



**DETERMINANTS AND CONSTRAINTS TO THE UTILISATION OF E-
AGRICULTURAL EXTENSION SERVICES AMONG POULTRY FARMERS IN
NIGER STATE, NIGERIA**

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ABSTRACT

Agriculture remains vital to economic growth, food security, and livelihood improvement in Nigeria. However, conventional agricultural extension services have been constrained by an inadequate number of extension personnel, limited coverage, and poor access to timely information. Consequently, e-agricultural extension services have emerged as an innovative approach to improving information dissemination and enhancing agricultural productivity. This study assessed e-agricultural extension service delivery to enhance poultry production in Niger State, Nigeria, with the specific objectives of determining the factors influencing poultry farmers' use of e-agricultural extension services and identifying the constraints associated with their utilisation. A multistage sampling procedure was employed to select 226 poultry farmers from the study area, while primary data were collected using a structured questionnaire. Descriptive statistics and a Logit regression model were used for data analysis, and statistical significance was determined at the 1%, 5%, and 10% probability levels. The findings revealed that years of poultry-rearing experience positively influenced the use of e-agricultural extension services, with a marginal effect of 0.115. Access to credit had a strong, positive and significant effect (marginal effect of 0.533 at the 1% probability level), indicating that farmers with access to financial resources were more likely to use digital extension technologies. Conversely, the cost of digital devices had a negative and significant effect on utilisation, with a marginal effect of -0.323 at the 5% probability level. At the 10% probability level, age and access to veterinary services positively influenced the use of e-agricultural extension services, with marginal effects of 0.027 and 0.277, respectively. The major constraints affecting the utilisation of e-agricultural extension services were the high cost of digital devices ($\bar{X} = 2.96$), poor infrastructure and power supply ($\bar{X} = 2.91$), and limited access to the internet ($\bar{X} = 2.90$). The study concludes that socioeconomic and technological factors significantly influence poultry farmers' utilisation of e-agricultural extension services in Niger State. The study recommends providing affordable digital devices, expanding rural Internet connectivity, improving electricity infrastructure, and increasing access to agricultural credit facilities.

Keywords: E-agriculture, poultry farming, information and communication technology (ICT), digital tools, poultry extension.

INTRODUCTION

Agriculture remains a critical sector for economic development, food security, and poverty reduction in Nigeria, with poultry production playing a vital role in improving nutrition, creating employment, and generating income for rural households (Food and Agriculture Organisation (FAO) 2020). Niger State, located in North-Central Nigeria, has substantial agricultural potential, and poultry farming is one of its most promising enterprises. However, despite its potential, poultry production in the State faces several challenges, including limited access to updated agricultural information, poor veterinary services, disease outbreaks, and inefficient management practices (Onyemekihian, 2021).

Agricultural extension services are essential for bridging the gap between research and farmers by disseminating improved practices and innovations. Conventionally, extension services in Nigeria have been delivered through face-to-face methods, which are often limited in coverage, costly, and logistically challenging, especially in rural areas (Agwu *et al.*, 2019). This situation has necessitated exploring alternative methods to deliver agricultural information effectively and efficiently.

E-agriculture, which uses information and communication technologies (ICTs) for agricultural development, offers a viable solution to these challenges. Tools such as mobile phones, social media platforms, online portals, and SMS-based advisory services have emerged as promising innovations for improving extension service delivery (Filli *et al.*, 2021). E-agricultural extension services can provide poultry farmers in Niger State with timely information on disease prevention, vaccination schedules, feeding practices, and market opportunities, thereby enhancing productivity and profitability (Oladupe and Olaniyi, 2020).

Despite the growing relevance of e-agriculture, its adoption and impact on poultry production in Niger State remain underexplored (Eweoya *et al.*, 2021). Understanding these dynamics is essential for developing strategies that leverage ICTs to improve agricultural extension service delivery and promote sustainable poultry farming practices in Niger State. Based on the foregoing, this study was conducted to achieve the following objectives:

- i. Determine the factors influencing poultry farmers' use of e-agricultural extension services in poultry production.
- ii. assess the constraints associated with the use of e-agricultural extension services in poultry production.

METHODOLOGY

A multistage sampling procedure was used in selecting poultry farmers in the study area. The first stage involved purposively selecting Agricultural Zone II, which comprises Bosso, Chanchaga, Paikoro, Shiroro, Munya, Tafa, Gurara, Rafi, and Suleja Local Government Areas (LGAs), because of their predominant poultry production activities (Mohammed *et al.*, 2021). The second stage involved randomly selecting Bosso and Paikoro LGAs. The third stage involved randomly selecting six villages from each LGA. The selected villages in Bosso were Maikunkele, Beji, Garatu, Bosso, Maitumbi, and Gurusu, while those selected in Paikoro were Kwatuti, Tungan Mallam, Adunu, Paiko, Kafin Koro, and Tungan Gana. The final stage involved proportionally selecting 226 poultry farmers from a population of 521 registered poultry farmers. The study used Yamane’s (1967) formula to determine the sample size because it is widely used in agricultural research for finite populations. It ensures that an adequate number of respondents is selected to achieve the desired level of precision while maintaining representativeness and reducing sampling error. The resulting sample of 226 poultry farmers was then proportionately allocated across the study area according to the number of registered poultry farmers in each sampling unit.

$$n = \frac{N}{1+N(e)^2}$$

Where:

- **n** = required sample size
- **N** = total population size
- **e** = level of precision (margin of error), usually **0.05** for a 95% confidence level

Data were collected using a semi-structured questionnaire and analysed using logit regression analysis and Kendall’s coefficient of concordance (W).

Logit Regression Analysis

In this study, several explanatory variables were selected and presented to respondents, including age, years of poultry rearing, access to credit, access to veterinary services, level of education, smartphone ownership, type of poultry bird, farm size, income, cooperative membership, cost of device, and extension service support.

Table 1: Distribution of respondents in the study area

S/No.	LGAs	Villages	Sampling Frame	Sample Size
1	Bosso	Maikunkele	75	32
		Beji	64	28
		Garatu	35	15
		Bosso	47	20
		Maitumbi	32	14
		Gurusu	16	7
		Sub-total	268	116
2	Paikoro	Kwakuti	41	18
		Tungan Mallam	39	17
		Adunu	33	14
		Paiko	55	24
		Kafin Koro	57	25
		Gana	28	12
		Sub-total	253	110
Grand Total			521	226

Source: Agricultural and mechanization Development Authority (NAMDA), 2024

The factors influencing e-agricultural extension service usage were estimated using a logit regression, following Baiyegunhi *et al.* (2020). The model was mathematically expressed as:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, X_{12})$

Where:

P = E-agricultural extension service usage (1 =Yes, 0 = No)

β_0 = intercept;

β_i = regression coefficients;

X_i = explanatory variables.

μ = Error term

The model can be expressed as:

$$\ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n$$

where:

- P
= probability of using e-agricultural extension services;
- $\frac{P}{1-P}$
= odds of using e-agricultural extension services;
- β_0
= intercept;
- β_i
= regression coefficients;
- X_i
= explanatory variables.

X_1 = Cost of device (Naira)

X_2 = Extension service support (Yes = 1, No= 0)

X_3 = Age (Years)

X_4 = Years of poultry rearing (Years)

X_5 = Access to credit (Yes=1, No=0)

X_6 = Access to veterinary services (Yes = 1, No= 0)

X_7 = Level of education (Years)

X_8 = Smartphone ownership (Yes = 1, No = 0)

X_9 = Type of poultry bird (Hybrid=1, otherwise= 0)

X₁₀ = Farm size (Hectare)

X₁₁ = Income (Naira)

X₁₂ = Cooperative membership (Yes = 1, No = 0)

The factors were operationalised using a 3-point Likert-type scale: Significant Influence (3), Insignificant Influence (2), and No Influence (1). The reference mean for the scale was calculated as: $(3 + 2 + 1) / 3 = 2.0$. Thus, a mean score greater than 2.0 was adjudged significant, while a mean score less than 2.0 was adjudged not significant.

Kendall's Coefficient of Concordance (W)

The challenges associated with using e-agricultural extension services were examined using Kendall's coefficient of concordance (W), as used by Adewumi and Fabiyi (2019). The technique was used to determine the degree of agreement among respondents regarding the constraints faced in using e-agricultural extension services.

The model was mathematically expressed as:

$$W = \frac{12 \sum (R_i - \bar{R})^2}{m^2(n^3 - n)}$$

Where:

- R_i = weighted sum for each con
- $\bar{R}$ = mean of the weighted sums
- m = number of respondents = 21
- n = number of constraints = 10

RESULTS AND DISCUSSION

The likelihood ratio statistic (LR $\chi^2 = 86.27$) indicates that the model is statistically significant, suggesting that the explanatory variables jointly explain farmers' use of e-agricultural extension services. The Pseudo R² value of 0.4344 implies that the variables in the model explain about 43.44% of the variation in the probability of using e-agricultural extension services. This indicates a reasonably good fit for a cross-sectional logit model.

The cost of digital devices had a negative coefficient, suggesting that higher device costs reduce the likelihood of poultry farmers using e-agricultural extension services. Although the effect was not statistically significant at the 5% level, the marginal effect of -0.323 indicates that an increase in the cost of digital devices decreases the probability of utilising e-agricultural extension services. This finding implies that the high cost of smartphones, tablets, and other

Table 2: Logit regression on factors influencing usage of e-agricultural extension services by poultry farmers

Variables	Coeff.	Std. Err.	Z-value	Marginal Effect
Constant	-16.063	4.349	-3.69	
Cost of device	-1.291**	0.568	-2.77	-0.32
Extension service support	0.027	0.801	0.03	0.007
Age	0.107**	0.061	1.76	0.027
Years of Rearing	0.461***	0.172	2.68	0.115
Access to credit	2.13***	0.654	3.26	0.533
Access to veterinary services	1.106*	0.651	1.70	0.277
Level of education	0.199	0.537	0.37	0.50
Smartphone ownership	2.166	1.423	1.52	0.542
Type of poultry birds	0.49	0.349	1.40	0.123
Income	0.941**	0.37	2.55	0.239
Cooperative Membership	0.667**	4.349	2.05	0.167
LR chi2(13)	86.27			
Pseudo R2	0.4344			
Log likelihood	-56.159			

Source: Computer output, 2025. ***, ** and * implies statistically significant at 1%, 5% a

digital devices is an important barrier to adopting digital agricultural technologies. This finding agrees with Olayiwola *et al.* (2023), who, in studies on ICT adoption in agriculture, identified the cost of digital technologies and limited financial capacity as major constraints to the utilisation of e-agricultural services among farmers.

Extension services had a positive but weak influence on the use of e-agricultural extension services, with a marginal effect of 0.007. This indicates that improved access to extension services slightly increases the likelihood of utilisation. Although the effect is small, the result underscores the importance of extension agents as facilitators of technology awareness and adoption. This finding agrees with Eleke *et al.* (2024), who reported that regular contact with extension agents positively influences farmers’ adoption of agricultural technologies and innovations and with Adebayo *et al.* (2002), who found that cooperative societies serve as a critical platform for disseminating agricultural innovations

Age had a positive, significant effect with a marginal effect of 0.027, meaning that a one-unit increase in age increases the probability of using e-agricultural extension services. This suggests that older farmers may have more farming experience and awareness of extension innovations. This implies that middle-aged farmers (often between 30-50 years) have more experience, resources, and willingness to engage with innovations than very young farmers, who may lack stability, or very old farmers, who may resist technology. This aligns with Akinbami (2021), who found that socioeconomic characteristics such as age can influence rural entrepreneurship, particularly among women.

Years of rearing experience and access to credit were positive and highly significant at the 1% level, with a marginal effect of 0.115. This means that each additional year of poultry rearing increases the probability of using e-agricultural extension services, indicating that experienced farmers are more likely to adopt such technologies. Experienced farmers understand the complexities of production, disease management, and marketing challenges, making them more open to solutions offered by digital extension services. The positive influence of poultry rearing experience on e-agricultural extension usage aligns with studies that found experienced farmers are more likely to adopt modern technologies to reduce risks and improve productivity. As Ezeibe *et al.* (2014) emphasised face-to-face entrepreneurship training, the present study demonstrates the potential of digital platforms to extend access to poultry management information beyond conventional training sessions.

Access to credit is positive and statistically significant at the 0.5% probability level, with a strong positive and significant effect and a marginal effect of 0.533. This implies that farmers with access to credit are likely to use e-agricultural extension services, likely because financial resources enable them to acquire smartphones, internet access, and other digital tools. This is because financial resources enable farmers to purchase smartphones, internet data, and other digital tools necessary for e-agricultural extension. The results therefore extend the findings of Akinrinola and Mafimisebi (2010) by showing that access to financial resources is not only important for general rural development but also facilitates farmers' participation in digital agricultural information systems. The positive coefficient indicates that farmers with access to credit are more likely to use e-agricultural extension services than those without access. Access to financial resources enables farmers to acquire smartphones, internet subscriptions, and other digital devices needed to access electronic extension services.

Access to veterinary services had a positive marginal effect of 0.277, indicating that farmers with veterinary access are likely to utilise e-agricultural extension services. This may reflect stronger institutional linkages and awareness. This is likely because farmers recognise the value of expert guidance in improving livestock health and production and see digital platforms as a way to complement physical veterinary services. The weak but positive influence of veterinary services

on e-agricultural extension adoption corroborates Igwe *et al.* (2020), who suggest that conventional extension services complement digital ones rather than substitute them.

Level of education had a positive marginal effect of 0.050, meaning that higher education increases the likelihood of usage, suggesting that educated farmers are better able to understand and adopt digital agricultural innovations. This agrees with Wongsim *et al.* (2018), who reported that poor ICT infrastructure remains one of the biggest challenges to agricultural innovation in rural areas; similarly, they highlighted that reliable internet access significantly boosts the adoption of mobile-based agricultural platforms in Nigeria. Smartphone ownership exerted a strong positive influence on the use of e-agricultural extension services, with a marginal effect of 0.542. This implies that farmers who own smartphones are more likely to utilise e-agricultural extension services than those without smartphones. However, the variable was not statistically significant at the 5% level.

Nevertheless, the result highlights the crucial role of smartphone ownership in facilitating access to digital agricultural information and advisory services. This corroborates Ezeibe *et al.* (2014), who demonstrated the importance of training in improving farmers' adoption of improved poultry management practices. Farmers need not only access to digital devices but also the knowledge and skills required to search for, interpret and apply agricultural information.

The type of poultry bird reared had a positive marginal effect of 0.123, suggesting that farmers engaged in certain poultry enterprises are more likely to use e-agricultural extension services than others. Likewise, farm size had a positive marginal effect of 0.009, indicating that larger farm holdings slightly increase the probability of utilising e-agricultural extension services, although the effect is relatively small. This finding is consistent with Olanipekun (2022), who identified farm size as an important determinant of agricultural technology adoption, with larger-scale farmers often having greater incentives and resources to adopt innovations.

Income positively and significantly influenced the utilisation of e-agricultural extension services, with a marginal effect of 0.235. This implies that higher income increases the probability of adoption, as higher-income farmers can better afford smartphones, internet subscriptions, and other digital technologies needed to access e-extension services. This result corroborates Shehu *et al.* (2021), who reported that income is a significant determinant of ICT and agricultural technology adoption among farmers. Cooperative membership had a positive marginal effect of 0.167, implying that membership in cooperative societies increases the likelihood of using e-agricultural extension services and provides better information sharing and collective learning opportunities. This is because cooperatives provide a support network, encourage peer learning, and often facilitate access to extension services and technology, highlighting the significant role of cooperatives in promoting e-agricultural extension usage, which aligns with Kamutuezu *et al.* (2021), who reported that cooperative membership significantly enhances technology adoption

among farmers by improving access to information, training opportunities, and institutional support.

Challenges associated with e-agricultural extension services.

Table 3 presents the distribution of respondents according to the constraints faced by poultry farmers. The findings revealed that the most severe constraint was limited access to the internet with a mean value of (2.98), followed by high cost of devices (2.96), poor infrastructure and power (2.91), language barrier (2.57) and digital illiteracy of the farmer (2.40). Thus, Kendall's coefficient of concordance (0.031) indicates very weak agreement among respondents on the ranking of constraints affecting the use of e-agricultural extension services. Although respondents generally identified limited internet access, high device cost, and poor infrastructure as major constraints, the overall consensus in the ranking of all constraints was low. Kendall's $W = 0.031$ (3.1% agreement).

Limited internet access was the most severe challenge associated with using e-agricultural extension services, with 98.1% of respondents rating it as very severe. This suggests that despite the potential benefits of digital platforms in enhancing poultry production, poor internet penetration and connectivity gaps remain critical barriers. In rural areas where most farmers reside, internet infrastructure is often underdeveloped, leading to unstable or non-existent connections. This limits farmers' access to timely information on breeding, feeding, health management, and marketing practices essential for improving productivity. Without reliable internet, digital tools such as mobile apps, online portals, and real-time advisory services cannot function effectively. Consequently, farmers may continue relying on traditional extension methods, slowing down the integration of modern e-agriculture. This constraint underscores the digital divide between urban and rural areas and highlights how inadequate internet access undermines the transformative potential of e-extension services in poultry farming. This aligns with Ibe *et al.* (2023), who reported low bandwidth (98.4%) as the most pressing challenge for farmers in Imo State, particularly during emergencies. Similarly, Pallavi *et al.* (2023) identified poor network and weak satellite infrastructure as critical limitations undermining ICT-driven extension.

The results show that poor infrastructure and inadequate power supply severely constrain the use of e-agricultural extension services, as 92.9% of respondents reported. E-agricultural extension services rely heavily on digital tools, smartphones, and online platforms, all of which require stable electricity and supporting infrastructure to operate effectively. In rural areas of Niger State, irregular or non-existent power supply makes it difficult for farmers to keep devices charged or to consistently use online services. This hampers access to vital agricultural

knowledge, weather updates, veterinary consultations, and marketing information. Moreover, poor infrastructure, such as bad road networks and limited telecommunication facilities, restricts the delivery of both physical and digital support. Unreliable power and infrastructure discourage farmers from investing in e-agricultural extension technology because its usability is compromised. Ultimately, this challenge directly limits the adoption and effectiveness of e-agricultural extension in boosting poultry productivity. This aligns with Hussaini *et al.* (2021), who identify persistent power shortages as one of the greatest impediments to ICT adoption in Nigeria. Daisy *et al.* (2021) further noted that infrastructural gaps such as unreliable electricity hinder effective implementation of e-agriculture frameworks in rural Kenya.

Another significant barrier is the high cost of devices, with a mean score of 2.96, indicating that respondents identified it as a severe challenge. Smartphones, laptops, and other digital tools required for e-agricultural extension services are often expensive relative to farmers' income levels. Because most poultry farmers in Niger State operate at a small to medium scale, buying such devices may compete with essential production costs such as feed, vaccines, and housing. The financial burden discourages adoption, particularly among younger and resource-poor farmers who might otherwise be more inclined to use technology. Without access to affordable devices, farmers cannot benefit from mobile apps, digital training modules, or online advisory platforms designed to improve poultry production. This challenge reflects the broader issue of economic inequality, where technological solutions remain inaccessible to those who need them most, widening the gap between modern and traditional farming systems. This corroborates Pallavi *et al.* (2023), who highlighted that high purchase and maintenance costs of ICT tools discourage adoption. Hussaini *et al.* (2021) also identified cost as a critical barrier limiting smallholder farmers' engagement with e-agricultural extension technology.

The result shows that digital illiteracy is a notable constraint, with 51.4% of respondents rating it as very severe and a mean score of 2.40. This suggests that many farmers lack the technical skills needed to use digital platforms and e-agricultural extension services effectively. While smartphones and internet-enabled devices may be available, low digital literacy often underutilises their full potential. Farmers unfamiliar with navigating online platforms, mobile apps, or chatbots may struggle to access agricultural information. This challenge is particularly pronounced among older farmers, who may be less exposed to technology than younger farmers. As a result, even when services are available, poor digital literacy creates a barrier to adoption, limiting the reach and impact of e-agriculture. This constraint highlights the importance of training and capacity-building to bridge the knowledge gap and enable farmers to confidently use e-agricultural extension tools. This finding aligns with Daisy *et al.* (2021), who reported low ICT skills and illiteracy as barriers preventing smallholder farmers from leveraging digital tools effectively. Similarly, Onyemekihian (2021) noted that despite widespread ICT use among

extension officers in Delta State, knowledge gaps remain a constraint for effective farmer engagement.

Table 3: Distribution of respondents according to challenges faced by poultry farmers

Variable	Very severe (Freq %)	Severe (Freq %)	Not severe (Freq %)	Weighted Sum (WS)	Mean	Rank	Remark
Limited Internet Access	206(98.1)	3(1.4)	1(0.5)	625	2.98	1 st	Severe
High cost of devices	202(96.2)	7(3.3)	1(0.5)	621	2.96	2 nd	Severe
Poor infrastructure and power supply	195(92.9)	11(5.2)	4(1.9)	611	2.91	3 rd	Severe
Financial constraints limit access to technology	171(81.4)	31(14.8)	8(3.8)	583	2.78	4 th	Severe
Language barriers	133(63.3)	64(30.5)	13(6.2)	540	2.57	5 th	Severe
Digital illiteracy of the farmer	108(51.4)	77(36.7)	25(11.9)	503	2.40	6 th	Severe
Unreliable or inaccurate information	82(39.0)	83(39.5)	45(21.4)	457	2.18	7 th	Severe
Data privacy and cyber security risks	33(15.7)	103(49.0)	74(35.2)	379	1.80	8 th	Not severe
Low awareness and adoption rate	21(10.0)	123(58.6)	66(31.4)	375	1.79	9 th	Not severe
Limited government and institutional support	48(22.9)	20(9.5)	142(67.6)	326	1.55	10 th	Not severe
R	502						
S	113436						
W	0.0312						

The findings also reveal that language barriers significantly hinder e-agricultural extension service usage, with the mean score of 2.57 indicating that respondents rated it as very severe. Most e-extension platforms and online resources are designed in English or other dominant languages, which may not align with the local languages spoken by poultry farmers in Niger State. This mismatch creates a communication gap that restricts understanding and application of digital advisory content. Farmers may struggle to interpret technical terms, feeding guidelines, or

disease management instructions provided in unfamiliar languages. As a result, these platforms become less effective, as misinterpretation can lead to poor decision-making and lower productivity. Language barriers disproportionately affect farmers with lower formal education, thereby excluding a significant portion of the target audience. Addressing this issue requires localised, multilingual e-agricultural extension platforms tailored to farmers' linguistic contexts. This reflects the findings of Hussaini *et al.* (2021), who argued that ICT content must be localised and simplified to match farmers' linguistic and educational contexts for optimal adoption.

Finally, unreliable or inaccurate information emerges as a severe challenge, with a mean score of 2.18, indicating that farmers report it as very severe. The credibility of e-extension services depends heavily on the quality of the information they disseminate. However, farmers sometimes encounter misinformation or conflicting advice from unverified digital sources, such as informal social media groups. This undermines trust in e-agriculture and poses risks to poultry farming practices. For instance, inaccurate health management recommendations can lead to poor disease control, while misleading feeding strategies can reduce productivity. Farmers who lack the capacity to verify digital information against expert advice are particularly vulnerable to these risks. Consequently, while e-agricultural extension platforms can enhance poultry production, unreliable content diminishes their impact and may discourage consistent use among farmers. This supports Pallavi *et al.* (2023), who stated that misinformation, ignorance, and lack of awareness undermine trust in e-agricultural platforms.

CONCLUSION

The study concludes that socioeconomic and technological factors largely influence the use of e-agricultural extension services among poultry farmers in Niger State. Age, poultry rearing experience, access to credit, and access to veterinary services positively enhance the utilisation of digital extension platforms, while the high cost of digital devices limits adoption. In addition, inadequate infrastructure, unreliable electricity, and poor internet connectivity remain major barriers to effective utilisation. Therefore, improving access to affordable digital technologies, strengthening rural digital infrastructure, expanding credit opportunities, and promoting digital literacy through targeted training programmes are essential to increase adoption of e-agricultural extension services and improve poultry production in Niger State.

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