JOURNAL OF AGRICULTURAL ECONOMICS, EXTENSION & SCIENCES
Official Journal of the College of Agricultural Economics and Extension
www.jaees.org
www.uam.edu.ng
Jaees Vol. 14 No. 2 2026, Page 40-47
ISSN (Print) 2545-5179, ISSN (Online) 2714-5018

ASSESSMENT OF UTILISATION OF DIGITAL AGRICULTURAL TOOLS FOR ACCESSING INFORMATION AMONG SMALLHOLDER CROP FARMERS IN KADUNA STATE, NIGERIA

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Abstract
This study assessed utilisation of digital agricultural tools for accessing information among smallholder crop farmers in Kaduna State, Nigeria. A multi-stage sampling technique was used to select 244 respondents, the data were collected usingstructured questionnaire Data collected were analysed using sigma scoring and mean score. The results showed that short message service and unstructured supplementary service data led usage was 69.3%, followed by WhatsApp and AgroMall (66.8%) and YouTube saw no actual usage despite some awareness. Most respondents (76.5%) reported moderate utilisation, indicating a preference for simple digital tools. The perceived benefits centred on improved productivity (2.98), pest management (2.98), and better decision-making (2.71). Constraints identified included fears of online fraud (2.87) and inadequate government support for ICT infrastructure (2.87). Language barriers and low digital literacy were less perceived as significant constraints.Farmers in Kaduna State moderately used digital agricultural tools, and these tools were beneficial for productivity and timely information but face constraints such as fear of online fraud, inadequate infrastructure, and the high cost of smartphones. The study recommended that agricultural extension agencies and digital platform providers should develop simple, affordable and farmer-friendly digital platforms that connect farmers with produce markets, input suppliers, mechanisation services and financial institutions, rather than limiting services to agricultural advisory information.
***Keywords:** Assessment, Utilisation,digital agricultural tools,information, crop farmers*

1.0 Introduction

Agriculture remains a cornerstone of Nigeria's economy, with smallholder farmers constituting approximately 70% of the agricultural workforce (Obi, 2025). These smallholder farmers predominantly engage in subsistence farming, cultivating staple crops such as maize, cassava, yams, and vegetables. According to National Bureau of Statistics (2024), the rebasing exercise led to a shift in sectorial economic contributions, making agriculture's share rise to 27.81 percent in 2024, up from 24.64 percent pre-rebasing. Nigeria's agricultural sector contribution to the economy rose to 27.8 percent in the first quarter of 2025, signaling a positive trend in the sector's performance (NBS, 2025).

Agricultural extension services have increasingly been recognized as a key driver of sustainable agricultural production, climate resilience, and food system transformation. Modern extension services go beyond the traditional transfer of information on technologies to farmers to include capacity building, innovation facilitation, digital advisory services, and market-oriented support for farmers. According to the Food and Agriculture Organization (FAO, 2022), extension

services now play a central role in helping farmers adapt to climate change, adopt climate-smart agricultural practices, and improve production while protecting natural resources. Agricultural extension services contribute to agricultural development by strengthening farmers' access to timely information on improved technologies, inputs, pest and disease management, weather and climate risks, market opportunities. Extension systems also, promote inclusiveness by targeting women, youth, and smallholder farmers, thereby supporting poverty reduction and rural livelihood improvement.

Agricultural extension service delivery in Nigeria has a lot ofconstrains that undermine its effectiveness in facilitating technology dissemination and agricultural transformation. Foremost among these is acute shortage of extension personnel, which has resulted in an unfavourable extension agent-farmer ratio far below the Foodand Agriculture Organization's recommendations. This human resource deficit significantly limits farmer coverage, reduces frequency of extension contact, and weakens advisory support, particularly for smallholder and remote farming communities. Compounding this challenge is chronic underfunding of extension systems, which constraints recruitment, training, mobility, and operational effectiveness of extension agents. Inadequate financial support also contributes to poor remuneration and low motivation, leading to high attrition rates and declining professional commitment within the extension workforce (Abdullahi*et al*., 2025). Furthermore, insufficient capacity development limits extension agents' ability to respond to emerging agricultural challenges such as climate variability, market integration, and sustainable intensification. These challenges are exacerbated by weak research-extension-farmer linkages, resulting in poor feedback mechanisms, low relevance of disseminated technologies, and suboptimal adoption rates. Structural constraints, including poor rural infrastructure and limited integration of information and communication technologies (ICTs), further restrict outreach efficiency and scalability of extension services. Collectively, these interrelated challenges reinforce a cycle of weak institutional performance, low technology uptake, and persistent productivity gaps in Nigerian agriculture (FAO, 2024; Ogundele, 2025).

Digital agricultural extension service refer to the application of digital and information communication technologies (ICTs) to deliver agricultural knowledge, advisory support, and decision-making information to farmers and other agricultural stakeholders. According to the Food and Agriculture Organization (FAO, 2024), digital extension enhances traditional extension systems by improving the speed, reach, and effectiveness of information dissemination, particularly among smallholder farmers who often have limited access to physical extension services. World Bank (2023) emphasizes that digital agricultural extension supports inclusive and sustainable agricultural development by enabling real-time access to agronomic advice, climate and weather information, pest and disease management strategies, and market intelligence. These services help farmers improve productivity, reduce production risks, and increase income while lowering the cost and logistical constraints associated with face-to-face extension delivery.

In Nigeria, the introduction of the National Electronic Extension Platform (NEEP) by the Federal Ministry of Agriculture and Food Security (FMAFS) in 2025 represents a national effort to institutionalize digital extension services (Federal Ministry of Agriculture and Food Security [FMAFS], 2025). The platform integrates research outputs, extension content, and farmer feedback into a digital system designed to strengthen advisory service delivery and address the challenge of low extension agent-to-farmer ratio (Nairametrics, 2025).

Farmers can access digital agricultural extension services through a variety of tools that enhance the reach, timeliness, and effectiveness of advisory services. Common digital agricultural extension tools include mobile phone-based SMS and voice messages, which provide tips, weather updates, and pest/disease alerts; smartphone applications offering interactive guidance on crop and livestock management; and interactive voice response (IVR) systems that allow farmers to receive messages or consult experts in local languages. Additionally, online platforms and web portals provide access to training materials, market information, and research outputs. Social media and messaging

platforms, such as WhatsApp and Facebook, enable extension agents to share multimedia updates with farmer groups.

Despite their significant contribution to food production and rural employment, smallholder farmers face numerous challenges, including limited access to modern farming techniques, financial resources, and market information. In the early 2020, digital technologies emerged as potential tools to address some of these challenges by providing timely information that can enhance productivity and improve market access (FAO, 2021). Farmers in Kaduna State have witnessed increasing mobile phone penetration and internet connectivity. National Bureau of Statistics data for the first quarter of 2024 recorded 7,305,854 active internet subscriptions in Kaduna State, indicating substantial access to mobile and internet-based communication infrastructure (National Bureau of Statistics [NBS], 2024). Some of the digital agricultural extension tools available for farmers include the following; national electronic extension platform, thriveagric digital advisory platform, farmcrowdy, agromall farmer app, crop2cash digital advisory services, agroxchange crop monitoring platform, zowasel digital marketplace platform, farmdirect platforms, SMS-based extension services, unstructured supplementary service data (USSD) and Voice call advisory systems and, WhatsApp and social media extension groups among others (FMAFS, 2025; Akinwale*et al*., 2023). Technological advancement present opportunities to integrate digital solutions into agricultural practices. It is however, not certain the extent to which smallholder crop farmers in KadunaState possess the necessary knowledge of utilising these digital tools for accessing agricultural information. It is also not certain how frequently digital tools are used by smallholder crop farmers, the specific types of agricultural information sought for, the benefits derived from the use of digital tools and the constraints to effective utilisation of digital agricultural extension tools by smallholder crop farmers in Kaduna State.

Although several studies have been conducted in the area of awareness, knowledge and utilisation of digital agricultural extension tools by smallholder farmers such as studies by Inegbedion*et al.* (2021); Akintunde (2023); Chorума*et al.* (2024);Abiri*et al*. (2023) and Izuogu*et al.* (2022), none of such studies were taken on utilisation level in the State. This constitutes a significant research gap which this study seeks to fill up.

2.0 Objectives of the Study

The broad objective of the study was to assess utilisation of digital agricultural tools by smallholder crop farmers and the specific objectives were to:

i. describe the level of utilisation of digital agricultural tools by the respondents;
ii. identify the perceived benefits of using digital agricultural tools by the respondents, and;
iii. identify the constraints to effective utilisation of digital agricultural tools by the respondents.

3.0 Methodology

The study was carried out in Kaduna State Nigeria. The State is located in the North-West geopolitical zone of Nigeria, lying between latitude 9°02′N and 11°32′N and longitudes 6°15′E and 8°38′E. It bordered by Zamfara and Katsina States to the north, Kano State to the north-east, Bauchi and Plateau States to the east, Nasarawa State and the Federal Capital Territory (FCT) to the south, and Niger State to the West. The State has a land area of approximately 46,053 square kilometres and a large rural population engaged predominantly in agriculture (Kaduna State Government, 2021). The study made use of Multi- stage random sampling. The sampling procedure was in stages, and the peculiarities of characteristics were taken into consideration at all the sampling stages for equal representation. In the first stage, Samaru-Kataf Agricultural zone of Kaduna State which comprises Zangon-Kataf, Kachia, Kaura, Jaba, Jema'a, Sanga and Kagarko Local Government Areas (LGAs) of Kaduna State was purposively selected based on the preponderance of smallholder crop farmers in the zone. In the second stage, Three LGAs (Zangon-Kataf, Kachia andKaura) were selected from the seven LGAs using simple random sampling.Four communities/wards were

purposively selected from each of the three selected LGAs based on the presence and concentration of smallholder crop farmers and their suitability for accessing agricultural information through digital communication channels obtained from the Kaduna State Agricultural Development Agency, giving a total of 12 communities/wards. Digital agricultural tools selected based on their relevance to the provision or dissemination of agricultural information and advisory services and their potential accessibility to smallholder crop farmers were such as SMS/USSD, WhatsApp, AgroMall, Interactive voice response (IVR), Facebook, YouTube, Instagram, LinkedIn, Telegram, Farmcrowdy, Thrive Agric, and Hello Tractor were selected. A comprehensive list of smallholder crop farmers from the selected communities was obtained during a preliminary survey. It shows that there were a total of 1,342 registered smallholder farmers. In the third stage, Krejcie and Morgan formula was applied to randomly select 244 smallholder crop farmers from the total population of 1,342 registered smallholder crop farmers in the study area, this formula was used to estimate the sample size statistically.

Krejcie and Morgan formula:

$$\mathrm{n} = \frac{x^2 \mathrm{NP}(1-\mathrm{P})}{d^2(\mathrm{N}-1) + x^2 \mathrm{P}(1-\mathrm{P})}$$

Where:

$\mathrm{n} =$ Required sample size

$\mathrm{N} =$ Total population size

$\mathrm{P} =$ Population proportion (assumed to be 0.5 for maximum sample size)

$\mathrm{d} =$ Degree of accuracy (margin of error), usually 0.05

$x^2 =$ Chi $-$ square value for 1 degree of freedom at 95% confidence level (3.841)

$1 - \mathrm{p} =$ Complement of population proportion

Therefore,

$\mathrm{n} =$ sample size

$\mathrm{N} = 1{,}342$

$\mathrm{P} = 0.5$

$\mathrm{d} = 0.05$

$x^2 = 3.841$

$$\mathrm{n} = \frac{3.841 \text{ X } 1342 \text{ X } 0.25}{0.0025(1341) + 3.841 \text{ X } 0.25}$$

$$\mathrm{n} = \frac{1288.6555}{3.3525 + 0.96025}$$

$$\mathrm{n} = \frac{1288.6555}{5.273}$$

$\mathrm{n} = 244.3875 \simeq 244$

Proportionate allocation formula:

$$\mathrm{ni} = \frac{\mathrm{Ni}}{\mathrm{N}} \text{ X n}$$

Where,

$\mathrm{ni} =$ Sample size for the LGAs

$\mathrm{Ni} =$ Population size for the LGAs

$\mathrm{N} =$ Total population

$\mathrm{n} =$ Total sample size

Proportionate allocation distribution for number of smallholder crop farmers in each LGA.

$$\text{Zango Kataf} = \frac{279}{1342}\ X\ 244 = 51$$

$$\text{Kachia} = \frac{308}{1342}\ X\ 244 = 56$$

$$\text{Kaura} = \frac{755}{1342}\ X\ 244 = 137$$

Primary data for this study were collected through the use of structured questionnaire. The level of utilization, perceived benefits of using digital agricultural tools by the respondents, and the constraints to effective utilisation of digital agricultural tools were analysed using sigma scoring and mean score. Two Likert-type scales were used in the study. A 4-point Likert-type scale of Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1) was used to measure respondents' level of agreement, with a mean cut-off point of 2.50. A 3-point Likert-type scale of Very Severe (3), Severe (2), and Not Severe (1) was used to measure the severity of constraints, with a mean cut-off point of 2.00.

4.0 Results and Discussion

4.1 Level of Utilisation of Digital Agricultural Tools by the Respondents State

Table 1shows that majority (69.3%) of the respondents adopted SMS and USSD services, followed by WhatsApp at 66.8%,AgroMall (55.9%), Interactive voice response (IVR) (53.8%), and Facebook (47.5%). Interestingly, YouTube recorded no reported utilisation.The overall utilisation classification shows that 76.5% of the respondents had moderate utilisation, while 16.0% had high utilisation and 7.6% had low utilisation.The finding suggests that digital agricultural tools were moderately used by farmers. The pattern of use further indicates that farmers tend to utilise simpler and more familiar platforms, particularly short message service/unstructured supplementary service data and WhatsApp.The findings agree with Idu*et al*. (2023), who reported high mobile-phone use among smallholder rice farmers in Kuje, Abuja.

Table 1:Level of Utilisation of digital agricultural tools by the respondents (n=120)

Variables		**Percentage**
SMS and USSD Advisory Services		69.3
Interactive Voice Response (IVR) Platform		53.8
WhatsApp		66.8
Facebook		47.5
YouTube		0.0
Instagram		5.5
LinkedIn		2.1
Telegram		18.9
Farmcrowdy		5.9
Thrive Agric		34.0
AgroMall		55.9
Hello Tractor		37.0
Utilisation level	**Sigma criterion**	**Percentage**
Low	< 15.46	7.6
Moderate	15.46 – 50.64	76.5
High	> 50.64	16.0
Total		**100**

4.2 Perceived benefits of using digital agricultural tools by respondents in the study area

Table 2 reveals that improved farm productivity and pest management ($\bar{x}$ = 2.98), timely access to weather and agronomic advice($\bar{x}$ = 2.88), easy sharing of farming tips with other farmers ($\bar{x}$ = 2.81), better farming decision-making ($\bar{x}$ = 2.71) and reduced cost and travel time compared to physical extension visits ($\bar{x}$ = 2.50) were the benefactors of using digital agric tools. This implies that

strengthening the availability, reliability and accessibility of digital agricultural extension services could improve the timeliness and efficiency of extension information delivery to smallholder farmers. This finding agrees with Okoronkwo*et al.* (2025) and Abioye*et al*. (2024), who reported that digital technologies enhanced farming efficiency, productivity, pest control and access to improved production practices. This is consistent with McCampbel*et al*. (2021), who reported that mobile applications improved communication and information sharing among farmers.However, the low scores for market access and price information ($\bar{x}$=2.25) and access to inputs, mechanization and finance ($\bar{x}$ =2.13) point to the fact that digital services were focused primarily on production advice. This implies that the digital agricultural extension services available to the farmers were more focused on production information than on linking farmers with markets, input suppliers, mechanisation services and financial institutions. This indicates a gap in the scope of digital agricultural services available to the farmers and suggests the need for more integrated digital platforms that provide both advisory information and access to broader agricultural services. This contrasts with McCampbel*et al*. (2021) who observed benefits in market monitoring. The difference may be due to weak links between digital platforms, markets, input suppliers and financial institutions.

Table 2:Perceived benefits of using digital agricultural tools by the respondents

Perceived benefits	Mean Score	SD
Improved farm productivity and pest management	2.98	1.121
Timely access to weather and agronomic advice	2.88	1.120
Easier sharing of farming tips with other farmers	2.81	0.814
Better farming decision-making	2.71	0.853
Reduced cost and travel time compared to physical extension visits	2.50	0.945
Better market access and price information	2.25	0.749
Easier access to inputs, mechanisation, and finance	2.13	0.839

Cut-off mean= 2.5

4.3 Constraints to Effective Utilisation of Digital Agricultural Tools

Table 3 depicts that fear of online scams/fraud ($\bar{x}$= 2.87), followed by insufficient government support to develop the rural ICT infrastructure($\bar{x}$ == 2.87) and high cost of smart phones ($\bar{x}$= 2.68).Finding indicate that fear of online scams/fraud ($\bar{x}$= 2.87) was one of the constraints faced by farmers for effective utilization of digital agricultural tools for information. Fraudsters are now everywhere online and their primary motive is to hack into people's 'online information and perform their nefarious act, for that reason, farmers are afraid of utilizing online agricultural tool for accessing information. Farmers may be reluctant logging into alien digital platforms where they could lose many vital information in addition to money.Digital agriculture tools should include measures to build trust, educate farmers about online safety, and provide clearly authenticated official platforms.Language barriers had relatively low($\bar{x}$=1.32), indicating that respondents did not view language as a major obstacle to utilization of digital agricultural tools.

Table 3:Constraints to effective utilisation to digital agricultural tools by the respondents (n=120

Constraints	Mean Score	SD
Fear of online scammer/fraud	2.87	0.337
Inadequate gov't support for rural ICT infrastructure development	2.87	0.337
High cost of smartphones	2.68	0.615
Fear of technology adoption and resistance to change	2.47	0.660
Unstable electricity	2.32	0.682
Inadequate institutional support	2.13	0.635

Limited trust in digital platforms	2.04	0.448
Poor network coverage	2.01	0.811
Inadequate training received on digital agricultural extension tools	1.99	0.574
Inadequate follow-up on training received digital agricultural extension tools	1.95	0.479
Limited awareness on availability of digital agricultural extension tools	1.88	0.509
High cost of mobile data	1.82	0.683
High cost of recharge credit	1.66	0.749
Low digital literacy	1.64	0.637
Language barriers	1.32	0.608

Cut-off Mean= 2.0

5.0 Conclusion and Recommendations

5.1 Conclusion

Digital agricultural tools improve access to timely agricultural information, support farm decision-making, facilitate knowledge sharing, reduce extension costs, and complement conventional extension services.The study revealed that farmers in Kaduna State moderately used digital agricultural tools, including SMS and USSD services.Farmers find these tools beneficial for productivity and timely information but face constraints such as fear of online fraud, inadequate infrastructure, and the high cost of smartphones.

5.2 Recommendations

It is recommended that agricultural extension agencies and digital platform providers should develop simple, affordable and farmer-friendly digital platforms that connect farmers with produce markets, input suppliers, mechanisation services and financial institutions, rather than limiting services to agricultural advisory information, and the Federal and State Governments should increase investment in rural ICT infrastructure by improving mobile network coverage, internet connectivity and electricity supply in farming communities.

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