



Utilization and Access of Information and Communication Technologies (ICTs) by Extension Agents for Enhancing Extension Service Delivery in Kaduna State, Nigeria

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Abstract: This study aimed to assess how field extension agents in Kaduna State access and use information and communication technology (ICT) for delivering extension services. A multi-stage sampling approach, combining purposive and simple random sampling techniques, was employed to select 200 extension agents for the research. Primary data were gathered using descriptive and inferential statistics to achieve the study's specific objectives. The findings indicated that 62% of the extension agents were male, with 43.5% aged between 41-50 years, and a majority (78%) being married. Furthermore, 85% had tertiary education, 45% had a household size of 1-3 persons, and 51.5% had a monthly income of ₦21,000-₦40,000. The analysis also revealed that the most commonly owned, accessed, and used ICT tools by the extension agents were radio, television, and phones, which were personally sourced from the open market. Consequently, the overall level of access to and use of these tools was then looked on to be low generally, with mean response scores of $x = 1.7$ for both. The extension agents' views on the usage of ICTs in agricultural activities revealed the following: gathering information from research institutions and farmers ($x = 2.7$), obtaining information on new seed varieties and seedlings ($x = 2.6$), best techniques for planting ($x = 2.6$), and methods of livestock management ($x = 2.6$), among others. Regression analysis indicated that gender, age, education level, and work experience did not impact greatly on ICT utilization. However, marital status, income, occupation, organization, awareness, and accessibility were key factors influencing the use of ICTs in extension service delivery. Based on these insights, suggestions were discussed to enhance the utilization of modern ICTs and provide adequate training for extension agents on ICT usage, among other suggestions.

Keywords: Information and Communication Technology (ICTs), extension agents, access, utilization, facilities.

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INTRODUCTION

The role of Information and Communication Technologies (ICTs) in agricultural extension services is increasingly recognized as vital for enhancing the transition of information and improving agricultural productivity. In the context of developing countries, ICTs offer innovative solutions to connect the divide between extension agents and farmers, facilitating timely and efficient dissemination of knowledge, and enhancing decision-making processes (Richardson, 2021; Adebayo and Adesope, 2022). In Nigeria, where agriculture remains a critical sector, the incorporation of information and communication technologies in extension services is crucial for tackling issues associated with

agricultural productivity, market access, and sustainable practices (Ajani, Onwubuya and Nwankwo, 2021).

Extension agents serve as the primary link between research institutions and farmers, playing a crucial role in converting scientific knowledge into real-world uses. However, the effectiveness of these agents is often constrained by limited resources, inadequate training, and infrastructural challenges (Adebayo and Adesope, 2022; Sennuga, 2021). ICTs possess the capability to mitigate some of these constraints by supplying instruments for enhanced communication, data management, and resource allocation. Despite these benefits, the extent of ICT access and utilization among extension agents in Kaduna State remains underexplored, necessitating empirical investigation (Olaniji and

Akintunde, 2020; Adeyemi, *et al.*, 2023). ICTs encompass a wide range of technologies, from traditional communication tools to modern digital platforms. Understanding the categories of ICTs and their respective roles in extension services can provide a clearer picture of their impact and potential. Broadly, information and communication technologies (ICTs) can be categorized into three main groups:

New ICTs

New ICTs include modern digital technologies such as smartphones, tablets, computers, and the internet. These tools enable real-time communication, access to vast information resources, and sophisticated data analysis capabilities. They support a variety of applications, including mobile apps for agricultural information, online training programs, and digital marketplaces (Ebisike *et al.*, 2021). The proliferation of smartphones has particularly revolutionized communication between extension agents and farmers, providing platforms for instant messaging, social media interactions, and access to agricultural databases (Qiang and Lam, 2020). Their integration into extension services can significantly enhance efficiency and outreach.

Old ICTs

Old ICTs refer to technologies like radio and television, which have been employed for decades to disseminate agricultural information. Despite being less interactive than new ICTs, they remain valuable due to their wide reach and cost-effectiveness. Radio, in particular, is highly accessible in rural areas and can broadcast important agricultural advice and weather updates (Olaniyi, Olayiwola and Adebawale, 2023).

Very Old ICTs

Very old ICTs encompass traditional methods such as printed materials (pamphlets, manuals, posters) and face-to-face communication through meetings and workshops. These methods, while limited in scope and scalability, are still relevant in regions with low digital penetration. They rely on direct human interaction and can be tailored to specific local contexts, ensuring that critical information is effectively communicated (Van den Ban and Hawkins, 1996; Aluko, *et al.*, 2021).

Agricultural extension services are pivotal in disseminating agricultural innovations and practices that can enhance productivity and sustainability among farmers. In Nigeria, the agricultural sector contributes significantly to the economy and livelihoods, especially in rural areas. Effective extension services are therefore vital for ensuring that farmers adopt improved techniques and access necessary resources. The advent of ICTs offers promising avenues to overcome traditional barriers in extension service delivery, such as geographic isolation, limited access to timely information, and inadequate extension personnel (Ajani *et al.*, 2021). ICTs can transform agricultural extension by enabling more efficient communication channels, providing platforms for continuous learning, and facilitating the collection and analysis of agricultural data. Cellular devices can be utilized "to send SMS alerts about weather forecasts, pest outbreaks, and market prices, which are critical for decision-making at the farm level (Ajani *et al.*, 2021). The internet and online platforms can offer access to a wealth of information and training resources, enhancing the knowledge base of extension agents and farmers alike (Ojo *et al.*, 2021; Achukwu, *et al.*, 2023).

Nonetheless, effectively incorporating ICTs into extension services depends on various elements, such as the availability of infrastructure, the digital proficiency of extension agents, the cost-effectiveness of these technologies, and the region's socio-economic conditions. In Nigeria, where the agricultural sector encounters multiple difficulties, grasping the present level of ICT access and use is vital for crafting strategies that improve the efficiency of extension services (Agwu and Uche-Mba, 2020).

Moreover, the perceived benefits and relevance of ICTs serve a crucial function in their utilization. Extension agents and farmers who recognize the advantages of using ICTs for agricultural activities are more inclined to incorporate these tools into their everyday routines. These advantages encompass enhanced access to market information, weather forecasts, pest and disease management advice, and new farming techniques (Adebayo and Adesope, 2022). Despite the potential benefits of ICTs, extension agents in this region may face significant barriers such as inadequate ICT infrastructure, high costs of devices and connectivity, and limited training on how to effectively use these technologies. These challenges can hinder the utilization of ICTs, thereby limiting their impact on extension service delivery (Agwu and Uche-Mba, 2020). Addressing these issues requires a comprehensive understanding of the current landscape of ICT access and utilization among extension agents (Adeyongo *et al.*, 2022).

Moreover, the socio-economic and cultural context of Kaduna State influences how ICTs are used. Factors such as education levels, age, gender, and socio-economic status can affect the ability and willingness of extension agents to embrace new technologies (Mittal and Mehar, 2016). Therefore, it is essential to take these situational elements into account when assessing ICT access and utilization and to create customized solutions that tackle the specific needs and constraints of extension agents in this region. The importance of ICTs in agricultural extension services cannot be overstated. By leveraging the power of digital technologies, extension agents can enhance their outreach, deliver timely and relevant information to farmers, and ultimately contribute to the overall growth and sustainability of the agricultural sector. Therefore, understanding the current state of ICT access and utilization among extension agents in Kaduna State is critical for identifying gaps and opportunities for improvement (Adangara, *et al.*, 2022).

The agricultural sector in Kaduna State is characterized by smallholder farming, which often faces numerous challenges, including limited access to modern agricultural inputs, inadequate extension services, and poor infrastructure. Extension agents are crucial in addressing these challenges by providing farmers with the necessary information and support to improve their practices and productivity. However, the traditional methods of extension service delivery are often insufficient to meet the diverse and dynamic needs of farmers in this region. ICTs present an opportunity to enhance extension services by providing more efficient and effective means of communication and information dissemination. Despite the recognized potential of ICTs, there is a paucity of empirical data on how extension agents in Kaduna State access and utilize these technologies (Ajani *et al.*, 2021). Without this data, it is challenging to develop policies and programs that can effectively integrate ICTs into extension services.

Additionally, the obstacles faced by extension agents in using ICTs are not thoroughly documented, impeding systematic efforts to overcome these challenges. Identifying these barriers is crucial for creating interventions that promote the efficient use of ICTs, which can lead to better agricultural results. Consequently, this study aimed to assess the access to and use of information and communication technologies among extension agents in Kaduna State. To obtain this, the following specific objectives were addressed:

- i. describe the socio-economic characteristic profile of the extension agents in the study area;
- ii. identify the presence, awareness, and sources of available ICT facilities among the extension agents in the study area;
- iii. evaluate the level of access to and usage of ICT facilities by the extension agents in the study area;
- iv. investigate the factors that affect the adoption of ICTs by the extension agents in the study area.

Literature Review

Theoretical Framework

The conceptual model for this research on extension agents' access to and utilization of ICTs in Kaduna State is based on several interrelated theories and models that explain technology use in both organizational and individual contexts. The primary theories informing this study are the Diffusion of Innovations Theory and the Technology Acceptance Model (TAM).

Diffusion of Innovations Theory

Everett Rogers introduced the Diffusion of Innovations Theory in 1962 to explain the mechanisms and speed at which new ideas and technologies spread across cultures. This theory is relevant to studying ICT adoption among extension agents because it identifies crucial factors influencing the diffusion process: innovation, communication channels, time, and the social system (Rogers, 2003). In this framework, ICTs are the innovations, encompassing new technologies like smartphones and mobile apps, older technologies such as desktop computers and radios, and even very old technologies like print media and public address systems. According to the theory, innovations that are perceived as

beneficial, compatible with existing values and practices, easy to understand, testable, and visible are more likely to be adopted rapidly. This model aids in understanding how ICTs are spread and embraced among extension agents, emphasizing the importance of communication channels and the social system in which these agents' function.

Technology Acceptance Model (TAM)

The Technology Acceptance Model, introduced by Davis in 1989, suggests that the perceived value and perceived simplicity are crucial elements in the adoption of technology (Davis, 1989). This model is particularly pertinent for comprehending how extension agents utilize ICT. Perceived usefulness is defined as the extent to which an extension agent believes that utilizing ICT will improve their job effectiveness, such as obtaining timely agricultural information and improving communication with farmers. Perceived ease of use refers to how effortless the extension agent believes using ICT will be, which depends on the complexity or simplicity of the ICT tools. Additionally, external factors such as age, education level, availability of ICT infrastructure, and organizational support can impact perceived usefulness and ease of use, thereby influencing the overall utilization of ICT.

Conceptual Framework

Figure 1 presents the conceptual framework for this study, exploring the correlation between different factors that affect the access to and utilization of Information and Communication Technologies (ICTs) by extension agents in Kaduna State. The dependent variable is the utilization of ICTs, which measures how frequently and effectively extension agents use these technologies in their work. The independent variables include age, gender, education, and farming experience, as well as economic factors like farm size, household income etc. Institutional factors such as access to credit, and membership of cooperatives are also considered. These variables directly impact the degree to which ICTs are utilized. The intervening variables, such as perceived utility and perceived simplicity of use, mediate the relationship between the independent variables and the dependent variable. These perceptions are crucial in determining whether the extension agents will embrace ICT tools. The framework highlights the interconnectedness of these factors and their combined effect on enhancing agricultural extension services.

Independent Variables	Intervening Variables	Dependent Variable
Socio-economic and Institutional characteristics of Respondents - Age - Gender - Level of education - Marital Status - Household size - Secondary occupation - Working experience - Annual income - Membership of social organizations	- Perceived Usefulness - Perceived Ease of Use	Utilization of ICTs

Fig 1: Conceptual framework of the study

Materials and Methods

Study Area

This research was carried out in Kaduna State, Nigeria. Kaduna is one of the 36 states in the country, situated in the North-Western region. According to the 2006 census by the National Population Commission, Kaduna had a population of approximately 6,066,562. With an annual population growth rate of 3.2%, the population was estimated to be 25,813,667 by 2026. The state is divided into 23 Local Government Areas (LGAs) and is located between latitudes 9°N and 12°N, and longitudes 6°E and 9°E. Covering a total land area of 48,473.2 square kilometres (NPC, 2006), the state experiences an average annual rainfall of 1,524 mm over a period of 7 to 9 months. The annual temperature in Kaduna ranges from 14.6°C to 36°C. The favourable soil and climate conditions support the cultivation of diverse crops. Kaduna State shares borders with Plateau State to the North East, Katsina and Kano States to the North, Niger and Zamfara States to the West and Nasarawa State and Abuja to the South.

Agriculturally, the State is renowned for producing arable crops such as rice, pepper yam, maize, groundnut, cassava, and various vegetables. Plantation crops like, banana, cocoyam plantain, oil palm and coconut are also prominent. Additionally, the livestock industry includes small ruminant farming, backyard poultry production, and fisheries. This diverse agricultural landscape makes Kaduna State a crucial area for studying the impact and utilization of ICTs in agricultural extension services.

Population of the Study and Research Design

The study population consists of extension agents working within Kaduna State. These extension agents serve as vital intermediaries connecting agricultural research institutions with farmers, facilitating the dissemination of agricultural innovations and information. This diverse population ensures that the study encompasses a comprehensive perspective on the access and utilization of Information and Communication Technologies (ICTs) among extension agents.

The selected research design for this study is a descriptive survey, intended to systematically gather data on the access and utilization of Information and Communication Technologies (ICTs) among extension agents. This method is well-suited for capturing the opinions, attitudes, and behaviours of a sizable population, thereby establishing a strong basis for identifying trends and patterns (Ologundudu and Eniola, 2021). Through this approach, the study aims to provide comprehensive insights into the present status of ICT integration in agricultural extension services within Kaduna State.

Sample Size and Sampling Techniques

A multi-stage sampling technique was used in selecting respondents for this study. In the Kaduna State of Nigeria, four (4) agricultural zones will be chosen purposively to ensure a thorough representation of the area which are Lere, Birnin-Gwari, Samaru-Kataf and Maigana. This approach allows for the focus on regions where the agents contributing to over 70% of the extension service delivery across the region. Criteria for selecting these areas include the extent of extension activities, the diversity of farming practices, and the demographic characteristics of the farming communities. The first stage was simple random sampling of one Local Government Area (LGA) from each of the zones. The randomly

sampled LGAs were Kubau, Igabi, Zagon-Kataf and Kudan, making a total of four (4) Local Government Areas (LGAs).

Once the chosen LGAs were identified, one village from each of the selected Local Government Areas (LGAs) were randomly selected which were Dutsenwai, Amana, Magamia I, and Taban-Sani. The next stage involved a straightforward random sampling method to select extension agents working within Kaduna Agricultural Development Project (KADPs). This method is essential for maintaining the statistical integrity of the sample, guaranteeing that every extension agent in the chosen village has an equitable chance to join the study. To execute this, random number generator was utilized to pick a sample of fifty (50) extension agents from each of the four (4) community, totalling two hundred (200) respondents.

Data Collection

The main instrument used for data collection in this research was a structured questionnaire. These questionnaires were distributed to collect data, with the survey lasting approximately 1 hour and 20 minutes. The key themes explored in the survey encompassed the socio-economic profiles of the extension agents, the origins of available ICT facilities, the level of access and utilization of these ICT resources, and the factors affecting their usage among participants. To ensure the questionnaire's validity and reliability, it underwent pre-testing in a pilot study. This pilot test involved a small group of extension agents not included in the main study sample. Through this pilot test, any ambiguities or issues in the questionnaire were identified, facilitating adjustments to enhance its clarity and effectiveness.

Data Analysis

The gathered data was analyzed utilizing descriptive statistics, which included percentages, frequency counts and means. Moreover, inferential methods, such as the logit regression model, were employed. Objectives (i) and (ii) were tackled using descriptive statistics, including frequency distribution tables and percentages. Objective (iii) was achieved by utilizing a 4-point Likert scale. The Statistical Package for the Social Sciences (SPSS) version 24 facilitated the data analysis process.

Model specification

Model for Likert scale rating

The Likert scale mean score, derived from a 4-point rating, served as a tool to assess the extension agents' utilization capabilities concerning their skill and knowledge in using various ICT components for extension delivery. To analyze the utilization capability of the respondents using this 4-point Likert rating system, specific ICT facilities were listed, and respondents were asked to rank them based on their level of agreement regarding their extent of utilization. The 4-point Likert scale ranged from "very great (VG)" assigned a value of 4 to "very low (VL)" assigned a value of 1, with a decision rule set at 2.5. The rating ranged from 4 to 1 as follows:

Very great (VG) – 4

Great (G) – 3

Low (L) – 2

Very low (VL) – 1

The Likert formular:

$$X_s = \frac{\sum fn}{Nr}$$

Where X_s = Mean score, F = frequency of each (4, 3, 2, 1) option, $\sum$ = summation, N_r = total number of respondents, n = responses of the respondents.

Logit Regression Model

A logistic regression model was employed to ascertain the factors influencing the utilization of ICT by extension agents in the study area. The implicit form of the Logit model is specified as:

$$Y = f(X_1, X_2, X_3, X_4, X_6, X_7, X_8, X_9, X_{10})$$

The Logit model in its explicit form is expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + e$$

Where;

Y = ICT use by the extension agents

X_1 = Age

X_2 = Gender

X_3 = Marital status

X_4 = Household size

X_5 = Education level

X_6 = Household size

X_7 = Household income

X_8 = Secondary occupations

X_9 = Working experience

X_{10} = Membership of social organizations

β_0 = constant

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Respondents

The age distribution among the respondents in Table 1 shows a majority within the 30-49 age bracket, with 35% aged 30-39 and 43.5% aged 40-49. The mean age is 40 years. This age range shows that most extension agents are in their mid-career stage, which could influence their openness to using new technologies. According to Rogers (2003) Diffusion of Innovations theory, middle-aged personalities tend to be more receptive to adopting new technologies. compared to older individuals due to their professional experience and relatively higher comfort with change.

The marital status distribution in Table 1 shows that 78.5% of the respondents are married, 16.5% are single, and 5% are divorced. Marital status can impact the workload and time availability of extension agents, potentially affecting their ability to engage with ICT tools. Married individuals might have additional responsibilities, which could limit their time for learning and using new technologies. According to Aker (2011), personal responsibilities can influence the effective use of ICTs in professional settings.

The findings displayed in Table 1 shows a significant male dominance with 62% of the respondents being male and 38% female. This gender disparity influences the usage patterns of ICT

tools, as various studies suggest gender-specific preferences and challenges in technology adoption. For instance, Oladele (2015) highlighted that women in agricultural extension services often face more barriers in accessing and utilizing ICTs compared to their male counterparts.

The educational attainment of the respondents in Table 1 indicates that 85% have post-secondary education, 10% have secondary education, and 5% have primary education. The mean educational level is 18 years. Higher educational attainment generally correlates with better understanding and utilization of ICT tools. Studies, such as those by Chapman and Slaymaker (2002), indicates that educational background notably impacts the efficacy of ICT usage in agricultural extension services. The high level of education among the respondents suggests a solid groundwork for integrating advanced ICT tools, as these agents are likely to possess the necessary skills to leverage these technologies effectively.

Household size data shows that 45% of respondents have small households with 1-3 members, while 36.67% have 4-6 members. Larger households (7-9 and 10-12 members) constitute 10% and 8.33%, respectively. The mean household size is 4.2, suggesting that many extension agents come from moderately large families. Larger households can benefit significantly from ICTs in agriculture, as multiple family members can contribute to and share information. Extension agents can utilize ICTs to deliver timely and relevant agricultural information to these households, enhancing their collective farming efficiency and decision-making processes (Davis and Addom, 2010). The use of ICTs can also facilitate better management of household labour and resources in agricultural activities.

Secondary occupations among the respondents reveal that 78.5% are engaged in farming, 16.5% in agro-processing, and 3.5% in agricultural trading. The involvement in secondary occupations indicates a diversification of income sources and experiences, which can enrich the understanding and application of ICT in agricultural extension services. According to Galloway and Mochrie (2005), exposure to multiple aspects of the agricultural value chain enhances the ability to utilize ICT for various agricultural practices. This diversification can lead to more comprehensive and practical use of ICT tools, benefiting extension service delivery.

The findings presented in Table 1 indicate that most of the respondents (58.33%) have 4-6 years of working experience, with a mean working experience of 5 years. This indicates a relatively experienced workforce capable of utilizing ICTs to enhance extension service delivery. Experienced agents are more likely to understand the practical challenges faced by farmers and can use ICT tools to provide tailored solutions (Anderson and Feder, 2004). Their familiarity with both traditional and modern extension methods allows them to effectively incorporate ICTs into their routines. Consequently, they can improve the dissemination of agricultural knowledge and innovations, ultimately enhancing the overall efficiency and impact of extension services.

The findings presented in Table 1 shows that 51.67% of respondents fall into the 21,000-40,000 Naira category, while 33.33% earn between 10,000-20,000 Naira. Higher income brackets are less common. The modest earnings of most respondents highlight the importance of affordable and accessible

ICT solutions to support their extension activities. Limited financial resources can hinder the adoption of advanced ICT tools, making cost-effective solutions essential for widespread utilization (FAO, 2011). Extension agents with higher incomes may have better access to ICTs, which can enhance their service delivery and provide a model for lower-income agents to aspire to.

The findings presented in Table 1 shows that a slight majority of respondents (53.33%) are members of social organizations, which can play a vital role in facilitating access to ICTs. Social organizations often provide platforms for knowledge sharing, training, and collective action, all of which can enhance ICT adoption (Aref, 2011). Membership in these organizations can help extension agents stay updated on the latest ICT developments and best practices, thereby improving their service delivery.

Table 1: Socio-Economic Characteristics of Respondents (n = 200)

Characteristics	Frequency	Percentage (%)	Mean
Respondents' age (years)			
21-30	20	10.0	40 years
31-40	70	35.0	
41-50	87	43.5	
Above 50	23	11.5	
Marital status			
Single	33	16.5	
Married	157	78.5	
Divorced	10	5.0	
Gender			
Female	76	38.0	
Male	124	62.0	
Educational Level			
No formal education	-	-	18 years
Primary education	10	5.0	
Secondary education	20	10.0	
Tertiary education	170	85.0	
Household size			
1-3	90	45.0	4.2 persons
4-6	73	36.5	
7-9	20	10.0	
10-12	17	8.5	
Secondary occupation			
Students	3	1.5	
Farming	157	78.5	
Agricultural trading	7	3.5	
Teaching	-	-	
Agro-processing	33	16.5	
Working experience (years)			
<3	58	29.0	5 years
4-6	117	58.5	
7-9	17	8.5	

9 and above	8	4.0
Monthly Income (Naira)		
10,000-20,000	67	33.5
21,000-40,000	103	51.5
41,000-60,000	20	10.0
61,000-80,000	7	3.5
81,000-100,000	3	1.5
Membership of social organizations		
No	93	46.5
Yes	107	53.5

Source: Field survey, 2024

Existence and awareness of ICTs among extension agents

The examination of data regarding the current ICT facilities in the research region uncovered noteworthy results. A considerable majority (96.17%) of the extension agents recognized the presence and familiarity with radios, establishing it as the most acknowledged ICT tool. This was succeeded by mobile phones, with 85.17% of respondents acknowledging their existence, and television, with 67.33% responding positively. Print media was noted by 31.17% of respondents. However, awareness of more sophisticated ICT tools like projectors was lower, with only 23.33% acknowledging their presence. Additionally, a smaller percentage of respondents (9.67% and 11.33%, respectively) were aware of the existence of internet-connected computers and cassette recorders/players. These results correspond with prior studies by Isiaka *et al.* (2009), indicating that extension workers had a moderate level of awareness regarding the potential of existing ICTs in extension service delivery. Our results corroborate earlier research showing a considerable awareness of traditional ICTs among extension agents in Kaduna State. However, a minor difference is observed compared to the study by Adebayo and Adesope (2007), which reported an even higher awareness level (88.5%) among female extensionists. This indicates that while awareness of traditional ICTs is robust, awareness of modern ICT tools may be lacking. Consequently, there is a necessity for targeted initiatives to educate extension agents about the presence and advantages of modern ICTs, potentially enhancing extension service delivery in the region.

Table 2: Percentage distribution of the respondents according to awareness of existing ICT facilities.

Existing ICTs	Frequency (n = 200)	Percentages (%)
Radio	577	96.17
Television	404	67.33
Mobile Phones (handset)	511	85.17
Print media	187	31.17
Internet connected computer	58	9.67
Cassette recorder	68	11.33
CD-ROM	134	23.12
GIS (geographical information system)	20	3.33
Projector	140	23.33
Facsimile	12	2.00
Total	2111*	

Source: Field survey, 2024

*Multiple responses

The findings concerning the origins of ICT facilities among the participants in the study area, as illustrated in Table 3, reveal that a majority (61%) acquired their ICT tools independently from the open market. Specifically, the breakdown of responses indicates that 95.67% obtained radios, 6.50% accessed internet-connected computers, 82.33% acquired televisions, and 93.33% procured mobile phones through this avenue. Additionally, 13.5% and 53.50% respectively obtained cassette recorder/players and prints/libraries from open market sources. Social organizations served as the source for 12% of respondents, while government procurement accounted for the lowest percentage at 2%. These results suggest that a significant portion of extension agents personally procured their ICT equipment from the open market, likely influenced by the liberalization of Nigeria's telecommunications sector, which has facilitated access to private telecom service providers. Consequently, there

has been a notable increase in the utilization of mobile phones and modems for browsing, even from the convenience of their own homes (Olaniyi and Akintunde, 2020).

Table 3: Percentage distribution of the respondents according to sources of ICT facilities in the study area (Sample size = 200)

Frequency (n = 200)						Percentage (%)				
ICTs facilities	Open market	ADP	Fellow farmers	Government	Social organizations	Open market (%)	ADP (%)	Fellow farmers (%)	Government (%)	Social organizations (%)
Radio	287	-	10	7	7	95.67	-	3.33	2.33	2.33
Television	247	13	13	7	13	82.33	4.33	4.33	2.33	4.33
Internet-connected computer	13	-	7	3	7	6.50	0.00	3.50	1.50	3.50
Cassette recorder	27	-	7	20	20	13.50	-	3.50	10.00	10.00
Mobile phone	280	-	7	33	20	93.33	0.00	2.33	11.00	6.67
Print media	107	13	7	7	20	53.50	6.50	3.50	3.50	10.00
Total	961*	26	51	77	87	61	5	7	2	12

Source: Field survey, 2024

*Multiple responses

Access and Utilization of ICTs

The analysis results presented in Table 4 regarding the access to ICT facilities among extension agents indicate that the majority ($x = 2.5$) had access to television, followed by number ($x = 2.6$ and 2.7) who had access to phones and radio, respectively. A smaller proportion (1.3 and 1.1) had access to print media and cassette recorders, while the lowest response ($x = 1.0$) was recorded for access to internet-connected computers and GIS, respectively. These findings are consistent with those of Olaniyi (2017) who observed extensive access to radio, television, and mobile phones among extension workers in Nasarawa state, while a smaller percentage (49%) had access to computers, which they deemed essential among all ICT facilities.

Table 4: Mean score responses of extension agents on the extent of access to ICT facilities

Items	Mean scores (x)	Decision rule = 2.5
Radio	2.7	Accepted
Mobile phone	2.6	Accepted
Television	2.5	Accepted
Print media	1.3	Rejected
Internet connected computer	1.0	Rejected
Cassette recorders	1.1	Rejected
Geographical Information System	1.0	Rejected
Average	1.7	Rejected

Weighted mean = 2.5

Source: Field survey (2024)

The results outlined in Table 5 concerning the scope of information and communication technology application by extension agents reveal that while nearly all farming-related information was spread via ICT, the degree of distribution was relatively low. Particularly, gathering information from research institutions and farmers (2.7), obtaining information on new seed varieties and seedlings (2.6), best planting techniques (2.6), and methods of livestock management (2.6) were areas where respondents exhibited a higher level of application. Conversely, learning how to store produce effectively (1.0) and obtaining market updates (2.4), among others, recorded a lower application level.

These results support the discoveries from Isiaka *et al.* (2009), who suggested that many extension employees lacked complete awareness of the possibilities. use of ICT devices such as computers, the internet, and GSM for efficiently accomplishing various functions in extension service delivery. This lack of awareness aligns with the observations of Wijekon and Newton (2000), who emphasized that without adequate comprehension of communication technology's potential, extension workers may not fully realize its efficient utilization.

Table 5: Mean score responses of extension agents on the use of ICTs

Categories	Decision
Obtain information on new seed varieties and seedlings	2.6 (Accept)
Get market situation updates	2.4 (Reject)
Gather information from research institutions and farmers	2.7 (Accept)
Acquire new skills	0.6 (Reject)
Learn the best planting techniques	2.6 (Accept)
Find out the optimal time for harvesting farm products	2.0 (Reject)
Discover the best processing methods	2.2 (Reject)
Learn how to store produce effectively	1.0 (Reject)
Maintain accurate records	0.4 (Reject)
Get information on farm inputs	1.8 (Reject)
Communicate with extension workers and farmers	2.0 (Reject)
Learn about agro-chemical usage	0.9 (Reject)
Find information on credit needs	0.7 (Reject)
Learn about improved poultry breeds	0.2 (Reject)
Understand methods of deworming pigs	2.1 (Reject)
Learn methods for disease prevention and control	1.9 (Reject)
Understand pest control strategies	1.8 (Reject)
Learn the best methods for feeding livestock	2.6 (Accept)
Average score	1.7 (Reject)

Average Mean score = 1.7, decision = 2.5

Source: Field survey, 2024

The result of the average score analysis with cut-off of 2.5 in Table 6 shows that the respondents utilized phones ($x = 3.0$), radio ($x = 3.0$), and television ($x = 2.8$) to a great extent. Others were cassette recorder/players ($x = 2.9$), internet connected computers ($x = 2.2$), projector ($x = 1.8$), prints/libraries ($x = 2.8$), and GIS ($x = 1.0$). In alignment with the research conducted by Olaniyi (2017), it was revealed that 56.2% of the extension workers surveyed utilized various ICT tools such as telephones, television, radio, cameras, video, internet and print media for agricultural extension activities. Their findings highlighted the necessity for heightened education and awareness initiatives to promote the effective utilization of ICTs among extension workers.

Table 6: Mean score responses of extension agents on the extent of utilization of ICT facilities

ICTs	Mean scores	Decision rule
Radio	3.0	Accepted
Mobile phone	3.0	Accepted
Television	2.8	Accepted
Print media	2.8	Rejected
Internet connected computer	2.2	Rejected
Cassette recorders	2.9	Accepted
Geographical Information System	1.0	Rejected
Average	2.3	Rejected

Weighted mean = 2.5

Source: Field survey (2024)

Regression results on factors influencing the utilization of ICTs in extension service delivery

The logit regression analysis identifies several significant factors influencing ICT utilization among extension agents. Marital status shows a strong positive effect (coeff. = 0.776, $p < 0.01$), indicating that married agents are more likely to use ICTs, possibly due to greater stability and

resources (Adebayo, 2013). Monthly income (coeff. = 0.045, $p < 0.05$) and secondary occupations (coeff. = 0.380, $p < 0.05$) also positively influence ICT utilization, suggesting that higher income and diversified income sources enhance the capacity to invest in and utilize ICTs (Olaniyi, 2017).

Awareness (coeff. = 0.664, $p < 0.01$) and accessibility (coeff. = 0.264, $p < 0.01$) are critical, highlighting the importance of exposure and easy access to ICT tools. These results are consistent with earlier research, emphasizing the role of awareness and accessibility in technology adoption (Aker, 2011). Interestingly, social organizations (coeff. = -0.150, $p < 0.05$) negatively affects ICT use, suggesting that this could be as a result of the absence of motivation because many researchers have found a strong mediating role of motivation between perceived organizational support and employee performance. In this context, it refers to the performance of extension agent in their organization when they use ICTs in extension work.

Other variables such as gender, age, level of education, and working experience did not show significant effects, indicating that these factors may be less critical in this context. The model's high Pseudo R^2 value (0.6295) demonstrates a strong explanatory power, affirming the importance of the identified factors in influencing ICT utilization among extension agents.

Table 7: Logit regression results on factors influencing the utilization of ICTs

Variables	Coefficients	Std. Error	P-Value
Gender	0.235	0.410	0.567 ^{NS}
Age	0.012	0.013	0.345 ^{NS}
Marital status	0.776	0.156	0.000**
Level of education	-0.377	0.203	0.064 ^{NS}
Working experience	-0.120	0.062	0.055 ^{NS}
Monthly income	0.045	0.022	0.041*
Secondary occupations	0.380	0.170	0.027*
Social organizations	-0.150	0.068	0.031*
Awareness	0.664	0.027	0.000**
Accessibility	0.264	0.041	0.000**
Constant term	0.313	0.217	0.307
No. of observation	200		
Log likelihood	- 57.1125		
LR Chi ² (10)	70.93		
Prob>chi-square	0.0000		
Pseudo R ²	0.6295		

Note: **, * and ^{NS} indicate significance at 10%, 5% probability level and not significant respectively.

Source: Field survey, 2024

Conclusion and Recommendations

The study aimed to uncover the present state of ICT access, utilization, and the primary factors influencing the use of ICTs among extension agents in the study area. It was observed that extension work is predominantly male-oriented due to cultural and religious norms, which traditionally associate it with men in the region, thus dissuading women from engaging in extension activities. Regarding ICT utilization, radio and television, followed by phones, emerged as the most accessed and utilized ICT tools among extension agents.

Furthermore, due to the uniformity among extension agents, there was no significant difference observed in terms of gender, age, level of education, or working experience concerning ICT

adoption. Similarly, factors such as marital status, monthly income, secondary occupations, involvement in social organizations, awareness, and accessibility were identified as influential in the utilization of current ICT components by extension agents in the study area. This utilization is anticipated to enhance the prompt and accurate delivery of extension messages, facilitating the dissemination of timely and up-to-date information.

Leveraging ICTs holds promise for substantial enhancement of both rural livelihoods and the agricultural sector, areas deeply intertwined with the lives of many rural individuals facing poverty. Realizing this potential necessitates increased investment, encompassing both human resources and capital, into ICT initiatives that align with modern technologies. Based on the

findings of this study, the following recommendations have been put forward:

- i. Extension services in Kaduna State should integrate or reinforce the utilization of various ICTs, particularly modern ones like the internet and mobile phones, for disseminating information to farmers. Extension organizations should establish websites to facilitate communication and collaboration with other stakeholders.
- ii. Structured ICT training programs should be implemented to empower extension agents with essential skills for maximizing the utilization of ICT facilities to enhance the delivery of extension services. These programs should emphasize the potential benefits offered by ICT tools in agricultural extension, aiming to increase awareness and proficiency among extension personnel.
- iii. Enhancing rural infrastructure, particularly electricity supply, is crucial in the study area.
- iv. Facilitating access to and utilization of ICTs by extension agents can be accomplished by furnishing them with financial and material resources. This could entail offering credit grants or providing equipment, which could be facilitated by government support.

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