy, *Journal of Agriculture & Education Research*, 1(1), 1-6.
- Chukwu, A. O., and Nwosu, A. C. (2023). Perception and use of ICT by women farmers in Imo State, Nigeria. *Journal of Agricultural Education and Extension*, 29(1), 31-48.
- Eze, S. O., and Okeke, P. A. (2021). Information and communication technology (ICT) needs of women farmers in Enugu State, Nigeria. *Journal of Agricultural Extension*, 25(2), 48-60.
- Food and Agriculture Organization. (2020). *Information and communication technologies for sustainable agriculture*. FAO.
- Ibrahim, M., and Mohammed, A. (2021). Crop production systems in North Eastern Nigeria. *Journal of Sustainable Agriculture*, 15(3), 41-58.
- Iliyasu, H., Sennuga, S. O., Bamidele, J., Osho-Lagunju, B. and Abdulahi, R. O. (2023). A Critical Review of the Impact of Climate Change on Food Security in Nigeria: A Vulnerability Assessment, *Merit Research Journal of Agricultural Science and Soil Sciences* 11(6), 077-087
- Kwatsha, L. D., and Okoh, E. E. (2020). Constraints to the use of information and communication technologies (ICTs) by women farmers in Benue State, Nigeria. *Journal of Agricultural Extension*, 24(2), 49-60.
- National Bureau of Statistics. (2020). *Nigerian women in agriculture*. NBS.
- National Bureau of Statistics. (2021). *Nigeria population census*. NBS.
- Nwosu, A. C., and Akintola, J. O. (2021). Contributions of women in

- agriculture. *Journal of Agricultural Science*, 13(2), 21-34.
- Obasi, C. I. (2022). Gender and use of information and communication technologies in agriculture. *ATBU Journal of Science, Technology and Education*, 10(2), 37-49.
- Ogunsanya, O. O., Bello, M., and Olatunde, A. M. (2023). Determinants of ICTs use among women farmers in Oyo State, Nigeria. *Journal of Agricultural Extension*, 27(1), 93-107.
- Okeke, C. A. (2022). Factors influencing the use of ICTs among women farmers in Anambra State, Nigeria. *Nigerian Journal of Rural Sociology*, 21(1), 33-44.
- Okoro, C. A., and Adebayo, A. A. (2021). Household size and resource use among women farmers in Southwestern Nigeria. *Journal of Agricultural Economics and Extension*, 15(2), 21-32.
- Okoro, C. A., and Olayinka, O. D. (2020). Women farmers' access to land in Southwestern Nigeria. *Journal of Gender Studies*, 8(2), 1-12.
- Okoye, B. C. (2020). Women in agriculture. *Journal of Agricultural Economics and Extension*, 14(1), 1-12.
- Okwu, O. J., and Obasi, P. C. (2022). Gender, religion and use of information and communication technologies in agriculture. *Journal of Agricultural Extension*, 26(1), 39-52.
- Olaitan, M. A., Bamidele, J., Joel, O. J., Oyediji, B. I., Joel, A. F. & Sennuga, S. O. (2024). Utilization and Access of Information and Communication Technologies (ICTs) by Extension Agents for Enhancing Extension Service Delivery in Kaduna State, Nigeria. *ISAR Journal of Agriculture and Biology*, 2(6), 1-12.
- Oluwatobi, F. A., Adewale, J. G., and Ifeoma, U. L. (2022). Socio-economic characteristics influencing the use of information and communication technologies (ICTs) by women farmers in Ogun State, Nigeria. *Journal of Agriculture and Human Ecology*, 6(2), 23-35.
- Sennuga, S. O. (2023). Evaluation of the Factors Affecting Smallholder Rice Farmers' Use of ICTs to Access Market Information in the Federal Capital Territory, Abuja, Nigeria. *African Journal of Agriculture and Allied Sciences*, 3(2), 1-15.
- Sennuga, S. O., Alo, A. O. & Angba, C. W. (2021). Evolution of Agricultural Extension Models in Sub-Saharan Africa: A Critical Review. *International Journal of Agriculture Extension and Rural Development Studies*, 8 (1), 29-51.
- United Nations. (2019). The world's women 2019: Trends and statistics. United Nations.