Proceedings of the Annual Conference of the Agricultural Extension Society of Nigeria
Number: Thirty-First Annual Conference
Theme: Strengthening the Agricultural Extension Innovation Systems for Greater Development Impacts
Date: 12th to 15th April 2026
Venue: Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
ISSN: 1595 – 1421.
Website: https://info@ajol.org,
Email: agricultural.extension.nigeria@gmail.com; editorinchief@aesonnigeria.org

Agricultural Extension Advisory Services and Agricultural Sustainability in Nigeria: Investigating the Mediated Role of ICT Use in VCDP and ATASP-1

https://dx.doi.org/10.4314/jae.v31i1.19S

Efobi Christian Obinna [1*], Obianefo Chukwujekwu Aloysius [2], Okeke Margaret Ngozi [3], Onwubuya Ngozi Admire [4], and Uchemba Victor Uzochukwu [5]

[1,3,5] Department of Agricultural Economics and Extension, Chukwuemeka Odumegwu Ojukwu University, Igbariam, Nigeria, [2,4] Department of Agricultural Economics, Nnamdi Azikiwe University, Awka, Nigeria
*Correspondence and presenting author: ca.obianefo@unizik.edu.ng; +2347039134994
[1] efobiobinna@gmail.com,+2348067983700; [3] megngookeke@gmail.com, +2348060650078; [4] onwubuyangozi@gmail.com, +2347036327929;
[5] vu.uchemba@coou.edu.ng, +2348109469945

Abstract:

*This study examined how agricultural extension advisory services influence agricultural sustainability in Nigeria, and whether information and communication technology (ICT) use mediated this relationship among farmers participating in VCDP and ATASP-1 in Anambra State. Data was collected from a random sample of 281 farmers, and analysed using structural equation modelling. The findings reveal that extension services had a statistically significant effect on agricultural sustainability (β = −0.482; C.R. = −6.75***) with acceptable model fit (GFI = 0.879; RMR = 0.097). Farmers particularly valued practical recommendations (0.913), frequent contact (0.944), and timely responses (0.864), which translated into improvements in soil fertility (0.957), income stability (0.809), and long-term productivity (0.669). Extension services also significantly increased ICT use (β = 0.576; C.R. = 8.87***), suggesting that advisory support encourages digital engagement. ICT use was significantly associated with sustainability (β = −0.704; C.R. = −6.94), though signs reflect SEM scaling. Mediation analysis uncovered that ICT did not significantly transmit the extension effect to sustainability (β = 0.032), despite a strong model fit (RMR = 0.002). These findings suggest that extension remains the primary driver of sustainability, while ICT plays a supportive role. Strengthening extension within VCDP and ATASP-1 is therefore critical for resilient and sustainable agriculture.*

Keywords: Extension advisory services, Agricultural sustainability, Mediating role

Introduction

The agricultural sector is central to Nigeria's economy in terms of GDP growth, rural livelihood enhancement, and contribution to food security; the sector continually seeks to achieve sustainability through improved resource management, climate resilience, and environmentally responsible practices (Obianefo et al., 2022). Agricultural extension advisory services (AEAS) use intervention programmes, including the Value Chain Development Programme (VCDP) and the Agricultural Transformation Agenda Support Program Phase One (ATASP-1), as platforms to communicate extension packages to farmers, promote improved agricultural

techniques, increase farmers' knowledge, improve production, enhance resource management, and support agricultural sustainability (Olagunju et al., 2021; Ogunleye et al., 2021; Aromolaran et al., 2024; Osuji et al., 2025), these intervention programs are key to reviving the sector. However, the widespread use and successful application of information and communication technologies (ICT) have greatly changed how extension services are delivered to signal timely information, improve knowledge sharing, thereby helping in decision-making via tools such as mobile devices, internet platforms, and social media (Ocran et al., 2024). Studies conducted in Nigeria and other parts of Sub-Saharan Africa have revealed increasing ICT use for extension support, market information, weather updates, and agricultural advisory services. Moreso, factors such as low digital literacy, education level, income, poor infrastructure, high cost of digital tools, and limited institutional support continue to constrain the effective use of these technologies among farmers and extension personnel (Abuta et al., 2021; Izuogu et al., 2023; Ifeanyi-obi and Corbon, 2023; Umunakwe et al., 2025; Okoronkwo et al., 2025; Adam, 2026). Although current studies highlight the need for extension services and ICTs for agricultural advancement, there is little knowledge on how these advisory services directly affect sustainability outcomes and ICT adoption among farmers in areas profiting from the programmes, therefore urging a more thorough investigation of ICT use and agricultural sustainability.

Although the existing literature recognises the growing role of ICT in agricultural extension and sustainability, most studies have not sufficiently examined how extension advisory services influence both ICT adoption and agricultural sustainability within programme intervention settings. A number of related studies provide useful evidence on digital extension and sustainability-oriented practices, but they remain limited in scope and analytical approach. For example, Adesida et al. (2021) observed that participation in the E-wallet scheme increased the likelihood of adopting fertiliser trees and animal manure, while Farmers' Field School participation increased the likelihood of adopting crop diversification and cover crops. The study is relevant because it links organised agricultural support to sustainability-oriented practice, but it did not focus specifically on extension advisory services, ICT use, or mediation analysis, which are key to this study. Again, Ifeanyi-obi and Corbon (2023) observed that all the extension agents in their study were aware of digital tools, while 74% used them in service delivery, with WhatsApp and video cameras being the most used tools. Their findings show that ICT is becoming embedded in extension practice, yet the study stopped at the level of utilisation by extension officers, it did not check whether ICT use translates into agricultural sustainability or mediates the relationship between extension advisory services and sustainability outcomes. Omeje et al. (2025) ultimately noted that only 17.09% of farmers used AI, although AI usage significantly improved crop production. This is relevant because it shows that digital tools can support agricultural performance, but the study focused on AI rather than broader ICT use and did not model agricultural sustainability as a latent outcome.

Reiteratively, ICT use has been recognized as a driver of agricultural sustainability that improves farmers' access to climate information, market data, and agronomic recommendations. This further enhances agricultural productivity, resilience, and sustainable farming practices (Obianefo et al., 2024) Scholars in Nigeria linked ICT-enabled extension services to improved knowledge dissemination and sustainability outcomes (Olagunju et al., 2021; Izuogu et al., 2023; Matthew, 2023; Osuji et al.,

2025; Joel et al., 2025).These studies treated extension services, ICT use, and sustainability outcomes separately; they were too descriptive in nature, with only a few focusing on determinants of ICT use rather than on causal pathways. The study by Obianefo et al. (2024) used advanced methods such as factor analysis and multinomial regression to achieve their objective of ICT use and extension advisory services, yet they fall short of the causal pathways. This leaves a critical gap in understanding ICT use as a mediating pathway through which extension advisory services influence agricultural sustainability, a gap this study addresses using Structural Equation Modelling (SEM) to generate stronger policy-relevant insights to strengthen ICT-enabled extension systems in Nigeria. It is upon this background that the study sought to:

i. ascertain the effect of agricultural extension advisory services on agricultural sustainability in the study area,
ii. examine the effect of agricultural extension advisory services on ICT use among the selected farmers,
iii. assess the effect of ICT use on agricultural sustainability in the study area, and
iv. test whether ICT use mediates the relationship between extension advisory services and agricultural sustainability in Nigeria.

Methodology

Study Area and Sampling Procedures

This study was conducted in Anambra State, Nigeria. The state was selected due to its strategic importance in ongoing agricultural development interventions relevant to this research. Geographically, Anambra State lies in Southeastern Nigeria, approximately between latitude 6°20′ N and longitude 7°00′ E, and occupies a land area of about 4,844 km². The state is characterized by a humid tropical climate with distinct wet and dry seasons (Nnadi et al., 2019).

A multistage sampling technique was used for the study. In the first stage, Ayamelum and Awka North LGAs were purposively selected from the VCDP areas, while Ogbaru and Orumba North LGAs were purposively selected from the ATASP-1 areas. The selection was based on the observed use of ICT tools by extension officers in disseminating agricultural information in these areas, as well as the demonstrated receptiveness of farmers to ICT-driven extension services. In the second stage, two communities were randomly selected from each of the four LGAs, resulting in a total of eight communities. Subsequently, five clusters or villages were randomly selected from each community, giving a total of 40 clusters for the survey. In the final stage, data were collected from a random sampling of 280 farmers coming from 20 ATASP-1 and 20 VCDP clusters. This process yielded a total sample size of 280 farmers for the study.

Model Specification

This study employed Structural Equation Modelling (SEM) to examine the direct and indirect relationships among agricultural extension advisory services, ICT use, and agricultural sustainability. The SEM was considered appropriate because the core variables of the study are latent constructs measured by multiple observed indicators, and the technique allows the researcher to assess both the measurement properties of the constructs and the structural relationships among them in a single framework. The model was designed in line with the study objectives. Specifically, it

examined the direct effect of agricultural extension advisory services (AEAS: AEAS1: Access to extension agents when advice is needed, AEAS2: Frequency of contact or visits by extension officers, AEAS3: Ease of reaching extension agents by phone or in person, AEAS4: Relevance of extension advice to farming needs, AEAS5: Practicality and ease of applying extension recommendations, AEAS6: Extension advice supports solving farm problems, AEAS7: Timeliness of extension advice for key farming decisions, AEAS8: Extension training increases confidence in farm decisions, AEAS9: Extension training improves farming knowledge and skills, and AEAS10: Responsiveness of extension agents to farmers' concerns) on agricultural sustainability, the effect of agricultural extension advisory services on ICT use (ICT1: Access to mobile phone for farming-related purposes, ICT2: Access to internet services for agricultural information, ICT3: Use of radio or television agricultural programmes for information, ICT4: Frequency of phone use for obtaining agricultural information, ICT5: Use of WhatsApp or other digital platforms for agricultural advice, ICT6: Use of ICT to check market prices before selling produce, ICT7: Use of ICT for weather or climate information, ICT8: ICT supports learning of improved farming practices and innovations, and ICT9: Communication with extension agents using ICT tools), the effect of ICT uses on agricultural sustainability (SUS1: Farming practices maintain or improve soil fertility, SUS2: Farming practices support conservation of soil and water resources, SUS3: Farm productivity is sustained over time through current practices, SUS4: Farming practices reduce environmental harm, SUS5: Farm income remains stable across seasons, and SUS6: Farming supports long term household welfare), and the mediating role of ICT use in the relationship between agricultural extension advisory services and agricultural sustainability.

The structural relationships among the latent variables are expressed as follows:

$$ICT = \beta_1 AEAS + \epsilon_1 \quad \text{... Eqn. 1}$$

$$SUS = \beta_2 AEAS + \beta_3 ICT + \epsilon_2 \quad \text{... Eqn. 2}$$

Where:

ICT represents ITC use, *SUS* represents the agricultural sustainability, *AEAS* denotes the agricultural extension advisory services, β_1 represents the effect of agricultural extension advisory services on ICT use, β_2 represents the direct effect of agricultural extension advisory services on agricultural sustainability, β_3 represents the effect of ICT use on agricultural sustainability, and ε_1 and ε_2 represents the disturbance terms. All variables used in the analysis were derived from Likert-scale responses.

The structural path for the mediating role of ICT use was examined through the indirect path:

$$AEAS \rightarrow ICT \rightarrow SUS \quad \text{… Eqn. 3}$$

The indirect effect is expressed as:

$$\beta_1 * \beta_3 \quad \text{... Eqn. 4}$$

The total effect of agricultural extension advisory services on agricultural sustainability is therefore given as:

$$Total\ effect = \beta_2 + (\beta_1 * \beta_3) \quad \text{... Eqn. 5}$$

In this specification, agricultural extension advisory services serve as the exogenous latent construct, ICT use serves as the mediating endogenous latent construct, and agricultural sustainability serves as the final endogenous latent construct.

Note: mediation is established when agricultural extension advisory services significantly predict ICT use, ICT use significantly predicts agricultural sustainability, and the indirect effect of agricultural extension advisory services on agricultural sustainability through ICT use is statistically significant.

Results and Discussion

Effect of Agricultural Extension Advisory Services on Agricultural Sustainability

The Structural Equation Modelling (SEM) results (Table 1 and Figure 1) show that the model achieved an acceptable fit, with GFI = 0.879 and RMR = 0.097, indicating that the model adequately explained the relationships among agricultural extension advisory services (AEAS), agricultural sustainability (SUS), and their indicators, consistent with acceptable SEM thresholds (Obianefo et al., 2023). Most variables measured were statistically significant at the 1% level, confirming the reliability of the constructs used.

A major finding was that agricultural extension advisory services significantly influenced agricultural sustainability (β = −0.482, C.R. = −6.75***), demonstrating that extension services play an important role in shaping sustainability outcomes among VCDP and ATASP-1 farmers in Anambra State. Although the coefficient was negative, it was interpreted as a model scaling issue rather than evidence of an adverse relationship. The findings support earlier studies showing that quality extension services improve productivity, soil management, resource efficiency, and long-term sustainability (Osuji et al. 2025; Pelemo et al. 2024; Ogunleye et al., 2021). The results further show strong positive covariance among extension dimensions (β = 0.975), suggesting that access, responsiveness, and training function as an integrated support system. Key extension indicators with strong loadings included frequent contact with extension officers, practical recommendations, relevance of advice, ease of reaching agents, responsiveness, and training support, reinforcing the importance of timely, practical, and farmer-oriented advisory services. This supports findings by Adesida et al. (2021) on the role of organised support systems and quality advisory delivery.

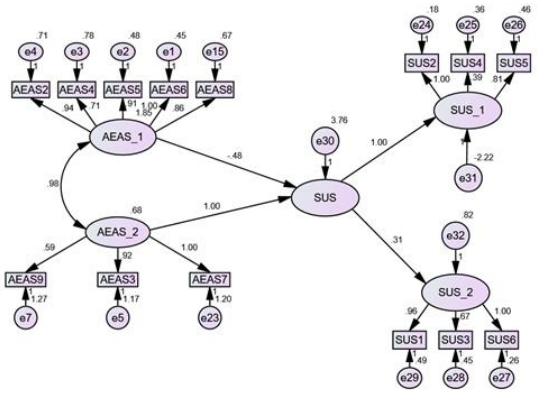

Figure 1: Structural paths for extension advisory service and sustainability

For agricultural sustainability, significant indicators included soil fertility maintenance, stable farm income, long-term productivity, and reduced environmental harm, indicating that sustainability outcomes were strongly associated with environmental and economic dimensions. The resource conservation indicator was not significant, suggesting some sustainability practices are not yet fully embedded among all farmers, which agrees with Sarku et al. (2025). Thus, extension advisory services directly contribute to agricultural sustainability and should be viewed as a productive economic input, not merely a welfare intervention.

Table 1: Effect of agricultural extension advisory services on agricultural sustainability

Variable indicators			Estimate	S.E.	C.R.
SUS	<---	AEAS_1	-0.482	0.071	-6.75***
SUS	<---	AEAS_2	1		
SUS_1	<---	SUS	1		
SUS_2	<---	SUS	0.306	0.243	1.26NS
AEAS6	<---	AEAS_1	1		
AEAS5	<---	AEAS_1	0.913	0.044	20.91***
AEAS4	<---	AEAS_1	0.712	0.046	15.37***
AEAS2	<---	AEAS_1	0.944	0.049	19.15***
AEAS3	<---	AEAS_2	0.916	0.123	7.47***
AEAS9	<---	AEAS_2	0.586	0.106	5.52***
AEAS8	<---	AEAS_1	0.864	0.047	18.55***
AEAS7	<---	AEAS_2	1		
SUS2	<---	SUS_1	1		
SUS4	<---	SUS_1	0.389	0.03	12.82***
SUS5	<---	SUS_1	0.809	0.041	19.95***
SUS6	<---	SUS_2	1		
SUS3	<---	SUS_2	0.669	0.045	14.82***
SUS1	<---	SUS_2	0.957	0.053	17.98***
		Covariance			
AEAS_1	<-->	AEAS_2	0.975	0.13	7.49***
Goodness of fit					
RMR			0.097		
GFI			0.879		
AIC			3575.028		

Source: Field Survey, 2025. *P≤0.05, **P≤0.01

Effect of Agricultural Extension Advisory Services on ICT Use

Table 2 and Figure 2 show that agricultural extension advisory services significantly influence farmers' ICT use, though the effect differed across extension dimensions. Specifically, AEAS_1 had a strong positive and significant effect on ICT use (β = 0.576, C.R. = 8.87***), indicating that better access, responsiveness, and practical extension support increase farmers' use of digital tools for agricultural decision-making. This finding aligns with Ifeanyi-obi and Corbon (2023), who showed that extension support can stimulate farmers' uptake of ICTs. In contrast, AEAS_2 was not statistically significant (β = 0.084), suggesting that routine contact or general training alone may not promote ICT adoption unless linked to practical, technology-focused support. This contrasts with Izuogu et al. (2023), Olanrewaju et al. (2022),

and Nwafor et al. (2021), but supports Umunakwe et al. (2025) and Okeke et al. (2022), who emphasised the role of factors such as education, income, and digital literacy in ICT uptake.

The measurement model showed that quality extension services are defined largely by practical, relevant, timely, and responsive support. Strong indicator loadings for practical recommendations, relevance of advice, frequent contact, responsiveness, and capacity-building suggest that farmers value extension services that solve problems and improve decision-making. These findings confirmed that the usefulness and quality of advisory services drive behavioural outcomes more than simple access. The positive and significant covariance between extension dimensions (β = 0.871) further confirmed that extension support operates as an integrated system, consistent with Adesida et al. (2021).

Results also show that ICT use among farmers is strongly tied to practical agricultural functions, particularly access to weather information, digital platforms such as WhatsApp, market price checks, communication with extension agents, as continued use of radio, television, and internet searches. These indicators demonstrate that farmers combine both traditional and digital channels in support of farm decisions, consistent with findings from Sarku et al. (2025). However, effective extension services act as a bridge to digital agriculture, encouraging farmers to use ICT tools for markets, climate information, and advisory support.

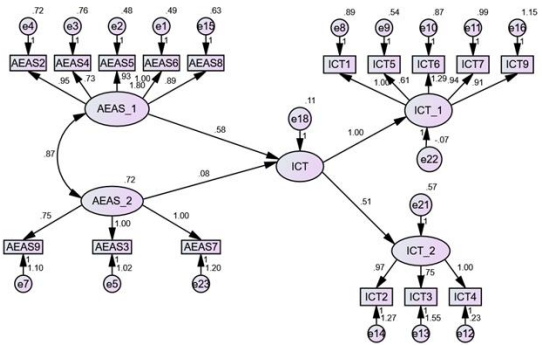

Figure 2: **Structural paths for extension advisory service and ICT use**

Table 2: Effect of agricultural extension advisory services on ICT use

Variable Indicators			Estimate	S.E.	C.R.
ICT	<---	AEAS_1	0.576	0.065	8.87***
ICT	<---	AEAS_2	0.084	0.092	0.91NS
ICT_1	<---	ICT	1		
ICT_2	<---	ICT	0.508	0.074	6.86***
AEAS6	<---	AEAS_1	1		
AEAS5	<---	AEAS_1	0.925	0.044	20.86***
AEAS4	<---	AEAS_1	0.726	0.047	15.54***
AEAS2	<---	AEAS_1	0.953	0.05	18.97***
AEAS3	<---	AEAS_2	1	0.132	7.55***
AEAS9	<---	AEAS_2	0.748	0.114	6.55***
ICT1	<---	ICT_1	1		
ICT5	<---	ICT_1	0.611	0.068	8.94***
ICT6	<---	ICT_1	0.292	0.025	11.48***
ICT7	<---	ICT_1	0.943	0.098	9.67***
ICT4	<---	ICT_2	1		
ICT3	<---	ICT_2	0.754	0.118	6.40***
ICT2	<---	ICT_2	0.968	0.129	7.49***
AEAS8	<---	AEAS_1	0.886	0.047	18.90***
ICT9	<---	ICT_1	0.906	0.1	9.05***
AEAS7	<---	AEAS_2	1		
			Covariance		
AEAS_1	<-->	AEAS_2	0.871	0.126	6.94***
Goodness of fit					
RMR			0.145		
GFI			0.766		
AIC			4927.702		

Source: Field Survey, 2025. *P≤0.05, **P≤0.01, ***P≤0.001

Effect of ICT Use on Agricultural Sustainability

Table 3 and Figure 3 show a reasonably acceptable model fit (GFI = 0.874; RMR = 0.146), indicating that the model adequately captured the relationship between ICT use and agricultural sustainability, though some residual variation remained. A major finding was that ICT use significantly influenced agricultural sustainability, with one ICT dimension (ICT_1) showing a strong and statistically significant effect (β = −0.704, C.R. = −6.94***). Although the negative coefficient could be attributed to modelling error or scaling issue as evident in the adverse relationship. Substantively, the results support the view that ICT use contributes positively to sustainability outcomes, consistent with findings by Osuji et al. (2025) and Matthew (2023). The result partly contrasts with Xu and Liu (2025), suggesting that ICT benefits depend partly on farmers' digital literacy and effective use of the technologies.

The measurement results show that ICT use was strongly represented by practical and decision-oriented indicators, particularly use of ICT for market prices, digital platforms, weather information, communication with extension agents, internet searches, radio and television programmes, and frequent phone use for agricultural information. These findings indicate that ICT use among farmers goes beyond access to devices and is embedded in real production and marketing decisions. This

supports earlier evidence from Sarku et al. (2025) and Olanrewaju et al. (2022), who noted that farmers rely on both digital and traditional communication channels for agricultural information. The positive covariance between ICT dimensions (β = 0.465) further suggests complementary use of multiple ICT channels among farmers.

For agricultural sustainability, key indicators included maintaining soil fertility, stable farm income, long-term productivity, and reduced environmental harm, reinforcing the idea that sustainability outcomes encompass both environmental stewardship and economic resilience. This supports Obianefo et al. (2024), who conceptualised sustainability as multidimensional. Thus, ICT functions as a critical enabler of sustainable agriculture, helping farmers access timely information, reduce uncertainty, improve resource use, and strengthen decision-making. outcomes among farmers, with important policy implications for digital agriculture interventions in Nigeria.

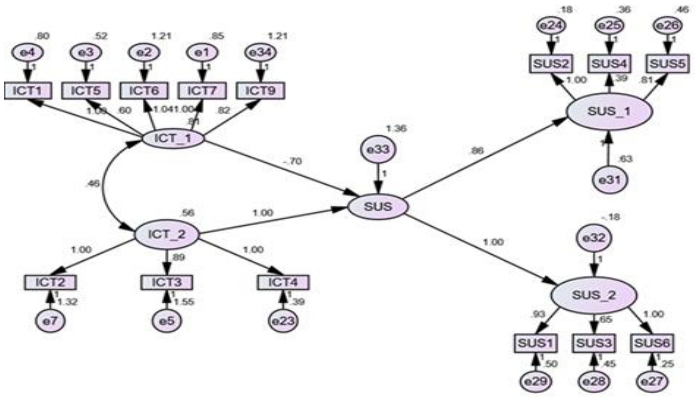

Figure 3: **Structural paths for ICT use and agricultural sustainability.**

Table 3: Effect of ICT use on agricultural sustainability

Variable indicators			Estimate	S.E.	C.R.
SUS	<---	ICT_1	-0.704	0.101	-6.94***
SUS	<---	ICT_2	1		
SUS_1	<---	SUS	0.86	0.14	6.15***
SUS_2	<---	SUS	1		
ICT7	<---	ICT_1	1		
ICT6	<---	ICT_1	0.043	0. 004	10.39***
ICT5	<---	ICT_1	0.602	0.063	9.54***
ICT1	<---	ICT_1	1		
ICT3	<---	ICT_2	0.889	0.13	6.83***
ICT2	<---	ICT_2	1		
ICT4	<---	ICT_2	1		
SUS2	<---	SUS_1	1		
SUS4	<---	SUS_1	0.39	0.029	13.49***
SUS5	<---	SUS_1	0.809	0.038	21.10***
SUS6	<---	SUS_2	1		
SUS3	<---	SUS_2	0.651	0.039	16.51***
SUS1	<---	SUS_2	0.93	0.046	20.13***
ICT9	<---	ICT_1	0.822	0.093	8.83***
Covariance					
ICT_1	<-->	ICT_2	0.465	0.064	7.27***
Goodness of fit					
RMR			0.146		
GFI			0.874		
RMR			0.145		
GFI			0.766		
AIC			4927.702		

Source: Field Survey, 2025. *P≤0.05, **P≤0.01, ***P≤0.001

Mediating Role of ICT Use in the Relationship Between Agricultural Extension Advisory Services and Agricultural Sustainability in Nigeria

The SEM mediation analysis tested whether ICT use mediates the relationship between agricultural extension advisory services and agricultural sustainability (Table 4 and Figure 4) by assessing the standard mediation conditions. The results showed that extension advisory services had a strong and significant positive effect on ICT use (β = 0.611, C.R. = 13.71***), confirming that effective extension services promote farmers' adoption and use of digital tools. This finding agrees with Ifeanyi-obi and Corbon (2023), who found that extension systems can stimulate ICT use by improving access to information and encouraging digital engagement.

However, the second pathway, ICT use for agricultural sustainability, was not statistically significant (β = 0.032, p = 0.734), indicating that ICT use did not significantly improve sustainability outcomes in this model. This might be because the second mediation condition was not satisfied, hence, ICT use was not found to mediate the relationship between extension services and sustainability. This contrasts with studies by Izuogu et al. (2023) and Matthew (2023), which reported

positive sustainability effects of ICT adoption, but aligns with Xu and Liu (2025) and Sarku et al. (2025), who noted that the impact of digital tools may be limited where usability, digital literacy, and relevance are weak.

The results further show strong measurement quality, with high factor loadings for ICT (0.865), sustainability (0.949), and extension services (0.942), indicating that the latent constructs were well represented by their indicators. In addition, model fit was excellent (RMR = 0.002; GFI = 1.000), confirming that the absence of mediation was not due to model weakness but reflected the actual pattern in the data. Thus, extension services directly support ICT use, but ICT use does not function as a mediating pathway linking extension to sustainability outcomes.

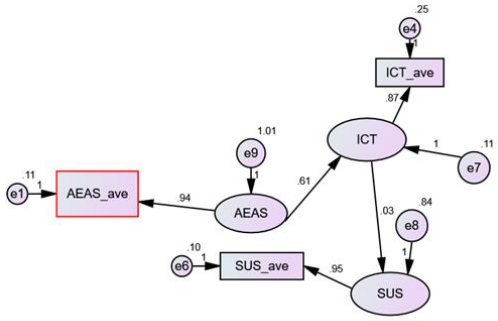

Figure 4: Structural paths for mediation analysis.

Table 4: Mediating role of ICT use on agricultural sustainability in Nigeria

			Estimate	S.E.	C.R.	Decision
ICT	<---	AEAS	0.611	0.045	13.71***	
SUS	<---	ICT	0.032	0.094	0.34^{NS}	Mediation not established
Average ICT	<---	ICT	0.865			
Average SUS	<---	SUS	0.949			
Average AEAS	<---	AEAS	0.942			
RMR			0.002		Good fit	
GFI			1.000		Good fit	

Source: Field Survey, 2025. *P≤0.05, **P≤0.01, ***P≤0.001

Conclusion and Recommendations

In conclusion, this study affirms the central role of agricultural extension advisory services in strengthening sustainable agriculture among VCDP and ATASP-1 farmers in Anambra State. Effective extension support remains essential for improving farmers' decisions, promoting better farm practices, enhancing productivity, and supporting long-term resilience. While ICT offers useful opportunities for wider access to information, it should be viewed as a supportive tool rather than a replacement for direct, practical, and farmer-centred advisory services.

Therefore, sustained investment in the quality of extension services is critical. This should include adequate funding, recruitment of competent extension workers, continuous training, proper motivation, and performance-based service delivery.

When extension systems are strengthened in these ways, it will help to deepen sustainability outcomes and contribute meaningfully to resilient agricultural development in Anambra State and Nigeria at large.

References

Abuta, C. M. A., Agumagu, A. C., & Adesope, O. M. (2021). Social media used by arable crop farmers for communicating climate change adaptation strategies in Imo State, Nigeria. *Journal of Agricultural Extension, 25*(1), 73-82. https://dx.doi.org/10.4314/jae.v25i1.8

Adam, A. G. (2026). ICT4Ag tools and extension service delivery in Nigeria. *Nigerian Journal of Agriculture and Agricultural Technology*, 6(1A). https://njaat.com.ng/index.php/njaat/article/download/1451/1042

Adesida, I. E., Nkomoki, W., Bavorova, M., & Madaki, M. Y. (2021). Effects of agricultural programmes and land ownership on the adoption of sustainable agricultural practices in Nigeria. *Sustainability, 13*(13), 7249. https://doi.org/10.3390/su13137249

Aromolaran, A. K., Wole-Alo, F. I., Sanusi, N. O., Tiamiyu, L. O., & Bamiduro, P. O. (2024). Extension agents' perspective on the effect of funders' mandate and fund access on sustainable development in Ogun State, Nigeria. *Journal of Agricultural Extension, 28*(3), 50-59. https://dx.doi.org/10.4314/jae.v28i3.6

Ifeanyi-obi, C. C., & Corbon, B. L. (2023). Utilization of digital tools in extension service delivery amongst extension agents in Akwa Ibom State, Nigeria. *Journal of Agricultural Extension, 27*(4), 67-76. https://dx.doi.org/10.4314/jae.v27i4.7

Izuogu, C. U., Olaolu, M. O., Azuamairo, G. C., Njoku, L. C., & Ibrahim-Olesin, S. (2023). A review of the digitalization of agriculture in Nigeria. *Journal of Agricultural Extension, 27*(2): 47-64. https://dx.doi.org/10.4314/jae.v27i2.5

Joel, A. F., Bamidele, J., Oyediji, B. I., et al. (2025). Effectiveness of ICTs in extension service delivery among smallholder farmers in Abuja, Nigeria. *Global Academic Journal of Agriculture and Biosciences*, 7(1), 8–17. https://doi.org/10.36348/gajab.2025.v07i01.002

Nwafor, C. U., Ogundeji, A. A., & van der Westhuizen, C. (2021). ICT adoption and productivity of smallholder farmers. *Technology in Society*, 64, 101488.

Obianefo, C.A., N.J. Obiekwe, N.O. Okoroji, Z.A. Shah, U.V. Uchemba, and E.G. Osegbue. 2024. Usability of E-extension technology and growth of agricultural productivity in southeast Nigeria: ADP extension workers' survey. Sarhad Journal of Agriculture, 40(2): 659-671. DOI | https://dx.doi.org/10.17582/journal.sja/2024/40.2.659.671

Ocran, J. K., Asante, I. K., & Ametepey, E. T. K. (2024). Benefits, barriers, challenges, and requirements for the application of digital technologies in agricultural extension in selected regions in Ghana: Perspectives from extension agents. *Journal of Agricultural Extension and Rural Development*, 16(2), 88-105, https://doi.org/10.5897/JAERD2024.1406.

Ogunleye, A. S., Adeyemo, R., & Bamire, A. S. (2021). Extension services and sustainable agricultural practices in Nigeria. *Sustainability*, 13(9), 4890.

Okeke, C. C., Eze, C. C., & Okoye, B. (2022). Digital inclusion and agricultural productivity in Nigeria. *African Journal of Science, Technology, Innovation and Development*, 14(3), 765–774.

Okoronkwo, I., Ndinechi, K., Joseph, C., & Uwandu, C. N. (2025). Utilisation of digital technologies among rural farmers in Imo State, Nigeria. *Journal of Agricultural Extension, 29*(4), 56-67. https://dx.doi.org/10.4314/jae.v29i4.7

Olanrewaju, O. A., Oladele, O. I., & Ogunlade, I. (2022). ICT tools usage among farmers in Nigeria. *Journal of Agricultural Informatics*, 13(1), 23–34.

Omeje, E. E., Ukwuaba, I. C., Nwangwu, K. N., Umaru, I. I., Ibe, J. C., & Offorma, J. T. (2025). Rural-urban differentials in utilization of artificial intelligence for improved agricultural production among crop farmers in Southeast Nigeria. *Journal of Agricultural Extension, 29*(2). https://journal.aesonnigeria.org/index.php/jae/article/view/5158

Osuji, E. E., Olaolu, M. O., Okereke-Ejiogu, N. E., Onoh, P. A., Peter-Onoh, C. A., Emma-Okafor, L. C., Chukwuma, O., Osuagwu, C. O., Aririguzo, B. N., & Adaohuru, A. R. (2025). Agricultural Extension Services and Climate Adaptive Capacity of Smallholder Farmers in Ebonyi State, Nigeria. *Journal of Agricultural Extension, 29*(2), 11-21.

Pelemo, J. J., Ajibola, B. O., Adeyemi, O. A., Shehu, M., & Adewumi, A. (2024). Adoption of climate-smart practices among arable crop farmers in Kogi State, Nigeria. *Journal of Agricultural Extension, 28*(4), 110-119.

Sarku, R., Addi, F., & Attoh, E. M. N. A. N. (2025). New information and communication technologies for climate services: Evidence from farmers in Ada East District, Ghana. *Climate Services, 37*, 100535. https://doi.org/10.1016/j.cliser.2024.100535

Umunakwe, P. C., Madukwe, M. C., Anaeto, F. C., Nwakwasi, R. N., & Aja, O. O. (2025). Proficiency for digital extension service delivery among public agricultural extension personnel in Imo State, Nigeria. *Journal of Agricultural Extension, 29*(1), 63-75. https://dx.doi.org/10.4314/jae.v29i1.7

Xu, B., & Liu, W. (2025). The real impact of digital agricultural technology extension on pesticide reduction behaviour among wheat farmers in Henan, China. *Agriculture, 15*(9), 1002. https://doi.org/10.3390/agriculture15091002.