Research Article

Usability of E-Extension Technology and Growth of Agricultural Productivity in Southeast Nigeria: ADP Extension Worker's Survey

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Abstract | The role of e-extension in wider information communication should be emphasized. E-extension will help accelerate agricultural growth, expand agricultural research, and strengthen customer systems. Farmers are exposed to multiple types of extended information. However, this study examined the ease of use of e-extension techniques or tools by advisors when contacting farmers. The ability of extension staff to disseminate agricultural information using electronic tools should always be evaluated. A structured questionnaire was used to randomly select 150 agricultural development program officers. Simple descriptive statistics, multinomial regression, and principal factor analysis were used for data analysis. According to the survey, ADP officials perceive e-extension as a cost-effective method of extension advisory services that goes beyond the role of technology transfer to serve farm stakeholders and provide an efficient feedback mechanism. Determinants of ease of use were gender, age, educational background, work experience, household size, work motivation, and organizational support, these were significant at various levels of probability. Constraints on the use of e-extensions were rotated into three factors (commitment, political, and institutional), and in the commitment factor, the extension worker suffered from a lack of support and inadequate training for the e-agriculture extension. At the political level, the advisors lacked the needed skills due to underfunding from the government, and at the institutional level as well. E-extension does not have government guidelines to support e-extension services that are not integrated with the system. The study, therefore, recommends that the advisors should be given the necessary support to strengthen e-extension capacity for agricultural growth.

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Introduction

To diversify the oil-based Nigerian economy; Electronic Agriculture and Advisory Services (E-AES) is expected to play an increasingly important role in reaching agricultural stakeholders. Olorunfemi *et al*. (2020) argue that the involvement of an agricultural advisory system is essential to provide farmers with information and educational programs about new technologies, but this depends on the knowledge, attitudes, skills, working conditions, and several factors related to technical competence. Adeel *et al*. (2016) pointed out that different advisory methods are employed to create conditions in which new information and knowledge can be freely shared between advisors and their target audience (farmers). Seeing the need to magnify the use of e-extension, Onah *et al*. (2021) submitted that the successful development of the e-extension system will lead to growth in the general economy as a whole. The economy will reap benefits such as cost-effectiveness, serving the stakeholders beyond technology transfer, developing an efficient feedback mechanism with wider coverage than the traditional system, empowering small and marginal farmers, facilitating better information access, supplementing inadequate technical manpower, ensuring gender equality in technology transfer, expand knowledge resources, strengthened research extension-client system to accelerate agricultural growth.

Oyinbo and Rekwot (2014) suggest that agricultural growth stimulates economic growth in the non-agricultural sector, which leads to increased employment and reduced poverty. Similarly, e-extension stimulates growth in agricultural production and boosts growth in the non-farm economy through a variety of mechanisms (Pauw and Thurlow, 2011). This agricultural growth is facilitated by improving agricultural productivity through adherence to the extension doctrine. However, measuring agricultural productivity is a complex task due to the diversity of capital used in agriculture (Obianefo *et al*., 2020). Sule and Yusuf (2019) also argued that the use of each factor of production should not depend solely on its availability. Agricultural productivity is therefore defined as the ratio or index of total agricultural production to the index of total inputs used in the agricultural production process (Obianefo *et al*., 2020). Agricultural productivity knowledge is often brought to the attention of farmers through advisors, and the sustainability of this knowledge is disseminated into packs of e-agricultural extension (E-AE) practice.

According to Bhalchandra *et al*. (2010); E-AE includes radio, television, cyberspace, print media, DVD, Android Applications, etc. to support the effective dissemination of agricultural information that improves not only agricultural production but the economy of the country as a whole. The same E-AE is defined as the information and communication technology (ICT) revolution, Onah *et al*. (2021); Kamruzzaman *et al*. (2021); Bhattacharyya *et al*. (2018) and Ghogare and Monga (2015) focused heavily on cyberspace (internet) component of E-AE. The serious emphasis on the cyberspace component corroborates Wolfert *et al*. (2017), Jim'enez *et al*. (2019); Klerkx *et al*. (2019); Mehrabi *et al*. (2021) and Klerkx (2021) who also directed their focus on cyberspace, they noted that in the more resource-constrained regions of the world, the massive advent of wearable devices coupled with the growing coverage of mobile networks and the internet of things has paved the way for disruptive agricultural innovations such as E-AE. E-AE often provides scientific or user-generated data to help farmers and other stakeholders make better decisions in the sector e.g.; broadcasting weather forecasts and better farming suggestions to the farmer's mobile phone via voicemail message, push-call (Cole and Fernando, 2021) or providing farmers with recommended fertilizer applications via video player or print media (Zossou *et al*., 2021).

The impact of e-extension technology on the agricultural sector will depend on the ability of the extension workers to force these gadgets onto farmers who need them. The ease of use and how effective advisors have been able to communicate with the farmers through e-extension technologies is what is referred to as usability. Orikpe and Gloria-Orikpe (2013) argue that the use of ICT stemmed from the need to cope with the information explosion in various sectors. To keep up with the dissemination of more and more information or discoveries from various research institutes, we use computers and telecommunications to process and disseminate information more quickly and accurately than manual processing and distribution by extension advisors. These ICT tools used are what is regarded as climate-smart technological initiatives by Olorunfemi *et al*. (2020), there is a need to facilitate the understanding of e-extension service delivery, these

services are being delivered by the extension officers. However, Kamruzzaman *et al.* (2021) suggested that extensionists are the engine of agricultural innovation who helps to strengthen adaptive networks among farmers. Equally, some authors opined that the ability of extension advisors to use e-extension technology depends on certain characteristics. Mustapha *et al.* (2022) indicate that such characteristics are determined by the agents marital status, level of organizational support, training, and other motivations from the office and home. In another study, Sa'adu *et al.* (2022) variables are age, education level, income, and training. A previous study by Yakubu *et al.* (2013) argued that training influenced the use of e-extension technology. A study by Anushree and Madan (2021) jointly pointed out that age, work experience, and position (field or administrative officer) are variables that determine the use of e-extension. Olorunfemi *et al.* (2020) also state that the level of education, experience, and training positively influences the use of e-extension technology. The above variables are important in this study to understand the efficacy of e-extension in Southeastern Nigeria. The regular use and communicability of these technologies (radio, television, cyberspace, print media, DVD) can help improve farmers' productivity. E-extension is needed at this time to reduce physical contact between farmers and advisors while disseminating the techniques needed to improve production. This study is of novel quality because of the need to improve information quality and restrain direct contact with the farmers due to the Covid-19 outbreak. Not many works to the best of the researcher's knowledge in the study area adopted the use of a multinomial logistic approach in understanding the extension advisors' preference for one tool to another. Based on this background, the study specifically:

1. identified extension workers' perceived advantages to the use of e-extension technology.
2. describe the determinants of the usability of e-extension technology.
3. ascertain the factors affecting the use of e-extension technology in the study area.

Materials and Methods

Study areas and sampling procedures

This study was conducted in Southeastern Nigeria. The five States that make up the region include Abia, Anambra, Ebonyi, Enugu, and Imo, which are made up of 101 Local Government Areas (LGAs) divided into 346 communities. About 60% of the population lives in rural areas, and more than 70% of these rural residents depend on agriculture for their livelihoods. The region is known for trade, adventure, and craft (Obianefo *et al.*, 2021). The National Population Census (NPC) put the population of the region as 28,415,006 (NPC, 2016). Farmers in this area often organize themselves into a farmer's cooperative to access extension advisory services. Orikpe and Gloria-Orikpe (2013) found that the ratio of extension workers to farmers was low, necessitating an e-extension approach. The southeastern zone (shown in Figure 1) is located at latitude 6°26`59``N and 6°44`99`` N and longitude 7°29`59`` E and 7°49`99`` E, and covers 41440 square kilometers of land.

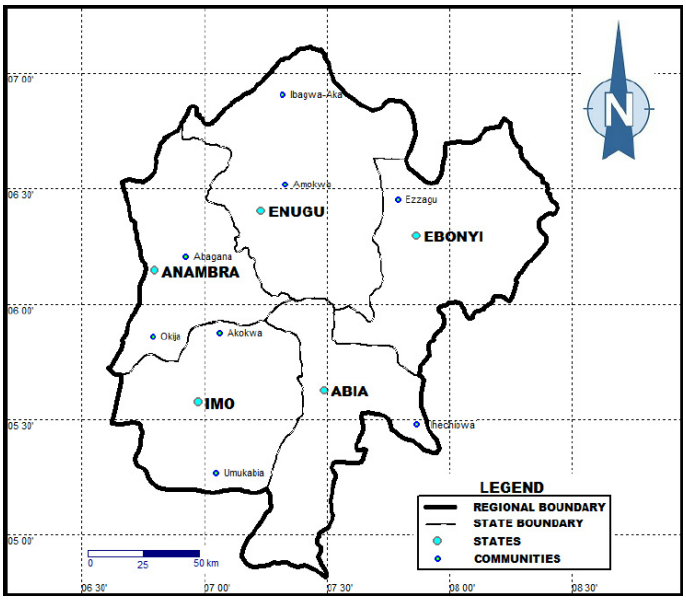

Figure 1: *Map of southeastern Nigeria with its states.*

A structured questionnaire served as the research instrument. One research assistant was recruited and trained from each state. Purposive and random sampling method was used to select the study participants. The Agricultural Development Programs (ADPs) in five Southeastern States were subjectively selected, and 30 ADP staff members from each State were randomly selected to make the total number of survey respondents 150 (sample size).

Empirical model specification

Multinomial logistic regression (MLR): A multinomial logistic regression is used to predict categorical data or the probability of category membership on a dependent variable based on multiple independent variables (Garson, 2009; Shah *et al.*, 2022). The predicting variables are either dichotomous (binary) or continuous (interval or ratio in scale) in

nature. Mertler and Vannatta (2002) submitted that MLR is an extension of binary logistic regression that uses the maximum likelihood estimation method to analyze the probability of categorical membership. The MLR model is often considered an attractive analysis because, it does not assume normality, linearity, or homoscedasticity problems. MLR assumed that the choice of or membership in one category is not related to the choice or membership of another category. This assumption means that the members are left with no alternative option but are presented with a list of options to choose from. In MLR; Vittinghoff *et al*. (2005) noted that the log odds of three or more contrasts are estimated simultaneously. The impact of predictor variables is usually explained in terms of odds ratios.

El-Habil (2012) suggested that the MLR model can be estimated for the parameter identified and compared to a baseline category. The model is defined as:

$$\Pr(Y_i = 1) = \frac{e^{\beta_1 x_i}}{\sum_{k=1}^{K} e^{\beta_k x_i}} \quad \ldots..(1)$$

$$\Pr(Y_i = 2) = \frac{e^{\beta_2 x_i}}{\sum_{k=1}^{K} e^{\beta_k x_i}} \quad \ldots..(2)$$

$$\Pr(Y_i = K) = \frac{e^{\beta_k x_i}}{\sum_{k=1}^{K} e^{\beta_k x_i}} \quad \ldots..(3)$$

The linear prediction is stated as:

$$f(k,i) = \beta_0, k + \beta_1 k x_{1i,} + \beta_2 k x_{2i,} + \cdots \beta_m k \quad \ldots(4)$$

Where; X_i is the vector of explanatory variables (age, experience, etc.), i,β_k is the regression coefficient corresponding to outcome K, X_iK is the associated score assigning observation i to category *k (radio, TV, etc.)*.

Principal factor analysis (PFA)

The PFA is a technique widely used for dimension reduction of larger data sizes in the presence of collinearity. It is one of the best policy tools that help to categorize constraints into a particular number of factors for dimensionality. Thus, the factors limiting the use of e-extension were analyzed with principal factor analysis, and the model adopted from Jöreskog (2007) is stated as:

$$Z_i = \delta_{i0} + \delta_{i1} F_1 + \delta_{i2} F_2 \ldots + \delta_{im} F_m + e_i$$

Where Z_i is the vector of measurements or observations, δ_{i0} is the vector of means, δ_{i1} - δ_{im} is the factor loading (regression weight), F_1-F_m is the number of factors, e_i is the residual variables or unobserved stochastic error term with zero mean and finite variance. During the estimation, the researcher(s) applied the associated assumptions to ensure the model maintained the recommended Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) value of ≥ 0.700, commonalities value for each variable ≥ 0.500, and the total variance of factor explained value ≥ 53.0%. These values are based on the rules of thumb quoted in Obianefo *et al*. (2020, 2021). The Promax rotation technique or matrix was adopted from SPSS software version 25.0, this approach used a discriminant rotation method to ensure no variable loaded in more than one-factor component.

Measurement of variables

Constructing academic research work requires a special skill to clearly define and measure all the variables of interest. For easy understanding, the variables to be measured are classified into dependent and independent observations.

Dependent variable: The dependent variable for this study is the extension advisor's preference to use a particular e-extension tool, four e-extension tools (radio, television, cyberspace, and VCD/DVD) were listed with a reference category of print media. What qualifies a variable to become dependent is when the outcome of the variable depends greatly on the manipulation of another variable. The nominal classification of these variables is 0= print media, 1= radio, 2= television, 3= cyberspace, and 4= VCD/DVD.

Independent variables: All the variables whose outcomes are not dependent on the manipulation of others have been identified and separated as the independent variables. Their units of measurement are shown as:

Gender: This is the social position of respondents, it is measured as a dummy variable where 0 is for females, and 1 is for males.

Marital status: Marriage is a union of two adults, the researcher(s) used 0 to represent single respondents, and 1 to represent married respondents.

Working status: By working status; the researchers meant the classification of the respondents into two

using a dummy approach, where 0 stands for non-extension advisor, and 1 stands for extension advisor.

Household size: This is the total number of people living and feeding from the same pot. It was measured as number or count of people.

Equally, the age, working experience and educational background information of the respondents were measured in years. This is because how many years the respondents have spent in formal learning institutions go a long way to affect their response to the use of a particular technology.

Also, the respondents counted the number of trainings, motivations, and any form of support they received from superiors to aid their use of e-extension tools. They were also given two options to tick either yes or no to questions relating their perception of e-extension to the economic benefits to the agricultural sector.

Finally, the challenges affecting the ease of use of e-extension tools were captured in a 5-point Likert scale which ranges from 1 – 5 (1= strongly disagree, 2= disagree, 3= slightly agree, 4= agree, and 5= strongly agree). This Likert observation was subjected to principal factor analysis to present decisions for policymaking.

Results and Discussion

Summary statistics of the variables used for the multinomial model

The summary of the independent variables introduced to the multinomial model is presented in Table 1. The variables' standard units of measurement have been correctly placed. Apart from marital status with a standard deviation value of 0.48, which is small to show little or no deviation in responses, the rest of the variables have large standard deviations showing that the answers by one respondent varied greatly from another. The table shows an average age of 39.84 (40 years), meaning that the extension advisors are young and active enabling them to participate in disseminating information about the adoption of e-extension technologies (Uchemba *et al.*, 2021). This is the prime of their employment age. Also, the extension advisors have spent about 18 years in school, indicating that the extension advisors are mainly graduates and the application of e-extension technologies will not be a difficult task to handle. This is because education helps in the areas of technology application. From the Table 1, it is evident that the extension advisors have been in the dissemination of agricultural information to rural farmers for more than a decade. This level of work experience (14.72) is enough to understand the dynamics of agricultural extension in the study area.

Perceived advantages of the use of E-extension technology to improve agricultural productivity

The result of the extension workers' perception of the use of e-extension is presented in Table 2. Respondents noted multiple answers to the listed questions. Their responses are ranked to facilitate easy policy decisions. These questions were empirically selected from peer-reviewed articles to reflect the researchers point of view. The survey found that 100.0% of its respondents argued that e-extensions not only help farm stakeholders beyond technology transfer but are a cost-effective way to deploy extension information. The costs and associated risks of mobilizing farmers can be solved electronically. Farmers now have free access to extended messages.

Table 1: *Summary statistics of the variables used for the multinomial model.*

Described independent variables	Min.	Max.	Mean	Std Dev.
Sex (dummy; 0 = female, 1 = male)	0.00	1.00	0.49	0.50
Age (years)	19.00	61.00	39.84	12.64
Marital status (dummy; 0 = single, 1 = married)	0.00	1.00	0.63	0.48
Educational background (years spent in formal	12.00	25.00	18.49	4.19
Working experience (years)	4.00	25.00	14.72	7.39
Household size (No)	1.00	9.00	5.84	2.69
Training (No)	1.00	10.00	5.21	2.73
Support received from the senior officer (No)	1.00	4.00	2.45	1.14
Motivation (No)	1.00	4.00	2.52	1.15
Status of work (dummy; 0 = none advisor, 1 = advisors)	0.00	1.00	0.43	0.50

Source: *Field survey, 2022.*

Table 2: *Perceived advantages of the use of E-extension technology to improve agricultural productivity.*

S.	The perceived advantage of the use of E-extension technology	Frequency	Percentage	Ranking
1	Providing cost-effective extensions	150	100.0	1st
2	Serving farm stakeholders beyond the technology transfer role	150	100.0	1st
3	Developing efficient feedback mechanisms	140	93.3	3rd
4	The e-agricultural extension has a wide coverage than the traditional system	136	90.7	4th
5	Empower small and marginal farmers	134	89.3	5th
6	Promote better information access	133	88.7	6th
7	Supplement inadequate technical manpower	132	88.0	7th
8	Ensuring gender equality in technology transfer	132	88.0	7th
9	Expanding knowledge resources	129	86.0	9th
10	Used to strengthen stronger research extension - client system	127	84.7	10th
11	Accelerates agricultural growth	108	72.0	11th

Source: *Field survey data, 2022.*

The survey also found that 93.3% of its respondents considered e-extension to be an efficient feedback mechanism; farmers can easily relate their experiences about a particular agricultural technology to the workstation of the extension agents without waiting for a fortnight meeting with extension advisers. 90.7% of respondents said that electronic extension has a greater reach than the traditional extension delivery system; because millions of farmers can be connected through cyberspace and other digital media. 89.3% of advisory workers said it empowers smallholder and marginal farmers; this makes information about the commercialization of agriculture available to smallholder farmers, who are not members of agricultural cooperatives. 88.7% of respondents confirmed that e-extensions improve access to information. Farmers are no longer limited in knowledge or dependent on a single source of education. 88.0% of them said the e-extension complements the inadequate technical workforce and ensures gender equality in technology transfer. These benefits are relevant in areas where sexism is stronger or where women are not allowed to meet freely with their male colleagues. The survey also found that 86.0% of extension advisers believed that e-extension would increase farmers' knowledge resources; this is because the farmer can learn multiple techniques with one click from their web or recorded video messages. 84.7% of the respondents indicate that e-extension is used to strengthen a more powerful research extension client system. This is because advisory staff can communicate with farmers during off-peak hours, build bonds, and gain their trust in adopting technology. Finally, 72.0% of extension workers said that e-extension would accelerate agricultural growth. Growth in this sector remains the goal behind the intensification of e-extension agriculture in the study area. These results are empirically consistent with the variables reported by Onah *et al.* (2021) in emerging electronic agricultural extension technology in Abia State. These results demonstrate that e-extensions if properly managed, can boost various agricultural sectors adjacent to livestock and beyond horticultural crop production.

Determinants of usability of e-extension technology

It was necessary to determine the variables impacting the extension advisors' usability of e-extension technologies. Multinomial logistic regression analysis was the approach of choice because the model uses maximum likelihood estimation criteria to estimate dependent variables with multiple outcomes (Table 3). Print media was the reference or baseline extension tool for the analysis because it is not different from the old approach of extension administration. The choice of print media as the base technology produced the best results compared to using other technologies as reference categories. Several analytical suppositions were tested to confirm the accuracy of the choice model. The value of the Akaike information criterion (AIC) and Binomial information criterion (BIC) are 242.587 and 375.055 respectively, which are far greater than the Log-likelihood ratio of 154.587 significant at 0.000 level of probability, this means that the model was a well-fitted model and the value of the Likelihood ratio text of 100.89*** significant at a 1% level of probability confirmed that the variables included in the analysis impacted the choice of e-extension technologies.

Table 3: *Determinants of usability of e-extension technology.*

E-extension determinants	Radio			Television			Cyberspace			VCD/DVD		
	Coeff.	Wald	Exp (B)	Coeff.	Wald	Exp(B)	Coeff.	Wald	Exp (B)	Coeff.	Wald	Exp (B)
Intercept	18.475	15.86		10.011	22.57		13.798	34.00		7.517	5.30	
Gender:												
Female	0.346	0.11	1.413	-0.815	2.15**	0.443	-2.915	19.15***	0.054	-2.002	4.58***	0.135
Male	0[b]			0[b]			0[b]			0[b]		
Marital status:												
Single	2.872	4.08***	17.680	0.202	0.10	1.224	-0.098	0.02	0.906	1.201	1.40	3.322
Married	0[b]			0[b]			0[b]			0[b]		
Work status												
Non-extension adviser	-1.223	1.05	0.294	0.668	1.64*	1.951	0.39	0.42	1.477	0.929	1.11	2.531
Extension adviser	0[b]			0[b]			0[b]			0[b]		
Age	0.144	2.94**	1.155	-0.024	0.49	0.976	-0.13	10.10	0.878	-0.14	7.03***	0.869
Education background	0.314	3.66***	1.369	-0.199	8.76***	0.82	-0.51	37.96***	0.6	-0.283	5.76***	0.754
Work experience	-0.13	0.82	0.878	-0.112	2.62**	0.894	-0.404	24.12***	0.668	-0.187	2.72**	0.829
Household size	-0.433	0.84	0.649	0.234	2.37**	1.264	1.207	35.75***	3.344	0.708	4.05***	2.031
Training	0.059	0.07	1.060	-0.197	3.71***	0.821	-0.262	5.02***	0.769	0.039	0.05	1.04
Support received	-22.989	0.00	0.000	-0.281	1.47	0.755	0.59	4.62***	1.805	0.585	1.84*	1.795
Motivation	-1.615	7.10***	0.199	0.167	0.52	1.181	0.707	6.86***	2.029	-0.167	0.16	0.846
Pseudo R^2 (Nagelkerke)						0.599						
Likelihood ratio						154.587						
Akaike information criterion (AIC)						242.587						
Binomial information criterion (BIC)						375.055						
LR						100.89***						
Overall accuracy classification = 86.7%			60.0%	97.3%			73.1%			33.3%		
Probability			0.600	0.833			0.797			0.771		
Obs.			150									

Source: *Field survey data, 2022. (*, ** and ***) Significant with the probability of 10%, 5%, and 1%, respectively.*

Again, the correctness or accuracy prediction of the available technologies revealed a classification value of 60.0% (radio), 97.3% (television), 73.1% (cyberspace), and 33.3% (VCD/DVD). Despite that VCD/DVD had the lowest classification, the overall accuracy of 86.7% confirmed that the number of independent variables added was enough to explain the relationship between extension advisers and their use of e-extension gadgets. Further revelation shows that Nagelkerke Pseudo R^2 type was the highest with a value of 0.599, which implies that 59.9% variation in e-extensions use was explained by the combined efforts of all the explanatory variables in the model, the remaining 40.1% unexplained could be due to errors beyond the control of the advisory staff. Such external failures include economic, lack of political will, and institutional factors, among others. This R^2 value of 0.599 is within the range reported by Moore *et al.* (2013) and Hair *et al.* (2013) in Uchemba *et al.* (2021) as recommended tolerance. The study further found that the probabilities of choosing other e-extension technologies over print media are 0.600 (radio), 0.833 (television), 0.797 (cyberspace), and 0.771 (VCD/DVD). These values are closer to one, which implies that the extension advisers in the study have a stronger affinity for e-extension tools than print media.

The coefficient of gender for the female officer was negatively related to television at a 5% level of probability and a 1% level of probability for cyberspace and VCD/DVD, respectively. This implies that female extension advisers prefer the use of print media tools. Thus, a 5% increase in the number of female extension advisers will increase the odd ratio of print media use by 44.3% (television), while a 1% increase in female

advisers will increase the exponential value of print media use by 5.4% (cyberspace), and 13.5% (VCD/DVD), respectively. Equally, the coefficient of marital status for singleness is positively related to the radio at a 1% level of probability. This implies that single-extension advisers prefer the use of radio over print media as an agricultural extension tool. A one-person increase in the number of single extension advisers will increase the odd ratio of radio usage by 17.680 units. Furthermore, the coefficient of work status for non-extension advisers (administrative officers) was positive and significant at a 5% level of probability. This implies that administrative officers prefer to use television over print media as a communication tool with the farmers. Thus, a one-person increase in the number of non-extension advisers will increase the odd ratio of television use by 1.951 units. Administrative officers may not be as experienced as the extension advisers who are always in the fields, and thus, may want to communicate straight to the farmers from the television broadcast. These findings are consistent with Anushree and Madan (2021) who noted that work status has a great influence on the use of e-extension tools.

The coefficient of age was positive and significant at a probability level of 5% for radio, the study, therefore, revealed that older extension advisers prefer to use radio over print media. Thus, a unit increase in age will cause a 1.155-unit increase in the odd ratio of radio use. Also, the coefficient of age is negatively related to VCD/DVD at a 1% level of probability. However, a further 1% increase in age will increase the odd ratio of print media use by 86.9% (the extension advisers prefer print media to VCD/DVD). This finding suggests that older ADP workers wanted electronic extensions to reduce the stress of physically traveling to their assigned location which will give them more time to attend to other family needs. This result agrees with Mustapha *et al*. (2022) who found a significant positive correlation between the introduction of e-extensions and the age of advisors. The age finding is also in agreement with the report by Kaiser *et al*. (2019), who found a significant relationship between age and the use of ICT tools.

The coefficient of the educational background was positively significant at a 1% level of probability for radio, and negatively significant at a 1% level of probability for television, cyberspace, and VCD/DVD. The assumption is that agricultural extension advisors prefer radio to print media. They likewise preferred print media to television, cyberspace, and VCD/DVD. The result implies that a unit increase in the number of educated extension advisors will increase the odd ratio of radio use over print media by 1.369 units. Also, a marginal change in the number of educated advisors will increase the odd ratio of print media by 0.820 units (television), 0.600 units (cyberspace), and 0.754 units (VCD/DVD), respectively. Education has been found to drive technology adoption because it helps field workers understand the underlying technical complexities of devices. This result is consistent with Olorunfemi *et al*. (2020), who argued that educational attainment is positively associated with extension adviser's use of e-extension technology. This finding also supported the argument by Adetarami *et al*. (2022) who submitted that the odds of using extension advisory services are higher among educated farmers.

The coefficient of working experience is negative and significant at a 5% level of probability for television, and VCD/DVD. It is also negative but significant at a 1% level of probability for cyberspace. The implication is that experienced extension advisors preferred print media to television, cyberspace, and VCD/DVD. The result implies that a marginal increase in the number of years the extension advisors have worked in disseminating agricultural extension packages will increase the odd ratio of print media preference by 0.894 units (television), 0.668 units (cyberspace), and 0.829 units (VCD/DVD) respectively. Experienced advisors seem dogmatic to change and have held to age-long print media tools of extension information dissemination. This result is not consistent with Anushree and Madan (2021), who found a positive and significant association between e-extension adoption and an agent's work experience. Furthermore, the study found that household size was positively significant at several levels of significance (5% for television, and 1% for cyberspace and VCD/DVD). Thus, extension advisors with more household sizes have more preference for television, cyberspace, and VCD/DVD. This implies that a marginal increase in household size will increase the odd ratio of e-extension use by 1.264 units (television), 3.344 units (cyberspace), and 2.031 units (VCD/DVD), respectively. The above e-extension tools can still serve as entertainment tools for family members. Some family members can assist the advisors in discharging their extension duties from their respective homes.

The study equally found that training was negative and significant at a 1% level of probability, the implication is that trained extension advisors prefer the use of print media to television and cyberspace. One important approach to agricultural extension is to start with what the farmers know to the unknown. The training received would have helped to identify the areas of challenges encountered in rural areas with the use of ICT tools with respect to network and power supply. Thus, a 1% increase in the number of trained extension advisors will increase the odd ratio of print media by 82.1% (television), and 76.9% (cyberspace) respectively. The study by Jasim *et al.* (2016) noted that the training of extension workers is an integral part of the production process. The training must be tailored to drive the information dissemination better.

Support received by ADP staff is positive and significant at a 1% level of probability for cyberspace, and a 10% level for VCD/DVD. This means that a 1-unit increase in the amount of organizational support an extension adviser receives increases their preference for cyberspace and VCD/DVD. Thus, the odd ratio of use over print media is 1.805 units for cyberspace, and 1.795 units for VCD/DVD, respectively. The support received seems relevant to improve the advisor's use of the e-extension technology. This finding was also consistent with the results of Mustapha *et al.* (2022) who found positive and significant results between socioeconomic profiles of e-extension and ADP workers. The study however proposed that the heads of department should provide support related to the facilitation of electronic extended service delivery. The coefficient of motivation was negative and significant at a 1% level of probability for radio technology, it is also positive and significant at a 1% level of probability for cyberspace. This implies a marginal increase in motivation will increase preference for print media for the sake of radio technology, on the other hand, it will also increase the use of cyberspace over print media. Thus, the odd ratio of print media increase is 0.199 units, and that of cyberspace increase is 2.029 units. Motivation is seen as a positive change in the usability of e-extension technology in the study area. The study is not in agreement with Yakubu *et al.* (2013), who found a positive and significant association between e-extension, training, and motivation.

Factors affecting the use of e-extension technology

Table 4 shows the results of factors affecting the use of e-extension technology. These three-component rotation matrices were adopted from Uchemba *et al.* (2021) as was used by Obianefo *et al.* (2022). This was used to select the one with the fewest number of factors responsible for the general variance (correlation) of a set of constraining variables. Based on model validity analysis, a KMO value of 0.700 was significant at the probability level of 0.001, agreeing with Obianefo *et al.* (2020) who proposed a sample validity value of 0.700. In their study, they also set a benchmark of

Table 4: *Factors affecting the use of e-extension technology.*

S. No	Challenges	Commitment factors	Political will factors	Institutional factors
1	Lack of facilitation of e-agriculture extension	0.86		
2	Inadequate training	0.815		
3	Few or no online database systems for agricultural advice or websites where farmers can find useful agricultural information	0.797		
4	Poor infrastructural development	0.616		
5	Advisors lacking the skills required for e-farming advice		0.800	
6	Poor funding by the government		0.761	
7	Farmers lacking the ICT skills required for e-agriculture advice		0.706	
8	Lack of government guidelines for e-Farm advisory systems			0.849
9	Lack of integration of e-Farm advisory services into farm advisories			0.764
	Diagnostic tools			
	Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.700		
	% variance of factor 1 explained	28.6		
	% variance of factor 2 explained	19.3		
	% variance of factor 3 explained	17.4		
	The total variance of factors explained	65.3		

Source: *Field survey data, 2022.*

53.0% for the total variance of the factors, which they declared reasonable to explain the limits of principal factor analysis. About the distribution of factors that affect the use of e-extensions, factor 1 (commitment) explains 28.6%, factor 2 (political will) accounts for 19.3%, and factor 3 (institution) explains 17.4% of the variance of factors constraining e-extension use, respectively. Therefore, the three factors cumulatively explained 65.3% of the variance of factors influencing e-extension use in the study area. However, the three factors cumulatively explained 65.3% of the total variance.

The variables that make up the commitment factor and its effect size are lack of facilitation of e-agriculture extension (0.86) and inadequate training (0.815), few or no online database systems for agricultural advice or websites where farmers can find useful agricultural information (0.797), and poor infrastructure development (0.616). Political will factors included advisors lacking the skills required for e-farming advice (0.800), lack of government funding (0.761), and farmers lacking the ICT skills required for e-agriculture advice (0.706). On the other hand, institutional constraints are the lack of government guidelines for e-farm advisory systems (0.849) and the lack of integration of e-farm advisory services into farm advisories (0.764).

The values in the factor column are regression weights or correlation values, representing the effect sizes of the challenges affecting the use of the E-Extension technology in information dissemination by ADP staff in the study. These regression weights represent variables that inhibit the diffusion of e-extension packages to farmers. Most of the challenges identified are similar to those identified by Sa'adu *et al*. (2022) and Onah *et al*. (2021).

Conclusions and Recommendations

The role of e-agriculture extension in the global economy at this time cannot be overstated. This is because it will help accelerate agricultural growth, expand agricultural research, and strengthen customer systems. Therefore, this study examined the ease of use of e-extension techniques or tools by advisors when contacting farmers. Questionnaires structured for data collection and analysis provided informed policy options which lead to the understanding of the benefits, determinants of use, and issues that may discourage the use of these tools. Readers are meant to understand the policy areas of interest. The results of this study were so logical that they guided the recommendations and contributed to the empirical insights of the study. It turns out that being active (work experience) and motivated are part of the determinants of the ease of use of e-extension technology today. These variables were largely driven by the commitment of advisory staff, the political will of executives, and economic growth through resulting agricultural productivity to achieve better implementation of e-extension technology. Judging from the challenges identified in this study, the study recommends that:

1. Extension workers should seriously conduct awareness campaigns on the use of e-extension technology among both farmers and extension workers.
2. Advisors should be given the support they need to strengthen their e-advisor capacity for agricultural growth in the Southeast.
3. Necessary measures to ensure farmers have adequate tools to use E-Extension technology should be promoted through advertising and other relevant means.
4. The Government must demonstrate good faith and political will in introducing E-Extension technology into the study area.

Novelty Statement

Apart from that e-agricultural extension approach offers a load of benefits such as ensuring gender equality in technology transfer and lowering the cost of information dissemination among other benefits. Several empirical pieces of evidence listed some ICT tools (radio, television, etc.) that aid the implementation of e-extension, but none was able to relate the ADP officer's economic profile to their ability to understand and use the e-extension tools. However, this study applied a multinomial logistic regression model to expose the connection between the officer's socioeconomic profile and their preference to use a particular e-extension gadget. The idea of this research is that it will help to address problems of food security. For example; extension personnel can warn the farmers ahead of time about impending climate disasters awaiting them based on a metrological forecast. This study also was able to rotate common problems that should be addressed to reduce difficulty in the use of the e-extension strategies.

Author's Contribution

Chukwujekwu A. Obianefo: The lead researcher initiated the study, and analyzed the data.
Nma O. Okoroji, Ngozi J. Obiekwe, and Uzochukwu V. Uchemba: Developed and designed the research article, and collected and sorted the data.
Zahoor A. Shah: Proofread the work and arranged the manuscript.
All the authors have read through the manuscript.

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Data are available upon reasonable request from the corresponding authors.

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