

HARNESSING INFORMATION AND COMMUNICATION TECHNOLOGY AS TRANSVERSAL SKILLS APPROACH IN TRANSFORMING FOOD SECURITY FOR SMALLHOLDER FARMERS IN KADUNA STATE NIGERIA: PERSPECTIVE OF EXTENSION AGENTS

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Abstract

This study focuses on harnessing ICT as a transversal skills approach in transforming food security for smallholder farmers in Kaduna State, Nigeria, from the perspective of extension agents. The research questions focus on the current level of ICT skills among extension agents, the challenges they face, the benefits and opportunities they perceive, and the necessary resources for effective implementation. The study adopted descriptive survey research design using a structured questionnaire to collect data from 100 extension agents. The study used Mean and standard deviation in data analysis. The study concluded that the current level of ICT skills among extension agents working with smallholder farmers in Kaduna State is low. The majority of the surveyed extension agents lack adequate ICT skills, which hinders their ability to utilize ICT tools and services for improving food security. Additionally, various challenges and barriers were identified, highlighting the difficulties faced by extension agents in harnessing ICT as transversal skills for enhancing food security among smallholder farmers in the state. Harnessing ICT skills across different aspects of food security through mobile applications, online platforms, and agricultural databases offers a means to deliver real-time information, weather updates, improved access to relevant agricultural knowledge, enhanced decision-making capabilities, and increased market opportunities for smallholder farmers will transform food security. The study recommended that Kaduna state government and non-governmental organizations should embark on capacity building programs for extension agents, aimed at enhancing their ICT skills and knowledge across all aspects of food security, efforts should be made by government and NGOs to ensure that extension agents and smallholder farmers have access to the necessary resources and infrastructure required for effective implementation of ICT-based solutions among others.

Keywords: ICT, Transversal Skills, Food, Security

Introduction

The issue of food security has gained significant attention on the global community, governments, non-governmental organizations, and international institutions in recent years and has been working towards transforming the food sector. Food security affects various aspects of life, including health, social stability, economic development, and environmental sustainability (Clapp, 2016). Food security is a multi-dimensional issue that encompasses not only the availability of food but also access, utilization, and stability of food supply (Perez-Escamilla, Gubert, Rogers & Hromi-Fiedler 2017a). Food security is a complex and multifaceted issue that requires a comprehensive approach. It involves not only ensuring the availability of sufficient food but also ensuring that people have access to it and can utilize it effectively. Furthermore, food security must be achieved in a sustainable manner that takes into account environmental, economic, and social factors (UN, 2017). As the global population continues to grow and

smallholder farmers lacks of adequate skills in ICT (Information and Communication Technology) threatens to disrupt agricultural production, ensuring sufficient and sustainable food supply is becoming increasingly challenging.

In 2022, countries heavily reliant on food imports experienced a significant increase in food inflation due to the conflict between Ukraine and Russia, and subsequent supply shortages, leading to sharp price hikes for wheat and other essential food items (National Emergency Management Agency, 2022). This, coupled with high fertilizer, fuel and transportation costs, resulted in a decline in food security. Widespread flooding during the 2022 rainy season, caused by climate change and variability, damaged over 676,000 hectares of farmland, leading to reduced harvests and an increased risk of food insecurity for families across the country. It is anticipated that more extreme weather patterns will continue to impact food security in the

future (National Emergency Management Agency, 2022).

In sub-Saharan Africa (SSA), the prices of staple foods rose by an average of 23.9 percent between 2020 and 2022 (Okou, Spray, and Unsal, 2022). Nigeria, in particular, is facing elevated levels of food insecurity. According to the 2021 Global Report on Food Crises by the Food Security Information Network (FSIN), Nigeria has the second-highest number of acutely food-insecure people in the world, with an estimated 13 million people facing severe food insecurity and malnutrition. The report also stated that Nigeria has the highest number of stunted children under five years old in sub-Saharan Africa, with a prevalence of 37% (FSIN, 2021). Governments, non-governmental organizations, and international institutions have recognized the importance of addressing food security and have implemented various strategies and initiatives to alleviate hunger and promote sustainable food security. One of the challenges facing these efforts is the lack of adequate ICT skills among smallholder farmers, which can limit their ability to access information and resources and improve food security.

ICT skills encompass a range of digital tools and technologies that can revolutionize agricultural practices, including farm management, access to market information, weather forecasting, and knowledge sharing. According to Ogbonna & Afolayan, (2016) ICT skills enables farmers to benefit from timely and accurate agricultural information, including weather forecasts, market prices, and pest management strategies, leading to informed decision-making and increased productivity. By integrating ICT skills in food security, smallholder farmers can optimize their production, improve resource management, mitigate risks, and make informed decisions. Online platforms and social media networks facilitate knowledge sharing among farmers and extension agents, enhancing capacity building in remote areas among smallholder farmers (Ogundipe & Ajiboye, 2018). Moreover, ICT skills can improve farmers' access to markets, reducing post-harvest losses, and ensuring fair prices for their produce (Oyelaran-Oyeyinka & Adeya, 2016). Remote sensing technologies like satellite imagery and drones enable precision agriculture, allowing farmers to make targeted interventions and optimize resource use (Ewuim & Obiniyi, 2020). Additionally, ICT facilitates access to digital financial services, including mobile banking and e-payment systems, which enhances farmers' financial inclusion, enabling them to invest in inputs, machinery, and technologies, ultimately

improving productivity and hence, food security (Olowookere & Aina, 2019).

Harnessing ICT as transversal skills in this study refers to utilizing ICT competencies across various components of the food security to enhance production and distribution of farm produce, problem-solving, critical thinking, collaboration and communication among smallholder farmers and extension agents. These skills are considered essential in the digital age, as they enable individuals to navigate and thrive in an increasingly technology-driven world. Furthermore, a study by the Global Forum on Agricultural Research and Innovation (GFAR) (2020) emphasized the importance of harnessing ICT as transversal skills in promoting food security and sustainability. The study highlighted the potential of ICT tools such as mobile apps, remote sensing, and blockchain technology to improve access to information, enhance transparency in food supply chains, and promote sustainable agricultural practices. The study also emphasizes the need to develop transversal skills such as digital literacy, critical thinking, and problem-solving skills in order to prepare smallholder farmers for the challenges of the digital age in the context of food security.

Harnessing ICT as transversal skills approach in transforming food security arises from the recognition that ICT can play a crucial role in addressing food insecurity challenges facing Kaduna state. ICT solutions have the potential to improve the efficiency and effectiveness of food security, enhance access to markets, improve productivity, and reduce food waste, among other benefits. However, the implementation of ICT solutions in the food sector faces significant challenges, such as inadequate ICT skills and digital literacy, limited ICT infrastructure, high taxes, gender disparities, data privacy and security concerns, and the need for sustainable solutions. Therefore, the study seeks to explore the challenges and opportunities of harnessing ICT skills as a transversal skills approach in transforming food security, with a focus on identifying practical and sustainable solutions to the identified challenges.

Approach in this study refers to the use of ICT skills as a strategy, or method or way of acquisition of skills necessary to effectively navigate and utilize technology, such as computer software, hardware, and online applications in food sector. This approach aims to equip smallholder farmers with the necessary skills to access, analyze, evaluate, create, and communicate information effectively and efficiently using digital technology. The approach in transformation of food

security in this study covers changes in the use of ICT skills in promoting sustainable farming practices that conserve natural resources, improve soil health, and reduce greenhouse gas emissions, improving access to markets for smallholder farmers, using digital technology by smallholder farmers, building the resilience of food systems to shocks such as climate change, conflict, and economic downturns.

Efforts have been made by the federal and state governments, along with NGOs, to transform the food system in Kaduna State, Nigeria. However, the utilization of information and communication technology as transversal skills to transform food security has seen limited progress. The Global Fund for Women has empowered women in Kaduna State through Climate Smart Agriculture (CSA), providing them with modern agricultural techniques and access to agricultural services (Olugboji, 2021). Synergos Nigeria and FCE Group AG (2021) partnered to improve agricultural outcomes, benefiting 450,000 farmers with digital tools, a cloud platform, and a payment system. Care and Action Research trained farmers in Climate Smart Agriculture, urban farming, and home gardening (Dogo, 2022). AGRA and GIZ supported extension agents' digital skills training and aided 300,000 farmers in the crop value chain (Ibrahim, 2022). When In Need Foundation (WIN) distributed seedlings as part of a food security program (Chetachi, 2022). Despite these efforts, extension agents and smallholder farmers still lack adequate ICT skills that cut across different dimensions of food security for services like weather forecasting, precision farming, e-financing, and digital marketing to transform the food system for sustainable food security in Kaduna state. As a result, Kaduna State continues to face serious food crises. This study aims to find sustainable solutions for food security in Kaduna State and Nigeria as a whole. Hence, this study determined in harnessing ICT skills as a transversal skills approach in transforming food security for Smallholder Farmers in Southern Part of Kaduna State, Nigeria: A perspective of Extension Agents

The lack of sufficient utilization of ICT skills as transversal skills in various dimensions of food security among smallholder farmers in the Kaduna State, Nigeria, presents a significant obstacle to attaining food security in the state. Despite the potential of ICTs in transforming agricultural productivity and sustainability, many smallholder farmers lack access to relevant and suitable ICT tools and lack the necessary skills to use them effectively. This situation is further compounded by the limited capacity of extension agents to effectively communicate agricultural information and ICT-based

innovations to farmers. As a result, smallholder farmers in the Kaduna state continue to face challenges in accessing information, improving their agricultural practices, and increasing their yields, leading to food insecurity and limited economic opportunities. Therefore, there is a need to explore the potential of harnessing ICT skills as a transversal approach to address these challenges and sustains food security among smallholder farmers in Kaduna State, Nigeria, from the perspective of extension agents.

Purpose of the Study

The general purpose of the study examines Harnessing ICT as Transversal Skills Approach in Transforming Food Security for Smallholder Farmers in Kaduna State, Nigeria: Perspective of Extension Agents. Specifically, the study sought to:

1. assess the current level of ICT skills among Extension Agents working with Smallholder Farmers in Kaduna State, Nigeria.
2. identify the challenges faced by Extension Agents in harnessing ICT skills for improving food security among Smallholder Farmers in Kaduna State, Nigeria.
3. explore the potential benefits of incorporating ICT skills as a transversal approach for transforming food security among Smallholder Farmers in Kaduna State, Nigeria, from the perspective of Extension Agents.
4. identify the necessary resources, infrastructure, and training needed to support the successful implementation of the ICT skills transversal approach for transforming food security among Smallholder Farmers in Kaduna State, Nigeria, according to Extension Agents.

Research Questions

1. What is the current level of ICT skills among Extension Agents working with Smallholder Farmers in Kaduna State, Nigeria?
2. What are the challenges by Extension Agents in harnessing ICT skills for improving food security among Smallholder Farmers in Kaduna State, Nigeria?
3. What are the potential benefits of incorporating ICT skills as a transversal approach for transforming food security among Smallholder Farmers in Kaduna State, Nigeria, from the perspective of Extension Agents?
4. What are the necessary resources, infrastructure, and training needed to support the successful implementation of the ICT skills transversal approach for transforming food security among Smallholder Farmers in Kaduna State, Nigeria, according to Extension Agents?

Methodology

The study adopted a descriptive survey research design and was conducted in Kaduna State. The design was considered appropriate because the opinions of a representative of the respondents were obtained using a questionnaire and the findings generalized upon the entire population. The population for the study was 200 extension agents. The population was obtained after a preliminary survey which revealed that there were 200 extension agents in Kaduna Agricultural Development Agency (KADA), 70% (140) of which were males and 30% (60) females. To ensure a fair representation of the extension personnel based on sex, a proportional sampling procedure was used to select 50% of the respondents from each category. The sampled population is 100 extension agents from Agricultural Development Agency (KADA). Thus, 70 males and 30 females were randomly selected using a table of random numbers obtained from KADA Monitoring and Evaluation (M&E) unit to select the number of respondents for each group.

A 60-items structured questionnaire was used to collect data from the extension agents. The questionnaire had response options of Very high, High,

moderate, Low, and Very low; significant challenge, major challenge, moderate challenge, minor challenge, and Not a challenge; and strongly agree, Agree, Undecided, Disagree and Strongly disagree. Each of the response options had a corresponding value of 5, 4, 3, 2, and 1 respectively. The instrument was validated by three experts from the Department of Agricultural Education, Faculty of Vocational and Technical Education University of Nigeria, Nsukka. The corrections and contributions from validation were incorporated into the questionnaire for improvement. The reliability of the instrument was determined using Cronbach Alpha which yielded a reliability index of 0.76 indicating that it was reliable for the study.

100 questionnaires were administered to the sampled extension agents and retrieved. The data collected was analyzed using arithmetic mean and standard deviation to answer the research questions. In taking decision regarding the research questions, a mean value of any response between 4.5-5.0 = very high, 4.0- 4.4 = high, 3.0 – 3.9 = moderate, 2.0 – 2.9 = low and 1.0 – 1.9 = very low. Likewise with the other response options.

Results and Discussions

Table Showing Mean and Standard Deviation on Current Level of ICT Skills among Extension Agents working with Smallholder Farmers in Kaduna State

	Item statement	X	SD	Remark
1	Proficiency in basic computer operations (e.g., using keyboard and mouse)	4.4	.84	*****
2	Knowledge of common software applications (e.g., word processing, spreadsheets)	2.7	.63	***
3	Familiarity with internet browsing and online search techniques.	4.4	.82	*****
4	Ability to effectively use email communication for professional purposes	2.0	.71	*****
5	Competence in using mobile devices (e.g., smartphones, tablets) for agricultural purposes	3.1	.72	***
6	Understanding of ICT tools and resources relevant to agricultural extension services	2.0	.83	**
7	Ability to troubleshoot basic ICT issues and perform routine maintenance	1.1	.66	*
8	Skill in using agricultural apps and software for farm management and data analysis	2.0	.48	**
9	Competence in using social media platforms for information dissemination and farmer engagement	4.1	.81	*****
10	Proficiency in utilizing online learning platforms and resources for professional development	2.1	.86	**
11	Knowledge of ICT-enabled climate information services for agricultural decision-making	2.5	.60	***
12	Familiarity with digital financial services and mobile banking for farmer transactions	2.1	.54	**

13	Ability to collect, manage, and analyze data using digital tools and software	2.4	.79	**
14	Skill in creating and delivering digital presentations and training materials	1.6	.59	*
15	Understanding of data privacy and security principles in ICT usage for agricultural purposes	1.4	.78	*

Key: ***** = very high; **** = high; *** = moderate; ** = low and * = very low

The result presented in Table 1 shows mean values of items 1-15 ranging from 1.1 - 4.6 indicating current level of ICT skills. Items 1, 3, 5 and 9 indicated high level of ICT skills among extension agents while items 2, 4, 6, 7, 8, 10, 11, 12, 13, 14, and 15 indicated that the current level of ICT skills among extension agents is low. Also, the corresponding standard deviation indicated scores range of 0.46 - 0.86 implying that the opinions of the respondents were close to each other. Hence, it was revealed by the respondents that the current level of ICT skills among extension agents working with smallholder farmers in Kaduna State is low. Extension agents and smallholder farmers lacks adequate ICT skills that cut across different dimensions of food security for services like weather forecasting, precision farming, e-financing,

and digital marketing to transform the food system for sustainable food security in Kaduna state. This finding is in agreement with the work of Deepati and Kanini in Okeke, Nwalieji, and Uzuegbunam(2015), who reported that most extension workers lack competence and confidence in handling and operation of ICT facilities because they lack training on how to handle most modern ICTs. Also, Chikaire et al. (2017), found out that utilization of ICT skills by smallholder farmers in Kaduna state is constrained by several factors including lack of awareness and necessary skills to use ICT gadgets in food production, an underdeveloped legal framework for information sharing, infrastructure problems, poor connectivity, maintenance challenges, weak research and development, and high tariff.

Table Showing Mean and Standard Deviation on challenges faced by Extension Agents in harnessing ICT as Transversal skills for improving food security among Smallholder Farmers in Kaduna State

	Item statement	X	SD	Remark
1	Limited access to reliable and affordable internet connectivity	4.3	.65	****
2	Insufficient ICT infrastructure (e.g., electricity, network coverage) in rural areas	4.5	.84	*****
3	Lack of technical skills and knowledge among Extension Agents	3.4	.90	***
4	Inadequate funding for ICT implementation and capacity building	4.7	.58	*****
5	Limited availability of ICT equipment and tools for Extension Agents	4.3	.64	****
6	Resistance to change and limited ICT adoption among farmers.	3.1	.78	***
7	Language barriers and limited ICT literacy among farmers	3.3	.48	***
8	Lack of awareness about the potential benefits and applications of ICT in agriculture	4.7	.67	*****
9	Limited availability of localized and context-specific ICT solutions	4.5	.60	*****
10	Inadequate technical support and maintenance for ICT systems	4.2	.66	****
11	Inadequate training programs and resources for Extension Agents on ICT skills	4.8	.61	*****
12	Limited collaboration and coordination among stakeholders in ICT implementation	3.1	.62	***
13	Policy and regulatory barriers hindering the use of ICT in agriculture	3.4	.77	***
14	Challenges in data management, privacy, and security	3.1	.45	***
15	Limited capacity for monitoring and evaluating the impact of ICT interventions	2.4	.65	**

Key: ***** = significant challenge; **** = major challenge; *** = moderate challenge; ** = minor challenge and * = Not a challenge

The result presented in Table 2 shows mean values of items 1-15 ranging from 2.4 - 4.8 indicating challenges. Also, the corresponding standard deviation

indicated scores range of 0.45 - 0.90 implying that the opinions of the respondents were close to each other. Hence, it was indicated by the respondents that all the

15 items are challenges faced by Extension Agents in harnessing ICT as transversal skills for improving food security among smallholder farmers in Kaduna State. This finding concurs with that of Deepati and Kanini in Okeke, Nwaleji, and Uzuegbunam(2018), who reported that poor ICT infrastructural development on which ICTs depend on such as erratic and fluctuating power

supplies determines the length at which ICTs will be utilized, most radio/ television for instance (FM, Channels) in the state charge a huge amount of money for any presentation and most rural areas lack internet access because of bad road network, poor enabling environment, interconnectivity and high costs of equipment of ICTs.

Table Showing Mean and Standard Deviation on Potential Benefits of Incorporating ICT skills as Transversal Approach for Transforming Food Security among Smallholder Farmers in Kaduna State from the Perspective of Extension Agents

	Item statement	X	SD	Remark
1	Increased access to agricultural information and knowledge	4.8	.72	*****
2	Enhanced efficiency in farm management and production practices	4.6	.73	*****
3	Improved market access and opportunities for farmers	4.8	.58	*****
4	Facilitated communication and knowledge sharing among farmers	4.9	.86	*****
5	Strengthened capacity for data collection, analysis, and decision-making	4.5	.72	*****
6	Enhanced resilience to climate change through ICT-enabled climate information services	4.8	.68	*****
7	Empowered farmers through digital financial services and mobile banking	4.1	.88	****
8	Improved record-keeping and traceability of agricultural activities	4.6	.60	*****
9	Enhanced networking and collaboration among farmers and stakeholders	4.4	.62	****
10	Increased adoption of innovative and sustainable farming practices	4.2	.65	****
11	Expanded extension services reach and impact	4.6	.71	*****
12	Improved targeting and customization of extension interventions	4.7	.55	*****
13	Increased farmer engagement and participation in agricultural programs	4.5	.60	*****
14	Facilitated access to government support programs and subsidies	4.1	.64	****
15	Empowered farmers through ICT-enabled access to agricultural inputs and services	4.6	.59	*****

Key: ***** = strongly Agree; **** = agree; *** = undecided; ** = disagree and * = strongly disagree

The result as presented in Table 3 showed mean values of items 1-15 ranging from 4.1- 4.9 indicating agreed. Furthermore, the corresponding standard deviation indicated scores range of 0.55 - 0.88 implying that the opinions of the respondents were close to each other. Therefore, it was agreed by the respondents that all the 15 items are potential benefits of incorporating ICT skills as transversal approach for transforming food security among smallholder farmers in Kaduna State. ICT is a transverse skill that is becoming increasingly important in the field of food security. By providing farmers with access to information, knowledge, and communication tools, ICT can help to improve agricultural productivity, increase food security, and reduce poverty in rural areas among smallholder farmers. In addition, ICT can also be used

to improve communication and collaboration between different stakeholders in the food security sector. This finding is in agreement with that of FAO, (2018), who reported that ICT can be used to connect farmers with extension workers, researchers, and other experts who can provide them with advice and support and GIS technology can help to map land use, soil types, and other important information that can help farmers make better decisions about where to plant their crops and how to manage their land. Also, mobile applications can provide farmers with real-time weather forecasts, market prices, and other important information that can help them make informed decisions about when to plant and harvest crops, and how to sell their produce for the best price (McDougall and Rozelle, 2016).

Table Showing Mean and Standard Deviation on Identifying the Necessary Resources, Infrastructure, and Training Needed to Support the Successful Implementation of the ICT as Transversal Skills Approach for Transforming Food Security among Smallholder Farmers in Kaduna State

	Item Statement	X	SD	Remark
1	Adequate funding to procure ICT equipment and tools	4.1	.76	****
2	Availability of reliable internet connectivity in the target areas	4.2	.66	****
3	Access to training programs on ICT skills for Extension Agents	4.8	.83	*****
4	Provision of technical support for troubleshooting and maintenance of ICT equipment	4.0	.68	****
5	Availability of computer labs or centers equipped with necessary infrastructure	4.3	.64	****
6	Provision of relevant software and applications for farm management and data analysis	4.0	.82	****
7	Access to ongoing technical training to keep up with advancements in ICT	3.1	.84	**
8	Availability of local trainers or experts to provide specialized ICT training for farmers	4.6	.79	*****
9	Support for establishing community-based ICT centers for farmer education	4.6	.68	*****
10	Availability of instructional materials and resources for ICT skills training	4.1	.82	****
11	Provision of mobile devices or smartphones for farmers to access ICT tools and information	3.3	.72	***
12	Access to ICT infrastructure (e.g., electricity, network coverage) in rural areas	4.7	.87	*****
13	Collaboration with telecommunication companies to enhance internet connectivity in target areas	4.4	.49	****
14	Provision of mentorship programs for Extension Agents on ICT implementation	4.6	.82	*****
15	Availability of monitoring and evaluation tools to assess the impact of ICT interventions	3.2	.66	***

Key: ***** = strongly Agree; **** = agree; *** = undecided; ** = disagree and * = strongly disagree

The result as presented in Table 4 showed mean values of items 1-15 ranging from 3.1- 4.8 indicating agreed. Furthermore, the corresponding standard deviation indicated scores range of 0.49 - 0.87 implying that the opinions of the respondents were close to each other. Therefore, it was agreed by the respondents that all the 15 items are resources, infrastructure, and training needed to support the successful implementation of the ICT as transversal skills approach for transforming food security among smallholder farmers in Kaduna State. This finding agrees with the work of Okeke, Nwalieji, and Uzuegbunam(2015), who reported that provision of commodity prices and market information on the internet where small scale farmers can sell their products to avoid middlemen who determine the prices to the detriment of farmers and extension agents and farmers should undergo training in order to become computer literates so that they will be able to use the Global Positioning System (GPS) as it will help them describe the exact latitude and longitude of their farms.

This is a way of promoting what is known as precise farming.

Conclusion

Based on the findings presented, it can be concluded that the current level of ICT skills among extension agents working with smallholder farmers in Kaduna State is low. The majority of the surveyed extension agents lack adequate ICT skills, which hinders their ability to utilize ICT tools and services for improving food security. Additionally, various challenges and barriers were identified, highlighting the difficulties faced by extension agents in harnessing ICT as transversal skills for enhancing food security among smallholder farmers in the state. Harnessing ICT skills across different aspects of food security through mobile applications, online platforms, and agricultural databases offers a means to deliver real-time information, weather updates, improved access to relevant agricultural knowledge, enhanced decision-making capabilities, and increased market opportunities for smallholder farmers will transform food security

Recommendations

1. State government should enhance training and capacity building of the extension agents in ICT skills to ensure equipping extension agents with the necessary skills to effectively assist smallholder farmers in adopting and utilizing ICT for improved food security in Kaduna state.
2. Efforts should be made by government and NGOs to ensure that extension agents and smallholder farmers have access to the necessary resources and infrastructure required for effective implementation of ICT-based solutions to challenges faced by extension agents.

3. Regular monitoring and evaluation should be conducted to assess the progress and impact of ICT interventions in improving food security among smallholder farmers. This includes collecting data on the adoption and usage of ICT tools, measuring the outcomes and benefits achieved, and identifying areas for further improvement and investment.
4. Governments at the state and national levels should develop supportive policies and strategies that prioritize the supply of necessary resources, infrastructures and training needed by both extension agents and smallholder farmers in integration of ICT in the agricultural sector.

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