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Determinants of Information Communication Technology Utilization for Service Delivery Among Extension Agents in Ondo State, Nigeria

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ABSTRACT

The study examines the level of ICT tool awareness, the extent of usage, constraints in using ICTs for agricultural extension service delivery, and the relationships between selected socio-economic characteristics and ICT usage. Data were collected through questionnaires distributed to 40 respondents using purposive sampling and analyzed using descriptive statistics (mean, frequency, standard deviation) and inferential statistics (Chi-square and PPMC). Findings revealed high awareness of ICT tools ($\bar{x}$=3.95) but low usage ($\bar{x}$=2.31). Major constraints included lack of electricity/power failures ($\bar{x}$=4.05), insufficient facilities ($\bar{x}$=3.97), ICT illiteracy ($\bar{x}$=3.88), non-availability of ICT facilities in ADP offices ($\bar{x}$=3.85), lack of government support and ineffective policies ($\bar{x}$=3.81), lack of support from ADP administration ($\bar{x}$=3.80), limited access to ICT tools ($\bar{x}$=3.77), corruption in governance ($\bar{x}$=3.75), and high costs of ICT facilities ($\bar{x}$=3.74). There was a significant relationship between gender (χ^2=0.362, p<0.05), religion (χ^2=2.511, p<0.05), and ICT tool awareness. Additionally, significant relationships were found between educational level (r=0.313, p<0.01), monthly salaries (r=0.267, p<0.05), and the extent of ICT usage among extension agents. The study recommends that governments develop policies to enhance ICT awareness, access, and usage among extension agents and provide alternative power sources. This will ensure greater integration of ICTs in extension service delivery and improve their effectiveness.

Keywords:
Information and communication technologies, awareness, usage, extension agents, tools

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INTRODUCTION

Information and Communication Technology (ICT) has become a cornerstone of modern life, reshaping how people communicate, access information, and conduct business (Nordin et al., 2021; Sema & Hema, 2022). In today's digital era, ICT tools empower individuals, organizations, and governments to enhance efficiency, productivity, and decision-making (Shao et al., 2022). The agricultural sector, a key driver of food security and economic development, is also benefiting from this technological revolution (Pawlak & Kołodziejczak, 2020).

In Nigeria, where agriculture is a major economic activity, ICT adoption among extension agents has the potential to transform agricultural practices, improve knowledge transfer, and boost productivity (Taofeeq et al., 2023). Extension agents, serving as vital intermediaries between farmers and the agricultural research and innovation system, rely on ICT tools to collect and disseminate critical information to farmers (Owolabi & Yekinni, 2022).

Information Communication Technology (ICT) has become an integral part of our daily lives, transforming how we communicate, access information, and conduct business (Nordin et al., 2021; Sema & Hema, 2022). In today's digital era, ICT tools empower individuals, organizations, and governments to enhance their efficiency, productivity, and decision-making capabilities (Shao et al., 2022). The agricultural sector is no exception to this technological revolution, as it plays a crucial role in ensuring food security and economic development (Pawlak & Kołodziejczak, 2020). In Nigeria, where agriculture is one of the main economic activities, using ICT among extension agents can significantly influence agricultural practices, knowledge transfer, and overall productivity (Taofeeq et al., 2023). The extension agents, who act as intermediaries between farmers and the agricultural research and innovation system rely on ICT tools to gather and disseminate relevant information to farmers (Owolabi & Yekinni, 2022).

Despite the potential benefits of ICT in agriculture, various factors significantly influence the extent to which extension agents adopt and utilize these technologies (Akinade et al., 2020). Understanding these factors is essential for formulating effective policies and strategies to enhance ICT adoption, ultimately boosting agricultural productivity and fostering rural development (Antwi-Agyei & Stringer, 2021). A critical determinant of ICT utilization is access to technology and infrastructure. The availability of resources such as computers, internet connectivity, and software applications often varies across regions (Fidelis & Onyango, 2021). Limited access to these resources creates significant barriers for extension agents, hindering their ability to effectively utilize ICT tools (Fatusin & Oladehinde, 2018). Another key factor is the level of digital literacy among extension agents, which refers to their ability to effectively use and navigate ICT tools and platforms. Familiarity with these tools and their functionalities plays a vital role in shaping agents' confidence and willingness to adopt them in their work. A lack of digital literacy skills can severely limit the effective use of ICT tools, reducing the potential benefits they offer (Mustapha et al., 2022).

However, despite the potential benefits of ICT utilization within the agricultural sector, various factors can positively or negatively impact the extent to which extension agents embrace and leverage these technologies (Akinade et al., 2020). Understanding these factors is crucial for developing effective policies and strategies to enhance ICT utilization among extension agents, leading to improved agricultural productivity and rural development (Antwi-Agyei & Stringer, 2021). One of the key determinants of ICT utilization among extension agents is their access to technology and infrastructure. The availability of ICT resources, such as computers, internet connectivity, and software applications, varies across different regions and localities (Fidelis & Onyango, 2021). Limited access to these resources can create barriers for extension agents, limiting their ability to utilize ICT tools effectively (Fatusin & Olade-

hinde, 2018). Also, the level of digital literacy among extension agents is another factor which is the ability to use and navigate ICT tools and platforms effectively. The extent to which extension agents are familiar with various ICT tools and their functionalities can influence their willingness and confidence to adopt these technologies in their daily work. A lack of digital literacy skills can hinder the effective utilization of ICT tools and limit the potential benefits they can bring (Mustapha et al., 2022). The attitudes and perceptions of extension agents toward ICT are pivotal in shaping their utilization patterns. Positive attitudes, such as viewing ICT as a valuable tool for information dissemination and knowledge sharing, encourage the adoption of these technologies (Mustapha et al., 2022). Conversely, negative perceptions or resistance to change can hinder the effective use of ICT tools (Sa'adu et al., 2022).Training and capacity-building programs tailored to the specific needs of extension agents are also critical. Such programs enhance digital literacy, equip agents with practical skills to use ICT tools for agricultural extension services, and address existing barriers or misconceptions about their adoption (Olagunju et al., 2021; Ifeanyi-Obi & Corbon, 2023). Furthermore, institutional support and policies play a significant role in promoting ICT utilization within the agricultural sector. Policies that prioritize investment in ICT infrastructure, offer incentives for adoption, and foster collaboration and knowledge sharing among stakeholders create an enabling environment for ICT use (Antwi-Agyei & Stringer, 2021; Pallavi et al., 2023).

Furthermore, the attitudes and perceptions of extension agents towards ICT play a significant role in determining their utilization patterns. Positive attitudes towards ICT, such as perceiving it as a valuable tool for information dissemination and knowledge sharing, can drive extension agents to explore and adopt these technologies (Mustapha et al., 2022). On the other hand, negative perceptions or resistance to change can impede the adoption and utilization of ICT tools among extension agents (Sa'adu et al., 2022). The availability of training and capacity-building programmes tailored to the needs of extension agents can influence their adoption and utilization of ICT (Olagunju et al., 2021). Effective training programmes can enhance the digital literacy skills of extension agents, provide them with practical knowledge on how to utilize specific ICT tools for agricultural extension services and address any existing barriers or misconceptions regarding their adoption (Ifeanyi-obi & Corbon, 2023). In addition, the level of institutional support and policies promoting ICT utilization within the agricultural sector can significantly impact the willingness and ability of extension agents to embrace these technologies (Antwi-Agyei & Stringer, 2021). Policies that prioritize investment in ICT infrastructure, provide incentives for extension agents to adopt ICT tools, and encourage collaboration and knowledge sharing among different stakeholders can create an enabling environment for ICT utilization (Pallavi et al., 2023). Despite the growing availability and significance of ICT tools in modern agricultural extension services, a gap remains in understanding the factors influencing their utilization among extension agents in Ondo State, Nigeria. This gap limits the effective adoption and integration of ICT into extension practices, reducing agents' ability to deliver timely, relevant information to farmers and potentially hindering agricultural productivity and socio-economic development in the region (Owolabi & Yekinni, 2022).

ICT tools have the potential to revolutionize agricultural practices. According to Sennuga et al. (2023), they enable farmers to gather demands, collaborate on learning, exchange critical information such as market prices and disease outbreaks, and improve the efficiency of extension systems. ICTs also facilitate farmer involvement in need assessment, multi-stakeholder brainstorming, exploration of alternative production technologies, market and credit access, training and demonstration activities, community learning, personalized information compilation, and disaster early warning systems. Connec-

tivity, whether through the internet or mobile devices, is transforming rural communities by providing access to financial, health, and market information in unprecedented ways (Feyen et al., 2021; Dwivedi et al., 2021). These advancements underscore the importance of addressing barriers to ICT adoption to maximize their impact on agricultural extension services.

Despite the increasing availability and importance of information communication technology (ICT) tools in modern agricultural extension services, there appears to be a gap in understanding the factors influencing the utilization of these technologies among extension agents in Ondo State, Nigeria. This knowledge gap hinders the effective adoption and integration of ICT into agricultural extension practices, potentially limiting the extension agents' ability to deliver timely and relevant information to farmers, ultimately impacting agricultural productivity and socio-economic development in the area (Owolabi & Yekinni, 2022). According to Sennuga et al. (2023), ICTs can help farmers better gather demands, collaborate on learning, exchange timely information (like market prices and disease outbreaks), improve the efficiency of extension systems and structures, involve farmers in assessing their own needs and solutions, facilitate multi-stakeholder brainstorming, explore alternative production technologies, make it easier for farmers to access markets and credit, provide training and demonstration, promote community learning, search, select, and compile information for individual clients, and provide early warning systems for weather and disasters. Additionally, it was noted that "connectivity," whether through the internet or mobile devices, is helping to transform people's lives in previously unheard-of ways by providing financial, health, and market information to rural locations (Feyen et al., 2021; Dwivedi et al., 2021).

Information distribution is most effective when grassroots extension workers operate within small areas of authority. Studies on extension organizations highlight that such a structure enhances efficiency for several reasons. Agha et al. (2018) emphasize that agricultural production and rural livelihoods in developing nations could significantly improve through a strong agricultural extension linkage supported by seamless information flow, made possible by the effective use of ICT. ICT enables extension workers to collect, store, retrieve, and communicate diverse information essential for farmers. In contrast, the current structure—characterized by large jurisdictions with limited operations—is less effective (Shaibume et al., 2021). Efficient ICT utilization by extension agents can simplify their tasks and improve the dissemination of extension services (Owolabi & Yekinni, 2022). ICT tools, particularly computers, allow agents to create work schedules and budgets, analyze data, publish scientific articles, develop training curricula and materials, and communicate more effectively with farmers (Shahid et al., 2019).

Information distribution is most successful when a grassroots extension worker covers a small area of authority for several reasons, according to several studies done on extension organizations. According to Agha et al. (2018), agricultural production and rural livelihoods in developing nations would be greatly increased by a robust agricultural extension linkage complemented by faultless information flow enhanced by the efficient use of information and communication technologies (ICT). ICT can assist by enabling extension workers to collect, save, retrieve, and communicate a wide variety of information needed by farmers. The current structure of huge jurisdictions, each with a limited range of operations, is less successful (Shaibume et al., 2021). Extension agents' jobs would be made simpler and the dissemination of information about extension services would be facilitated if they utilize ICT effectively and efficiently (Owolabi & Yekinni, 2022). They will be able to create work schedules and budgets, evaluate data, publish scientific articles, create curriculum and handouts for trainers, and communicate with farmers more readily with the use of computers (Shahid et al., 2019).

ICTs have the potential to complement traditional extension systems by facilitating the distribution of "Knowledge Resources" to millions of farmers, offering a much-needed boost to the agricultural sector (Aravind et al., 2020). ICT is often regarded as a tool that transforms the world into a global village, enhancing the delivery of goods and services and ensuring an efficient flow of information (Titus, 2020). However, these communication channels remain underutilized, with only a few extension organizations leveraging ICT for disseminating agricultural innovations and service delivery. This underuse is attributed to factors such as limited knowledge, low perceived utility, lack of ease of use, and other barriers (Owolabi & Yekinni, 2022).

ICTs can supplement the traditional extension system for "Knowledge Resource" distribution to millions of farmers, and it is anticipated that their incorporation into agricultural extension would provide the agricultural industry a much-needed boost (Aravind et al., 2020). Generally, it is believed that ICT is the tool that makes the world a global village which brings about high delivery of goods and services and an effective flow of information (Titus, 2020). These channels of communication are not fully utilized, only a few numbers of extension organizations use ICT for dissemination of agricultural information on innovation and service delivery due to a lack of knowledge, low level of perceived usage, ease of use, and a lot more (Owolabi & Yekinni, 2022).

The determinants of ICT utilization among extension agents in Ondo State, Nigeria, are complex and interconnected. Addressing key factors such as enhancing access to technology and infrastructure, improving digital literacy, fostering positive attitudes toward ICT, offering targeted training programs, and implementing supportive policies can encourage the adoption and effective use of ICT tools in agriculture (Afzal et al., 2023). These efforts can unlock ICT's potential to increase agricultural productivity, enhance rural livelihoods, and promote sustainable development in Ondo State. Given the importance of ICT in modern agricultural practices, it is essential to examine the determinants of its utilization among extension agents in the region. The objectives of this study are to:

Describe the socio-economic characteristics of extension agents.

Assess the levels of awareness of ICT tools among extension agents.

Examine the extent of ICT usage by extension agents.

Identify the constraints to ICT utilization among extension agents.4oThe determinants of ICT utilization among extension agents in Ondo State, Nigeria are multifaceted and interlinked. Addressing these factors, such as improving access to technology and infrastructure, enhancing digital literacy skills, fostering positive attitudes towards ICT, providing relevant training programmes, and promoting supportive policies, can stimulate the adoption and effective utilization of ICT tools within the agricultural sector (Afzal et al., 2023). By doing so, we can unlock the potential of ICT to boost agricultural productivity, improve rural livelihoods, and contribute to sustainable development in Ondo State. There is a need therefore to examine the determinants of ICT utilization among extension agents in Ondo state. The study objectives were to:

Describe the socio-economic characteristics of the extension agents.

Determine the levels of awareness of ICT tools among extension agents.

Examine the extent of ICT usage by extension agents.

Identify the constraint to the use of ICT among extension agents.

Hypotheses

There is no significant relationship between the socio-economic characteristics of extension agents and their level of awareness of ICT.

There is no significant relationship between the socio-economic characteristics of extension agents and their extent of ICT usage.

METHODOLOGY

The study was conducted in Ondo State,

which is divided into four zones (Ikare, Owo, Ondo, and Okitipupa) based on the Agricultural Development Programme (ADP) delineation. These four ADP zones were purposively selected for the study. The target sample consisted of extension agents working under the Ondo State Agricultural Development Project (ODSADEP) across the four zones. Due to the unavailability of data on the sampling frame, 10 extension agents were purposively selected from each zone, resulting in a total sample size of 40 extension agents. Interviews were conducted using a standardized questionnaire, with each of the 40 selected extension agents from the four zones participating. The data collected from the respondents were analyzed using both descriptive and inferential statistics.

The study was conducted in the Ondo State. The State is divided into four zones (Ikare, Owo, Ondo, and Okitipupa) according to the Agricultural Development Programme (ADP) delineation. The four ADP zones were purposively selected. The total population of extension agents working under the four Zones of the Ondo State Agricultural Development Project (ODSADEP) is the study's target sample. However, 10 extension agents were chosen via purposive sampling in each zone because the researcher was unable to obtain the data on the sampling frame. Ultimately, the study's sample size consisted of 40 extension agents. Using a standardized questionnaire, interviews were conducted with each of the 40 extension agents who were chosen for the zones. The data gathered from the respondents was analyzed using both descriptive and inferential statistics.

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

The study was conducted in Ondo State, which is divided into four zones (Ikare, Owo, Ondo, and Okitipupa) based on the Agricultural Development Programme (ADP) delineation. These four ADP zones were purposively selected for the study. The target sample consisted of extension agents working under the Ondo State Agricultural Development Project (ODSADEP) across the four zones. Due to the unavailability of data on the sampling frame, 10 extension agents were purposively selected from each zone, resulting in a total sample size of 40 extension agents. Interviews were conducted using a standardized questionnaire, with each of the 40 selected extension agents from the four zones participating. The data collected from the respondents were analyzed using both descriptive and inferential statistics.

Table 1 shows that the average age of extension agents in Ondo State is 38 years old, with the majority (77.5%) falling between the ages of 31 and 50. Merely 10.0 percent and 12.5 percent of the population, respectively, were younger than 30 and older than 51. This is consistent with the research conducted by Adebayo et al. (2020), which found that most extension agents in Ondo State are young and in their prime years for employment. It is anticipated that this quality would increase their ICT innovation. Just 37.5 percent of the extension agents were female, with over half (62.5%) being male. This suggests that men make up the majority of ODSADEP's workforce. This is in line with the findings of Owolabi and Yekinni (2022), who among extension agents in Southwest Nigeria observed a similar conclusion.

The findings also indicated that the majority of respondents were married (82.5%), with 10.0 percent being single, suggesting that most are responsible adults likely to be committed and focused on their roles as extension agents. Additionally, 5.0 percent were divorced, and 2.5 percent were widowed. In terms of educational qualifications, 32.5 percent of extension agents held a B.Sc. degree, while 22.5 percent had an HND (Higher National Diploma). Furthermore, 17.5 percent held a PGD (Postgraduate Diploma), 15.0 percent had an OND (Ordinary National Diploma), and 4.0 and 2.5 percent possessed an M.Sc. and NCE (Nigeria Certificate in Education), respectively, as shown in Table 1. These figures highlight that a significant proportion of extension agents in the region have formal education. Adebayo et al. (2022) and Musta-

pha et al. (2021) also reported that the majority of extension agents in Southwest and Northeast Nigeria are well-educated and proficient in ICT. Table 1 further shows that nearly 30.0 percent of respondents had between 11 and 15 years of work experience, followed by 25.0 percent with less than 5 years, and smaller proportions with 6 to 10 years and 16 to 20 years. Only 10.0 percent had more than 21 years of experience. This suggests that the respondents possess considerable experience in extension work and are likely to be receptive to using ICT to enhance their performance.

Likewise, the findings showed that the majority of the respondents were married (82.5%), and 10.0 percent were single implying that they can be tagged as responsible adults who are likely to be committed and focused on their duty as extension agents. While 5.0% are divorced and 2.5 percent widowed. Close to half 32.5 percent of extension agents have a B.Sc. degree, with 22.5 percent having HND (Higher National Diploma). While 17.5 percent and 15.0% have PGD (Postgraduate Diploma) and OND (Ordinary National Diploma) respectively with 4% and 2.5% having M.Sc. and NCE (Nigeria Certificate in Education) as shown in Table 1. This indicates that a large proportion of extension agents in these regions possess formal education. According to research by Adebayo et al. (2022) and Mustapha et al. (2021), the majority of extension agents in Nigeria's southwest and northeast have strong educational backgrounds and are proficient with ICT. Table 1 also reveals that almost half of the respondents (30.0%) had between 11 and 15 years of work experience, followed by those with less than 5 years (25.0%), those with 6 to 10 years, and those with 16 to 20 years. 10.0 percent, however, have worked for more than 21 years. This suggests that the respondents have a great deal of experience working on extensions, and it is believed that they would be open to using ICT to carry out their responsibilities more successfully.

The investigation also revealed that the monthly pay of extension agents was approximately N50,000 ($40.1), with 92.4 percent of them earning between N50,000 and N100,000 ($40.1 to $80.2) per month. This suggests that the extension agents in the study area fall within a low-income bracket, which may negatively impact their ability to use ICT effectively. This finding aligns with the research by Muhammad et al. (2019), who noted that extension workers lacked the financial resources to purchase and maintain most ICT tools, particularly smartphones and PCs with their peripherals. Similarly, Mustapha et al. (2021) observed that the monthly income of extension workers in Northeast Nigeria also ranged from N50,000 to N100,000 ($40.1 to $80.2), which could explain their relatively lower use of ICT compared to agricultural researchers in the region.

Furthermore, the investigation revealed that extension agents' level-based monthly pay was around N50,000 ($40.1). The income range for half (92.4%) of extension agents is N50,000 to N100,000 ($40.1 to $80.2) per month. This suggests that the extension agents in the study area were low-income individuals, which may have had a detrimental effect on their use of ICT. This result is consistent with the findings of Muhammad et al. (2019), who found that the extension workers lacked the financial means to purchase and maintain the majority of ICTs, particularly smartphones and PCs together with their peripherals. Mustapha et al. (2021) found that the monthly income of extension workers in North-East Nigeria ranged from N50,000 to N100,000 ($40.1 to $80.2). This may explain why they use ICT less frequently than agricultural researchers in the area.

In terms of specialization, half (50.0%) of the respondents studied Agricultural Extension, while 17.5 percent studied General Agriculture and 12.5 percent studied Agricultural Economics. This indicates that a significant portion of the extension agents have a background in Agricultural Extension, which equips them with the knowledge to understand farmers' needs and how they may respond to innovations that can enhance their agricultural practices.

Table 1
Distribution of Respondents Based on Socio-economic Characteristics.

Selected socio-economic characteristics	Frequency	Percentage
Age (Years)		
≤ 30	4	10.0
31-40	20	50.0
41-50	11	27.5
≥ 51	5	12.5
Gender		
Male	25	62.5
Female	15	37.5
Marital Status		
Single	4	10.0
Married	33	82.5
Divorced	2	5.0
Widowed	1	2.5
Religion		
Christian	29	72.5
Islam	9	22.5
Traditionalist	2	5.0
Education qualification		
NCE	1	2.5
OND	6	15.0
HND	9	22.5
B.Sc.	13	32.5
PGD	7	17.5
M.Sc.	4	10.0
Work experience (Years)		
< 5	10	25.0
6-10	8	20.0
11-15	12	30.0
16-20	6	15.0
≥ 21years	4	10.0
Monthly salary (N)		
< 50,000	6	15.0
50,001-100,000	20	50.0
100,000- 150,000	6	15.0
150,001-200,000	3	7.5
200,001-250,000	4	10.0
≥ 250,001	1	2.5
Area of degree specialization		
General Agriculture	7	17.5
Agricultural Extension	20	50.0
Agricultural Economics	5	12.5
Agronomy	3	7.5
Fisheries	2	5.0
Forestry	2	5.0
Agricultural Biology	1	2.5

Awareness of ICT tools among extension agents

Table 2 shows that, with a mean score of 4.43, more than half (62.5%) of the extension agents were highly aware of phones as ICT tools, followed by moderately aware television sets (47.5%) and computers (45.6%). Additionally, half (50.0%) of the extension agents were extremely aware of printers (67.1%), cameras (53.4%), radios (45.5%), internet (websites) (44.3%), computer software (42.0%), e-mail (37.5%), and USB drives (43.2%) as ICT tools. Meanwhile, less than half were extremely aware of search engines (36.4%) and GIS (35.2%), with a mean score of 3.75, as well as projectors (34.1%) and scanners (35.2%). Hasan and Sabbir (2020) emphasized that consumers do not make quick purchase decisions but go through an adoption process, with awareness being the first stage. Sa'adu et al. (2022) suggested that governments should create strategies focused on increasing extension agents' awareness of, access to, and training in ICTs, which would help them stay in the system and use ICTs more frequently in extension services. Moreover, Kumar et al. (2021) noted that extension agents had a moderate understanding of the ICT technologies currently used for providing extension services.

Table 2
Frequency Distribution of Extension Agents' Awareness of ICT Tools.

ICTs	NTA	SLA	SMA	MDA	EXA	Mean
Phones	1(2.3)	2(3.4)	3(5.7)	9(26.1)	25(62.5)	4.43
Television set	1(2.5)	3(7.5)	8(20.0)	19(47.5)	9(22.5)	4.43
Camera	3(5.7)	2(4.5)	5(12.5)	9(23.9)	21(53.4)	4.15
E-mail	2(6.8)	5(10.2)	4(9.1)	14(36.4)	15(37.5)	3.88
Computer	2(5.7)	1(4.5)	4(8.0)	11(25.0)	22(56.8)	4.23
Projector	5(12.5)	2(6.8)	6(13.6)	13(33.0)	14(34.1)	3.69
GIS	3(8.0)	5(12.5)	4(11.3)	13(33.0)	15(35.2)	3.75
Internet (Website)	3(5.7)	3(5.7)	6(14.8)	11(29.5)	17(44.3)	4.01
Pocket devices	4(10.2)	6(14.8)	9(23.9)	11(26.1)	10(25.0)	3.41
Radio	2(6.8)	1(3.4)	4(10.2)	13(34.1)	18(45.5)	4.08
USB drive	4(10.2)	3(8.0)	5(13.6)	11(25.0)	17(43.2)	3.83
Scanners	7(15.9)	3(8.0)	5(13.6)	10(27.3)	15(35.2)	3.58
Computer software	4(11.4)	1(3.4)	2(6.8)	15(36.4)	18(42.0)	3.94
Search engines	4(10.2)	4(10.2)	4(10.2)	13(33.0)	15(36.4)	3.75
Printers	3(5.6)	1(2.3)	4(11.4)	12(30.7)	20(50.0)	4.17

NTA=Not Aware, SLA=Slightly Aware, SMA=Somewhat Aware, MDA=Moderately Aware, EXA=Extremely Aware

Level of awareness of ICT tools among extension agents

Table 3 presents the descriptive data on the ICT awareness level of extension agents. Based on the defined range of (1-2.33) as low, (2.34-3.67) as moderate, and (3.68-5.00) as high, the mean scores and standard deviations of the degree of agreement were calculated on a 5-point Likert scale. The results in Table 3 indicate that the level of ICT tool awareness among extension agents is high (M = 3.95; SD = 0.86).

Table 3
Level of Awareness of ICT Tools.

Awareness of ICT tools	Frequency	Percentage	Mean	SD
Low	3	7.5		
Moderate	9	22.5	3.95	0.86
High	28	70.0		
Total	40	100		

M=mean, SD=Standard deviation

Extent of ICT usage by extension agent

Table 4 illustrates the distribution of respondents based on the extent of ICT usage. More than half (64.8%) of the extension agents used phones every time, with a mean of 4.36. Additionally, 43.2 percent used a camera, and 39.7 percent used a television set every time, with means of 4.03 and 3.99, respectively. Less than half (42.0%) of the extension agents used e-mail, with a mean of 3.98, followed by 40.9 percent using computers (M = 3.97), 44.3 percent using radio (M = 3.95), and 44.3% using printers (M = 3.83). Internet (website) was used by 33.0 percent(M = 3.75), computer software by 34.1percent (M = 3.74), and search engines by 33.0 percent (M = 3.61) every time. In contrast, less than half used GIS (33.5%), pocket devices (29.5%), USB drives (26.1%), and scanners (28.4%) occasionally, with means of 3.27, 3.23, 3.38, and 3.46, respectively. Only 31.8 percent used projectors every time, with a mean of 3.53. This suggests that nearly all extension agents used ICT tools frequently, albeit primarily for personal purposes rather than for extension service delivery. A similar study by Islam et al. (2017) in Bangladesh found that extension workers also used ICT tools more for personal purposes than for official duties.

Table 4
Frequency Distribution of Extent of ICT Usage by Extension Agents.

Extent of ICT usage	NVR	RRY	OCC	AET	EYT	Mean
Phones	2(3.4)	1(2.3)	5(13.6)	6(15.9)	26(64.8)	4.36
Television set	3(5.7)	2(4.5)	5(13.6)	14(36.4)	16(39.8)	3.99
Camera	1(2.3)	4(10.2)	5(12.5)	13(31.8)	17(43.2)	4.03
E-mail	2(4.5)	3(6.8)	8(17.0)	12(29.3)	16(42.0)	3.98
Computer	3(8.0)	2(4.5)	4(11.4)	14(35.2)	16(40.9)	3.97
Projector	4(10.2)	4(10.2)	9(21.6)	13(31.9)	10(26.1)	3.53
GIS	5(11.4)	4(9.1)	15(37.5)	10(25.0)	6(17.0)	3.27
Internet (Website)	2(4.5)	5(12.5)	8(19.3)	12(30.7)	13(33.0)	3.75
Pocket device	5(13.6)	7(16.0)	11(29.5)	7(16.0)	10(25.0)	3.23
Radio	2(5.7)	3(6.8)	7(18.2)	10(25.0)	18(44.3)	3.95
USB drive	5(12.5)	5(12.5)	11(26.1)	8(22.8)	11(26.1)	3.38
Scanners	3(6.8)	6(14.8)	12(28.4)	11(26.1)	8(23.9)	3.46
Computer Software	2(5.7)	4(10.2)	9(22.7)	11(27.3)	14(34.1)	3.74
Search engines	3(9.0)	4(10.2)	9(23.9)	9(23.9)	12(33.0)	3.61
Printers	2(6.9)	3(9.0)	9(22.7)	8(17.1)	19(44.3)	3.83

NVR=Never, RRY=Rarely, OCC=Occasionally, AET=Almost Every Time, EYT= Every Time

Level of ICT usage among extension agents

Table 5 presents the descriptive statistics regarding the extent of ICT usage by extension agents. Using a 5-point Likert scale with a range of (1-2.339) indicating low usage, (2.34-3.67) indicating moderate usage, and (3.68-5.00) indicating high usage, the mean scores and standard deviations were calculated. The results indicate that the overall extent of ICT usage is low, with a mean of 2.31 and a standard deviation of 0.64.

Table 5
Level of ICT Usage.

Level of ICT usage	Frequency	Percentage	Mean	SD
Low	23	57.5		
Moderate	14	35.0	2.31	0.64
High	3	7.5		
Total	40	100		

M=mean, SD=Standard deviation

Hypotheses testing

Table 6's results show that there was no significant association between marital status and awareness of ICT tools (χ^2=3.574, p<0.05). However, a significant relationship was found between extension agents' awareness of ICT tools and gender (χ^2=0.362, p<0.05) and religion (χ^2=2.511, p<0.05). This suggests that the extension agents' awareness of ICT tools is influenced by their gender and religion, but not by their marital status. According to Idowu et al. (2021), gender differences revealed that male extension agents were generally more aware of ICTs and used them more than their female counterparts. However, female extension agents were found to use phones more frequently, while male agents used media vans, cameras, and the internet more. Furthermore, the correlation between awareness of ICT tools and religion (χ^2=2.511, p<0.05) indicates that the predominant religion in the study area—Christianity—had an impact on the respondents' awareness of ICTs. Despite this, the presence of other religions in the area suggests there is no religious bias or discrimination in the provision of extension services, as highlighted by Taiwo & Amosu (2020).

Table 6

Chi-Square Analysis of the Relationship between Selected Socio-economic Characteristics and the Awareness of ICT Tools.

Selected socio-economic characteristics	χ^2	df	*p*-value	Decision
Gender	0.362	1	0.054	Significant
Marital status	3.574	2	0.591	Not significant
Religion	2.511	3	0.047	Significant

*Significant: p<0.05; x^2: Chi-square value; df: degree of freedom; p-value: asymptotic significance value.

The findings presented in Table 7 demonstrate a statistically significant and positive correlation between the level of ICT usage and the education (r=0.313, p<0.05) and monthly salary (r=0.267, p<0.05) of extension agents. This indicates that the use of ICT tools is positively influenced by the respondents' educational attainment—more educated extension agents tend to use ICT tools more frequently. This result aligns with the findings of Mathews and Jadav (2020) and Adebayo et al. (2020), who also observed a positive and significant relationship between education and ICT usage. Additionally, a significant correlation was found between ICT usage and monthly income, suggesting that extension agents' lower income levels restrict their ability to purchase and maintain ICT tools, particularly expensive devices like laptops and peripherals. This result is supported by Dire et al. (2016), who found that low salaries limit extension agents' capacity to afford ICT technologies necessary for their work. Furthermore, the analysis revealed a substantial negative correlation between the age of extension agents (r=-0.260, p<0.05) and the frequency of ICT usage. This suggests that older extension agents are less likely to use ICT tools frequently. Similar findings were reported by Akintunde and Oladele (2019), who noted a 23 percent decrease in ICT usage for every unit increase in age, indicating that as extension agents age, their likelihood of using ICT tools for their work decreases.

Table 7

Pearson Product Moment Correlation (PPMC) Shows the Relationship between Selected Socio-economic Characteristics and the Extent of ICT Usage.

Selected socio-economic characteristics	r-value	*p*-value	Decision	Remark
Age	-0.260*	0.015	Significant	H_0 rejected
Educational level	0.313**	0.003	Significant	H_0 rejected
Years of experience	-0.203	0.057	Not significant	H_0 accepted
Monthly salaries	0.267*	0.012	Significant	H_0 rejected

*p<0.05; ** p<0.01

Constraints to the utilization of ICT among extension agents

The constraints faced by extension agents in using ICT tools, as highlighted in Table 8, include inadequate facilities (M=3.97) and power outages (M=4.05), which were identified as the most critical barriers. Lack of ICT facilities at ADP offices (M=3.85) and ICT illiteracy (M=3.88) were also significant challenges. Additionally, 39.8 percent of respondents agreed that poor policies and lack of government support (M=3.81) are very serious constraints, while 34.1 percent reported insufficient support from ADP administration (M=3.80). Other notable barriers include difficulties in acquiring ICT tools (M=3.77), governance-related corruption (M=3.75), and the high cost of ICT infrastructure (mean=3.74).These findings underline the substantial challenges hindering the smooth utilization of ICT tools by extension agents. They reflect systemic issues such as inadequate infrastructure, insufficient institutional support, and economic barriers. This aligns with Vihi et al. (2021), who noted that poor power supply, low network coverage, and connectivity issues significantly impact ICT usage for agricultural extension services. Similarly, Sa'adu et al. (2022) emphasized that high ICT costs, energy problems, lack of training, ICT illiteracy, and network challenges are critical obstacles in the effective deployment of ICT tools in extension work.

Table 8
Frequency Distribution of Constraints to the Use of ICT.

Constraints to ICT utilization	NSC	LTC	MSC	SSC	VSC	Mean
ICT illiteracy	5(12.5)	4(11.4)	8(19.3)	13(31.8)	10(25.0)	3.88
Lack of technical know-how	6(13.6)	7(18.2)	7(18.2)	11(28.4)	9(21.6)	3.26
Poor network service for television, telephones, and internet services	3(8.0)	2(5.7)	6(15.9)	13(31.8)	16(38.6)	3.46
Non-availability of ICT facilities in ADP offices	4(9.1)	3(5.7)	6(14.8)	12(31.8)	15(38.6)	3.85
Lack of access to ICT tools	3(6.9)	4(10.2)	7(17.0)	12(30.7)	14(35.2)	3.77
Lack of electricity/power failure	2(4.6)	4(8.0)	7(17.0)	8(19.3)	20(51.1)	4.05
Insufficient facilities	2(4.5)	3(6.8)	8(18.2)	11(28.5)	18(42.0)	3.97
Lack of support by the ADP administration	2(4.5)	5(11.4)	7(17.0)	14(34.1)	13(33.0)	3.80
Lack of interest of extension agents and ADP Management in ICT usage	8(21.7)	4(10.2)	7(17.0)	10(25.0)	11(26.1)	3.24
Lack of supportive government and bad policies	4(9.1)	3(6.8)	7(18.2)	11(26.1)	16(39.8)	3.81
Mismanagement of ICT facilities	4(11.3)	7(18.2)	5(12.5)	13(30.7)	11(27.3)	3.44
Corruption in the governance structure	3(8.0)	4(9.1)	8(21.6)	10(22.7)	15(38.6)	3.75
ICTs too complicated	9(22.6)	4(11.4)	5(12.5)	14(33.0)	8(20.5)	3.17
Lack of time	7(18.2)	7(18.2)	7(18.2)	8(20.4)	11(25.0)	3.16
Age /poor eyesight	6(14.9)	9(22.7)	6(13.6)	11(29.5)	8(19.3)	3.16
High cost of ICT facilities	3(8.0)	4(10.2)	7(17.0)	12(29.5)	14(35.3)	3.74

NSC=Not Serious Constraint, LTC=Least Constraint, MSC=Moderately Serious Constraint, SSC=Serious Constraint, VSC=Very Serious Constraint

CONCLUSION

The findings indicate that extremely serious barriers to ICT utilization in extension work include power outages, inadequate facilities, ICT illiteracy, lack of ICT resources in ADP offices, poor policies, insufficient government and ADP support, limited access to ICT tools, governance corruption, and the high cost of

ICT infrastructure. Significant correlations were found between gender, religion, and ICT awareness, as well as between educational level, monthly income, and ICT usage. To address these issues, governments should formulate policies focusing on improving ICT awareness, accessibility, and utilization among extension agents. Such policies should also incorporate provisions for alternative power sources to mitigate the impact of electricity shortages. These measures will help extension agents integrate ICT into their work more effectively, thereby enhancing the delivery of extension services.

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CONFLICT OF INTERESTS

The authors have declared no conflict of interest.

AUTHOR CONTRIBUTIONS

The first draft of the manuscript was written, analyzed, and written by OOO and OAG. OKO, AO, and KGF took part in the review, correction, and formatting of the paper. The final manuscript was read by OOA, COB, OAT and approved by all authors.

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