

## Effectiveness of ICTs in Extension Service Delivery among Smallholder Farmers in Kwali Area Council, Abuja, Nigeria

Ayoola Faith Joel<sup>1</sup>, Joseph Bamidele<sup>2</sup>, Beatrice Itoya Oyediji<sup>3</sup>, Mudashir Adeola Olaitan<sup>4</sup>, Ugochinyere Princess Eleke<sup>4</sup>, Oluwamayowa Joseph Joel<sup>1</sup>, Abubakar Tukur Tata<sup>4</sup>, Samson Olayemi Sennuga<sup>4\*</sup>

<sup>1</sup>Communication for Development Centre, AMAC Estate, Airport Road, Abuja, Nigeria

<sup>2</sup>Faculty of Business and Law, University of Northampton, Waterside Campus, University Drive, Northampton NN1 5PH, United Kingdom

<sup>3</sup>Department of Agricultural Extension and Rural Development, Faculty of Agriculture University of Ibadan, Nigeria

<sup>4</sup>Department of Agricultural Extension and Rural Sociology, Faculty of Agriculture, University of Abuja, FCT, P.M.B. 117, Abuja, Nigeria

### \*Corresponding Author

**Samson Olayemi Sennuga**

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

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**Abstract:** This study examined the effectiveness of Information and Communication Technologies (ICTs) in extension service delivery among smallholder farmers in Kwali Area Council, Abuja. A multistage sampling technique was employed to select 120 smallholder farmers on which structured questionnaire was administered complemented with interview schedule. Primary data collected were analyzed using descriptive statistics such as frequency counts, percentages and mean. Findings from the study revealed that majority farmers are male (91.7%), 63.3% aged between 36-45 years, married (66.7%), 60% have secondary education. Household sizes typically range from 4 to 6 members (45%), with farming experience mainly between 6 to 10 years (80.8%). Despite the importance of ICT in agriculture, only 10% of farmers currently use these technologies, primarily mobile phones (75%), with infrequent use overall. ICT-based extension services have notable impacts, including expanded information accessibility (75%), timeliness and relevance of information (90%), knowledge exchange (83.7%), skills development (72.5%), advancements in agricultural methods (85%), market access and financial integration (55%), risk management support (67.5%), and collaboration opportunities (73.3%). However, 80% of respondents find ICT tools not accessible or moderately accessible, and 90% have difficulty accessing ICT for farming information and support. Key constraints include limited ICT infrastructure (97.5%), high costs of devices and services (99.2%), low digital literacy (75%), language barriers (66.7%), geographical isolation (70%), limited content relevance (45%), inadequate technological support (95.8%), privacy concerns (47.5%), cultural barriers (90%), and poor connectivity (93.3%). Therefore, the study recommends; enhancement of ICT infrastructure, subsidizing ICT devices and services, improving digital Literacy, developing relevant and accessible ICT content and establishing technological support systems in the study region.

**Keywords:** ICTs, Extension Service, Delivery, Farmers, Digital Literacy, Adoption.

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## 1.0 INTRODUCTION

Agricultural extension services have long been recognized as essential tools for sharing information and knowledge among farmers. These

services provide guidance and support aimed at improving agricultural practices, marketing methods, and processing techniques (Okeke, Nwalieji and Uzuegbunam, 2019). The primary objective of these

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extension services is to foster rural development and elevate farmers' living standards by boosting farm productivity and increasing income opportunities (Sennuga *et al.*, 2024).

Recently, Nigeria's ICT sector has experienced remarkable growth, marked by a significant increase in both volume and coverage due to the advent of global systems of mobile (GSM) networks. This advancement has attracted substantial investments, particularly from private firms both domestically and internationally. As highlighted by Akinwale, Sanusi and Surujlal (2018), the deregulation and subsequent competition in the telecommunications sector have been crucial to this growth. Alongside mobile networks, other ICT services such as internet networking, software and database development, information security, and artificial intelligence have also made significant inroads into the Nigerian market (Lai-Solarin *et al.*, 2024).

Interestingly, despite Nigeria's economic downturns in 2016 and 2020, the ICT sector continued to show positive growth. Notably, the sector achieved a remarkable 14.70 percent growth in the final quarter of 2020 (NBS, 2020). The ICT sector's contribution to Nigeria's GDP has also been on the rise, growing from 12.1 percent in the last quarter of 2021 to an impressive 20.32 percent in the third quarter of 2022 (NBS, 2022). Beyond its direct contribution to GDP, the ICT sector exerts significant multiplier effects, transforming various aspects of social, economic, cultural, and psychological life in the country. It plays a crucial role in enabling participation in the global economy and attracting investments (Oyediji *et al.*, 2024).

Information and Communication Technologies (ICTs) play a crucial role in supporting farmers and agricultural communities by enhancing productivity and sustainability in farming practices (Abdullahi *et al.*, 2019). Through e-agriculture, farmers gain access to a wealth of information at both national and regional levels. ICT tools enable farmers to stay informed about the latest developments in areas such as cropping patterns, irrigation techniques, fertilizers, weather forecasts, crop marketing, and innovative methods for improving crop quality and yields (Abubalar *et al.*, 2024).

E-agriculture encompasses a broad array of integrated technologies, including traditional telecommunications, television, radio, CD-ROMs, cell phones, and smart devices. It also includes more advanced technologies like computers, the internet, sensors, Geographic Information Systems (GIS), and satellites. The primary goal of ICT in this context is to facilitate the transfer of information from one

location to another, thereby providing farmers with the knowledge they need to optimize their agricultural practices (Eleke *et al.*, 2024).

ICTs have fundamentally transformed the operations of individuals, governments, and businesses, both large and small, in today's world. The widespread adoption of these technologies has greatly improved communication and expanded access to services and information for previously underserved populations. According to Badhe *et al.*, (2021), innovative strategies to enhance information and communication processes have significantly advanced agricultural and rural development through technology, particularly in the context of Indian agriculture, or "e-agriculture." Farmers can now remotely manage their operations using sensing technologies, drones, and other devices that collect crucial data on soil conditions, air quality, crop health, and weather patterns. This data allows farmers and agribusinesses to monitor crop growth closely, optimize the application of agrochemicals and natural resources, and quickly adjust to changing environmental conditions (Oyediji *et al.*, 2024b).

In recent times, ICTs have become pivotal in transforming agricultural extension services. They have revolutionized the dissemination of knowledge and innovations to farming communities by offering timely information, enhancing market connections, and providing training opportunities. ICTs play a crucial role in promoting the adoption of advanced agricultural practices and managing agricultural enterprises (Okeke *et al.*, 2019).

Despite their potential, traditional extension systems such as the Training and Visit (T&V) model face notable limitations, particularly in countries like Nigeria (Suvedi, Ghimire, & Kaplowitz, 2017). Challenges such as insufficient training for extension staff and understaffing in Agricultural Development Programs (ADPs) hinder effective engagement and support for farmers. However, ICTs offer a promising avenue to bridge these gaps, amplifying the effectiveness of extension services. Digital platforms facilitate agricultural outreach by overcoming geographical limitations, providing broader access to information and advisory services, and contributing to more efficient resource management, data collection, and communication (Perez *et al.*, 2022).

The COVID-19 pandemic highlights the essential role of ICTs in maintaining agricultural extension services during emergencies (Bidemi, 2020). Movement restrictions and social distancing measures disrupted face-to-face interactions, making ICTs indispensable for sustaining communication and support for rural farmers. Agricultural extension professionals can leverage various digital tools and

platforms, such as mobile apps and online portals, to provide customized, context-relevant information and services to rural areas (Okello *et al.*, 2020; Mohammed *et al.*, 2024).

While agriculture remains central to the socio-economic structure of communities, especially for smallholder farmers, integrating ICTs into extension services is not without challenges. In smallholder farming communities, several barriers hinder the adoption of ICTs. A lack of reliable internet access, digital literacy gaps, and financial constraints are significant obstacles. Many farmers lack awareness of available ICT-based extension services, limiting their impact on agricultural productivity (Tsan *et al.*, 2019; Nnanna *et al.*, 2024).

Other issues include language barriers, as many ICT tools are not available in languages easily understood by Kwali's linguistically diverse population, and unreliable electricity, which hampers regular use of ICT devices. Additionally, concerns about data privacy and inadequate technical support prevent farmers from resolving ICT-related issues. Behavioral resistance to change and the misalignment of ICT tools with local farming practices also restrict widespread adoption (Muhammad & Abdullahi, 2023). Addressing these challenges requires a thorough understanding of the current state of ICT adoption in Kwali's extension services. This research aims to explore these issues, identify key barriers, and propose strategies to enhance the effectiveness of ICT-based extension services. By addressing these intricate challenges, ICTs can be harnessed to promote sustainable agricultural practices, improve the livelihoods of smallholder farmers, and transform the agricultural landscape of the study area. Therefore, it is crucial to evaluate the effectiveness of information and communication technologies in extension service delivery among smallholder farmers in Kwali Area Council, Abuja. Hence, the following objectives were formulated: to describe the socio-economic characteristics of smallholder farmers; evaluate the current state of Information and Communication Technologies (ICTs) adoption among smallholder farmers in the study area for extension services; identify the effect of ICT-based extension services on knowledge dissemination among smallholder farmers, examine the accessibility of ICT tools and platforms in the context of extension service delivery for smallholder farmers and identify the constraints faced by smallholder farmers in utilizing ICTs for extension services in the study area.

## 2.0 MATERIALS AND METHODS

### 2.1 The study Area

The study was conducted in Kwali Area Council of the Federal Capital Territory (FCT), Abuja,

which is located between longitude 7.01° east and latitude 8.87° north and covers approximately 1,700 square kilometers (Jimme, Okeke, and Uzuegbunam, 2015). The Area Council covers approximately 1,700 square kilometers and had a population of 85,837 as of the 2006 census. Kwali is renowned as the rural residence of Dr. Ladi Kwali, a distinguished potter whose likeness is featured on the 20 Naira currency note. The area comprises 10 wards: Ashara, Dafa, Kilankwa, Kundu, Kwali, Gumbo, Pai, Wako, Yangoji, and Yebu, with each ward managed by a Councilor. The residents of Kwali engage in various occupations including farming, hunting, and commerce. The Significant landmarks in Kwali Area Council include the Federal Government College, the National Mathematical Center Sheda Kwali, the Sheda Science and Technology Complex, and the Nigerian National Petroleum Corporation (NNPC) pump station in Awawa.

### 2.2 Sampling Procedure and Sample Size

For this study, a multistage sampling technique was employed. In the first stage, Wako, Dafa, Gumbo, and Pai communities were purposively selected. In the second stage, twelve (12) villages were systematically chosen from the fifty (50) villages where smallholder farmers were predominant (three villages from each of the four selected communities). Finally, in the third stage, ten (10) respondents were randomly selected from the total number of smallholder farmers in each of the twelve villages. This resulted in a sample size of 120 respondents.

### 2.3 Data Collection and Analysis

The data for this research were gathered from primary sources only. The data were collected using the interview method with a well-structured questionnaire administered among the respondents. The study centered around five main themes; socio-economic characteristics of smallholder farmers, current state of Information and Communication Technologies (ICTs) adoption, impact of ICT-based extension services on knowledge dissemination among smallholder farmers, accessibility of ICT tools and platforms in the context of extension services delivery for smallholder farmers and constraints faced by smallholder farmers in utilizing ICTs for extension services. The primary data obtained from the study were analyzed using descriptive statistics such as frequency and percentages. All results were presented using frequency and percentage. Coded results were first imputed on an Excel spreadsheet, which was then transferred to the Statistical Package for the Social Sciences (SPSS) for analysis.

## 3.0 RESULTS AND DISCUSSION

### 3.1 Socio-Economic Characteristics of Respondents

The socio-economic characteristics of the respondents described in the study include gender, age, marital status, educational level, household size, access to credits, farm experience, members of cooperative and land tenure system.

The results presented in Table 1 shows a significant male dominance, with 91.7% of the farmers being male and only 8.3% being female. The high percentage of male 91.7% farmers suggests that agricultural activities are primarily undertaken by men. While the low representation of female farmers, at just 8.3%, indicates that women face substantial barriers to participating in farming activities. This is in line with the findings of Kimaro, Towo and Benson, (2015), who stated that more males are involved in agricultural production because they possess more physical ability than their female counterparts.

In terms of age, the result shows that the most of smallholder farmers fall within the 36-45 age group, constituting 63.3% of the respondents. This suggests that the farming community primarily consists of individuals in their mid-productive years. The second-largest age group is 26-35 years, representing 31.7% of the farmers, indicating significant involvement of younger adults in farming activities. A smaller percentage of farmers belong to the 18-25 age group (1.7%) and the 46-55 age group (2.5%). Farmers aged 56 and above represent only 0.83% of the total. The predominance of the 36-45 age group implies that this age range represents the peak productive years for farming, with individuals likely having sufficient experience and resources to manage agricultural activities effectively.

Moreover, the result indicates that the 66.7% of smallholder farmers are married. While Single farmers represent 16.7% of the total, while 15% are widowed. A smaller percentage of farmers, constituting 1.7%, are divorced. The predominance of married farmers suggests the significance of family support and stable domestic arrangements in agricultural activities, while the presence of single, widowed, and divorced farmers underscores the diversity of household structures within the farming community. Muhammad-Lawal, Omotesho and Falola, (2009), stated that farmers tend to marry early in order to supply family labour for their farming activities.

Educationally, the result shows that 60% have attained secondary school education, 31.7% have completed primary school, 5.8% have no formal education, 1.7% have vocational education, and 0.8% have tertiary education. The relatively high level of education, particularly secondary education,

suggests that many farmers possess the basic literacy and numeracy skills necessary for understanding and adopting modern farming techniques and information and communication technologies (ICTs). This educational background can facilitate the effective dissemination and utilization of extension services, potentially leading to improved agricultural practices and productivity. This is in line with Agwu, Nwankwo and Anyanwu, (2012), who found out that the more educated individuals are, they are less likely to participate in agricultural activities.

The results from Table 1 also showed that 45% of smallholder farmers have 4-6 members, 38.3% have 7-9 members, 13.3% have 1-3 members, and 3.3% have 10 or more members. Medium-sized households (4-6 members) are the most common, suggesting that many farmers operate within family structures that provide adequate labor for farming activities. Larger households (7-9 members) also constitute a significant proportion, indicating the potential for extended family involvement in farming. Smaller households (1-3 members) may face challenges in terms of labor availability, while very large households (10 or more members) may experience increased pressure on resources and a need for efficient management practices. This aligns with the results of Debonne, Van Vliet, Ramkat and Verburg, (2021).

Additionally, 86.7% of smallholder farmers do not have access to credit, while only 8.3% have access, and 5% are unsure. The lack of access to credit among the majority of farmers suggests significant barriers to obtaining financial resources necessary for investment in agricultural inputs, equipment, and technologies. The farming experience of smallholder farmers shows that 80.8% have 6-10 years of experience, 10% have 11-15 years, 6.7% have 1-5 years, and 2.5% have 17 years or more. The high proportion of farmers with 6-10 years of experience indicates a relatively seasoned farming population with substantial practical knowledge and skills. This level of experience can contribute to more effective adoption of best practices and technologies in farming. However, the presence of less experienced farmers (1-5 years) highlights the need for continuous training and support to ensure their successful integration into the agricultural sector. This agrees with the research of Abdul-Razak and Kruse (2017).

The result indicates that membership in cooperatives is prevalent among smallholder farmers, with 75% indicating that they are members and 25% not being members. Cooperative membership provides farmers with access to shared resources, collective marketing opportunities, and financial services. The high rate of cooperative

membership suggests a strong culture of collaboration and mutual support within the farming community.

**Table 1: Summary of socio-economic characteristics of respondents (n = 120respondents)**

Socio Economic Variables	Frequency	Percent (%)
<b>Gender</b>		
Male	110	91.7
Female	10	8.3
<b>Age (years)</b>		
18-25	2	1.7
26-35	38	31.7
36-45	76	63.3
46-55	3	2.5
56 and above	1	0.83
<b>Marital status</b>		
Single	20	16.7
Married	80	66.7
Divorced	2	1.7
Widowed	18	15
<b>Education level</b>		
No formal education	7	5.8
Primary school	38	31.7
Secondary school	72	60
Vocational training	2	1.7
Tertiary institution	1	0.8
<b>Household size (members)</b>		
1-3	16	13.3
4-6	54	45
7-9	46	38.3
10 or more	4	3.3
<b>Access to credits</b>		
Yes	10	8.3
No	104	86.7
Not sure	6	5
<b>Farm experience (years)</b>		
1-5	8	6.7
6-10	97	80.8
11-15	12	10
17 and more	3	2.5
<b>Member of cooperative</b>		
Yes	90	75
No	30	25

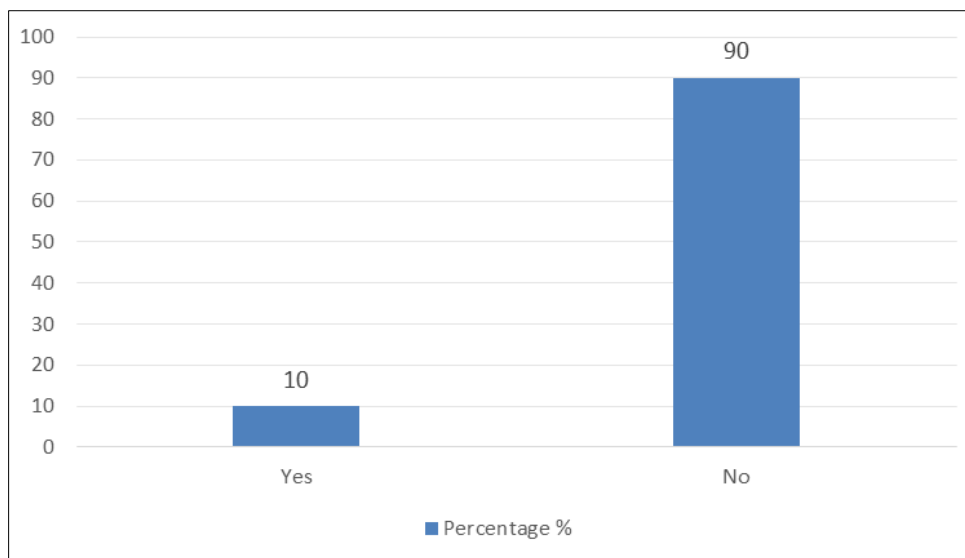
Source: Field survey, 2024.

### 3.2 Evaluation of the Current State of ICT Adoption among Smallholder Farmers

#### 3.2.1 Current State of ICT Adoption

The result presented in Figure 2 indicates a low level of adoption of Information and Communication Technologies (ICTs) among smallholder farmers. Only 10% of the farmers

reported using ICTs for extension services, while a significant majority, 90%, do not use any ICT tools. This disparity highlights the need for targeted interventions to increase ICT adoption and improve the accessibility and usability of these technologies for agricultural extension purposes.



**Figure 1: Current use of ICT tools by the Farmers**  
 Source: Field survey 2024.

### 3.2.2 Types of ICT Tools Currently Used

The result in Table 2 shows that mobile phones are the most commonly used ICT tool, with 75% of the farmers utilizing them. This high usage rate can be attributed to the widespread availability and relatively low cost of mobile phones, as well as their versatility in accessing various forms of information, including voice calls, text messages, and internet-based applications. Radios are the second most commonly used tool at 20%, reflecting their

traditional role in disseminating agricultural information. Televisions are the least used ICT tool, with only 5% of farmers reporting their use, possibly due to higher costs and limited access in rural areas. This aligns with the research by Iwuchukwu, Eke, and Nwobodo (2019), who found that respondents primarily own and use mobile phones due to the availability of many affordable options, making communication faster compared to other ICT devices.

**Table 2: Most Currently Used ICT Tools among Farmers**

ICT tools Currently Used	Frequency	Percentage %
Phone	90	75.0
Tv	6	5.0
Radio	24	20.0
<b>Total</b>	<b>120</b>	<b>100.00</b>

Source: Field Survey 2024.

### 3.2.3 Frequency of ICT Tool Usage

The majority of farmers (55%) use ICT tools infrequently, indicating sporadic or limited engagement with these technologies. This infrequent use may be due to factors such as limited digital literacy, inconsistent access to reliable electricity or internet, or a lack of relevant content tailored to the farmers' needs. On the other hand, 40% of the

farmers use ICT tools frequently, suggesting a more regular and integrated approach to utilizing these technologies for accessing information and extension services. Only a small proportion (5%) use ICT tools very frequently, indicating a high level of engagement and reliance on these tools for their agricultural practices.

**Table 3: Frequency of ICT Tools Usage among Farmer**

Frequency of ICT Tool	Frequency	Percentage %
Not frequent	66	55
Frequent	48	40
Very frequent	6	5

Source: Field Survey 2024

The overall low adoption rate of ICTs (10%) among smallholder farmers underscores the need for strategic efforts to enhance the penetration and

effective use of these technologies. Given the predominant use of mobile phones (75%) among the few adopters, initiatives should focus on leveraging

mobile technology to disseminate agricultural information and extension services. Enhancing digital literacy, improving access to affordable and reliable internet connectivity, and developing relevant and localized content can significantly increase the frequency and effectiveness of ICT usage among farmers.

The relatively high proportion of farmers who use ICT tools infrequently (55%) suggests that while some access to technology exists, there are barriers preventing regular and effective use. Addressing these barriers through infrastructure development, and tailored support services can transform the sporadic use of ICTs into more consistent and impactful engagement.

### **3.3 Impacts of ICT-Based Extension Services on Knowledge Dissemination among Smallholder Farmers**

The result from Table 4 shows that 75% of smallholder farmers experienced expanded information accessibility through ICT-based extension services, while 25% did not. This indicates that the majority of farmers who utilize ICTs find it significantly easier to access a broader range of agricultural information, which can enhance their farming practices and decision-making processes. The ability to access timely and diverse information is crucial for staying updated on best practices, market trends, and weather forecasts. The result also indicates that a substantial 90% of the respondents reported that ICT-based extension services provided timely and relevant information, compared to 10% who did not. This high percentage underscores the effectiveness of ICTs in delivering information when it is most needed, allowing farmers to make informed decisions quickly. Timely information can lead to improved crop management, pest control, and overall farm productivity. Okeke, Nwalieji and Uzuegbunam, (2015), that the integration of Information and Communication Technology (ICT) in agriculture can be utilized for providing accurate, timely, relevant information and services to farmers, thereby facilitating environment for more remunerative agriculture.

The result reveals that 83.7% of farmers found ICT-based extension services to facilitate knowledge exchange, while 16.3% did not. This high level of positive response suggests that ICTs are effective in promoting the sharing of ideas, experiences, and solutions among farmers. Facilitated knowledge exchange can lead to community learning, innovation, and the adoption of

improved agricultural practices. According to the result, 72.5% of farmers experienced skills development through ICT-based extension services, whereas 27.5% did not. This demonstrates that a significant proportion of farmers are able to enhance their agricultural skills and techniques through access to training materials, tutorials, and expert advice via ICT platforms. Agwu (2007) reaffirms that ICTs has become the most effective method of training, informing and disseminating proven technologies to rural farmers.

The result shows that 85% of farmers reported advancements in their agricultural methods due to ICT-based extension services, while 15% did not. This indicates that the use of ICTs has led to the adoption of more efficient and effective farming practices among the majority of farmers. These advancements can contribute to higher yields, better resource management, and increased sustainability. Only 55% of the farmers reported improved market access and financial integration due to ICT-based extension services, while 45% did not. This lower percentage compared to other impacts suggests that while ICTs have some positive effect on market and financial access, there are still significant barriers that need to be addressed. Enhancing market linkages and providing better financial services through ICTs could further improve the economic conditions of smallholder farmers. Kace, (2011), revealed that market information is provided through SMS so that smallholders have access to daily agricultural commodity prices, extension agents and channels to sell or bid text messages.

Furthermore, the result also shows that 67.5% of farmers found ICT-based extension services to provide risk management support, compared to 32.5% who did not. This suggests that ICTs play a role in helping farmers anticipate and manage risks related to weather, pests, and market fluctuations. Effective risk management support can increase the resilience and stability of farming operations.

The result also shows that 73.3% of farmers reported that ICT-based extension services provided collaboration opportunities, while 26.7% did not. This indicates that ICTs help in connecting farmers with peers, experts, and organizations, fostering a collaborative environment that can lead to shared resources, joint ventures, and collective problem-solving. Okeke, Nwalieji, and Uzuegbunam (2015), stated in their study that ICT is a promising area for encouraging the sharing of knowledge and agricultural information among farmers.

**Table 4: Impacts of ICT-Based Extension Services**

Impacts	Frequency	Percentage%	Rank
Timeliness and relevance of information	108	90	1 <sup>st</sup>
Advancement in agricultural methods	102	85	2 <sup>nd</sup>
Facilitated knowledge exchange	100	83.7	3 <sup>rd</sup>
Expanded information accessibility	90	75	4 <sup>th</sup>
Collaboration opportunity	8	73.3	5 <sup>th</sup>
Skills development	87	72.5	6 <sup>th</sup>
Risk management support	81	67.5	7 <sup>th</sup>
Market access and financial integration	66	55	8 <sup>th</sup>

Source: Field Survey 2024

### 3.4 Constraints Faced by Smallholder Farmers in Utilizing ICTs for Extension Services

Table 5 shows the results of Constraints Faced by Smallholder Farmers in Utilizing ICTs for Extension Services in the study area.

The study identified several significant constraints faced by smallholder farmers in utilizing ICTs for extension services. Limited access to ICT infrastructure is a major challenge, with 97.5% of farmers reporting insufficient infrastructure. This lack of infrastructure hinders the effective use of ICT tools and platforms essential for modern agricultural practices. Additionally, the high cost of ICT devices and services is a considerable barrier, as reported by 99.2% of the farmers. The financial burden associated with purchasing and maintaining ICT devices, as well as affording data plans, limits the widespread adoption of these technologies.

Low digital literacy among farmers is another critical constraint, affecting 75% of the respondents. Many smallholder farmers lack the necessary skills to effectively use ICT tools, which hampers their ability to access and utilize digital agricultural information and services. This issue is compounded by language and literacy barriers, with 66.7% of farmers indicating difficulties due to language differences and low literacy levels. These barriers prevent farmers from fully understanding and benefiting from ICT-based extension services.

Furthermore, the geographical isolation poses a significant challenge, as reported by 70% of

the farmers. Many smallholder farmers reside in remote and isolated areas with limited connectivity, making it difficult to access ICT services and support. Furthermore, 45% of farmers indicated that the content provided through ICT platforms is not always relevant to their specific needs. This limited content relevance reduces the effectiveness of ICT-based extension services in addressing the unique challenges faced by smallholder farmers.

Moreover, Inadequate technological support is another critical issue identified in the study, with 95.8% of farmers reporting a lack of sufficient support. Farmers often face technical difficulties with their devices and have limited access to assistance, which discourages continued use of ICT tools. Privacy and security concerns are also notable, affecting 47.5% of the respondents. Farmers express apprehensions about the security of their data and privacy when using ICT tools, which can deter them from fully engaging with these technologies.

Lastly, cultural and social barriers are significant, with 90% of farmers indicating that cultural norms and social dynamics affect their use of ICTs. These barriers can prevent certain groups, particularly women, from accessing and benefiting from ICT-based extension services. Poor connectivity is another major constraint, as reported by 93.3% of farmers. Inconsistent or non-existent network coverage in rural areas limits the ability of farmers to use ICT tools effectively. This correspond with the findings of Chadwick (2003) and Mukesh, Deepati and Kanini (2010).

**Table 5: Constraints Faced by Smallholder Farmers in the Study Area**

Challenges	Frequency	Percentages %
Limited access to ICT infrastructure	117	97.5
High cost of ICT devices and services	119	99.2
Low digital Literacy	90	75
Language and Literacy barriers	80	66.7
Geographical isolation	84	70
Limited content relevance	54	45
Inadequate technological support	115	95.8
Privacy and security concerns	57	47.5
Cultural and social barriers	108	90
Poor connectivity	112	93.3

Source: Field Survey 2024



## 4.0 CONCLUSION

In a nutshell, it has been revealed that the demography is predominantly composed of middle-aged, married men with secondary education and significant farming experience. Despite the recognized potential of ICTs in enhancing agricultural practices, the adoption rate among these farmers remains low, primarily due to substantial barriers such as high costs, limited infrastructure, low digital literacy, and poor connectivity. The predominant use of mobile phones among the few who have adopted ICTs highlights the need for targeted efforts to make these tools more accessible and relevant. ICT-based extension services have positively impacted information accessibility, timeliness, knowledge exchange, skills development, and market access. However, these benefits are not fully realized due to the constraints identified. Limited ICT infrastructure, high device and service costs, digital literacy challenges, language barriers, geographical isolation, content irrelevance, inadequate support, privacy concerns, cultural barriers, and poor connectivity collectively hinder the effective utilization of ICTs by smallholder farmers.

### 4.1 Recommendations

Based on the findings of this study, the following recommendations are proposed to enhance the effectiveness of ICTs in extension service delivery among smallholder farmers in the study area:

1. Governments and private sector stakeholders should invest in telecommunications infrastructure, expand the national grid, and promote alternative energy sources like solar power.
2. Governments, financial institutions, and ICT manufacturers should collaborate to provide subsidies, low-cost loans, and affordable data plans for smallholder farmers.
3. Extension agents, NGOs, community-based organizations, and educational institutions should organize training programs and awareness campaigns to enhance farmers' ICT skills and knowledge.
4. Local agricultural experts, governments, and ICT developers should collaborate to create locally relevant and accessible content tailored to the needs of smallholder farmers.
5. Governments, NGOs, and private tech companies should establish ICT support centers and helplines to assist farmers with technical issues and encourage ICT adoption.

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