

ZIBELINE INTERNATIONAL  
PUBLISHING

ISSN: 2990-9279 (Online)

CODEN: AEDCAH

# Agriculture Extension in Developing Countries (AEDC)

DOI: <http://doi.org/10.26480/aedc.02.2025.116.121>

## RESEARCH ARTICLE

# EXPLORING SMALLHOLDER FARMERS' PERCEPTION ON THE USE OF E-EXTENSION FOR POSTHARVEST LOSS MANAGEMENT OF SELECTED HORTICULTURAL CROPS IN KANO STATE

Abdul, I. M<sup>a\*</sup>, Kamilu, M<sup>a</sup>, Olaleye, O.O<sup>b</sup>, Dayo, O<sup>a</sup>, D. Wazis<sup>a</sup><sup>a</sup>Research Outreach Department, Nigerian Stored Products Research Institute, Kano<sup>b</sup>Perishable Crop Department, Nigerian Stored Products Research Institute, Kano\*Corresponding Author Email: [ibrahimhammadabdul8@gmail.com](mailto:ibrahimhammadabdul8@gmail.com), [m.ib2010@yahoo.com](mailto:m.ib2010@yahoo.com)

This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ARTICLE DETAILS

### Article History:

Received 23 April 2025

Revised 15 May 2025

Accepted 30 June 2025

Available online 02 July 2025

## ABSTRACT

The study assessed the benefits and challenges associated with the use of e-extension tools in addressing information gaps on postharvest loss management in Kano state, Nigeria. Data were collected from 55 vegetable farmers selected through a random sampling procedure using structured questionnaire and augmented by FGD. The analysis involved the use of descriptive statistics and correlation techniques. For socioeconomics, results revealed that 52.7% of the vegetable farmers were within the age of 31-40 years with a mean age of 38 years. Vegetable farming was male dominated (100%) with 72.7% of the farmers being married. A high percentage had non-formal education (61.8%), mean farming experience of 14 years and with an average income of ₦305,800pa. 89.1% of the farmers stressed poorly extension service delivery. The findings further revealed that (58.2%) of the farmers expressed very low satisfaction regarding the postharvest management information and technologies availability. The information and technology needed as expressed by 31.7% of the farmers was storage facilities. Mobile phones were the highest and the most utilized electronic media or tools by the majority (85.5%) of farmers. The most perceived benefit of e-extension where cutting cost in seeking postharvest information ( $\bar{x}=3.71$ ), linkages ( $\bar{x}=3.71$ ), provision of reliable of market information ( $\bar{x}=3.49$ ), fast information sharing and delivery ( $\bar{x}=3.31$ ) and provision of information (through exposure to postharvest technologies and specialized training ( $\bar{x}=3.27$ ). The major challenges as by majority of the vegetable farmers on e-extension were new knowledge and skills ( $\bar{x}=4.71$ ), network problems and poor infrastructural development ( $\bar{x}=4.44$ ), and inadequate technical advice on how to use the technologies ( $\bar{x}=4.27$ ). The study also found a significant correlation between age, farm size, and annual income of vegetable farmers with the information needs. It is therefore recommended that governmental agencies saddled with the responsibilities of postharvest research and value addition technologies such as NSPRI, NAERLS among others should establish e-extension approaches to facilitate information needs on postharvest management and government should support in the provision of adequate internet facilities in rural areas.

## KEYWORDS

Vegetable farmers, Postharvest loss, Challenges, Benefits, E-extension

## 1. INTRODUCTION

Agricultural extension is a crucial component for agricultural development, improvements in food security, and the enhancement of rural livelihoods (Tata et al., 2016). The programmes agricultural extension has been offered since colonial eras to help deliver essential knowledge to farmers and rural dwellers in both developed and developing countries (Danso-Abbeam et al., 2018). Information which is the bottom-line of Agricultural extension services is an essential element for agricultural development.

However, one of the numerous challenges of agricultural development in Nigeria is the inability of farmers to access vital information that can help boost their productivity and income such as relevant market information, local and timely agronomic and weather information, information on how to access finance, agricultural technology, transport and distribution as well as storage systems. The traditional extension services face several

challenges in Nigeria (due to shortages of extension agents, very few to cover the extremely diversified farmers) that limit their efficiency. Also, poor infrastructure couple with natural emergencies e.g. Covid-19 makes it harder and more costly to visit remote areas. Therefore, there is an urgent need to improve on extension delivery systems in order to enhance the quality of agricultural information, its availability and accessibility to all agricultural stakeholders. One of such ways is through the leveraging on digital technologies to provide e-extension services and digital advisory services to the farmers.

E-extension as the name implies refers to the use of ICT platforms to bridge the information gap requires or needed by the farmers. E-extension has been widely circulated in different terms by different scholars in several studies, in addressing different issues, few includes: e-Agriculture, ICT extension service, digital innovation, digital agricultural extension are defined e-extension as the use of electronic technologies to enhance face to face and paper-based transactions (Rashid et al., 2016;

## Quick Response Code



## Access this article online

Website:  
[www.aedc.com.my](http://www.aedc.com.my)DOI:  
10.26480/aedc.02.2025.116.121

Kapuscinski, 2017; Yousaf et al, 2021; Oluwatoyin, 2021; Opeyemi, 2018). E-extension also refers to as the use ICTs and various mass media in the delivery of agricultural extension advices. Extension workers can interact with farmers through the use of audiovisual messages (video), interactive voice response (IVR), short message services (SMS), and social media platform (SMP) among others.

The first e-extension initiative or programme in agricultural sector in Nigeria was the introduction of electronic wallet (e-wallet) in 2012 under the Growth Enhancement Scheme (GES) saddled with the responsibility in the aspect of purchasing and distribution of agricultural inputs to farmers in order to curb the menace of corrupt practices, insincerity and perennial problems afflicting the systems (Yusuf et al., 2015). The adoption and usage of ICTs has created great chances for growth in the agricultural sector (Getahun, 2020). According to this study, recorded more than 140 digital agricultural initiatives worldwide in their assessment of the potentials and obstacles found in the use of ICT in agricultural job (Aker et al., 2016). E-extension technologies have enabled farmers to become more motivated on the market by linking them to individuals who can buy or sell their produce which directly has help to mitigate postharvest losses (Aker et al., 2016). Quite a lot of these initiatives are made possible in different areas of agricultural extension service via mobile phones, computers, and web-based tools (Aker et al., 2016; Onubedo et al., 2018).

Horticultural vegetables crops play an important role in human diet due to the amount of vitamin, fat, carbohydrate, protein, and mineral substances they contain (Maciel et al., 2013; Atnan et al., 2014). E-extension activities are seemed relevant in the area of postharvest loss reduction especially for vegetable farmers of tomato, onion and pepper were large harvest of their produce get wastage, due to limited access to postharvest technologies and fast extension advice on new innovation. As asserted, Nigeria is one of the leading producers of tomatoes, pepper, onions, plantain, okra and other vegetables yet, produces are lost at an alarming rate of 30-50% annually through poor pre and post-harvest practices (Charles, 2009).

It is against this backdrop that this study tends to explore smallholder vegetable farmers perception on the use of e-extension toward postharvest loss management for sustainable livelihood in Kano State. As it is believed that the integration of digital technology will play a very important role in bridging knowledge gaps. E-extension is a scalable, cost-effective solution that allows farmers access to actionable knowledge (Kurdyś-Kujawska et al., 2021).

### 1.1 Objectives

Exploring Smallholder Farmers Perception on the Use of E-extension Towards Postharvest Loss Management in Selected Horticultural Crops (Vegetables) in Kano State is the main objective.

The specific objectives of the study were:

- To identify and describe the socio-economics profiles of the Smallholder vegetable farmers;
- to examine the type of ICTs/electronic media mostly utilized by the smallholder vegetable farmers;
- to identify and assessed the various information and technology needs of the smallholder vegetable farmers;
- to ascertain the perceived benefit/impacts and challenges associated with e-extension by the smallholder vegetable farmers.

**Ho:** The Vegetable farmers' selected socioeconomics profiles have no significant effect on the information needs of vegetable farmers.

## 2. MATERIALS AND METHODS

The research was carried out in Kano State. Kano State is noted for high intensity of vegetable farming activities. A purposive sampling technique was used to select Bunkure, Kura and Garun Mallam vegetable farmers' clusters within Kano River Irrigation Project (KRIP) in Kano State, Nigeria. Then using random sampling, 20 farmers were selected from each cluster. Thus, a total of 60 vegetable farmers formed the sample size for this study. Meanwhile, 55 of the 60 questionnaires were found suitable for data analysis. Information of socioeconomics were described. The perceived benefits of e-extension was measured by rating 7 perceptual questions with the response options of 'Strongly agree', 'agree', 'disagree' and 'strongly disagree' with scores of 4, 3, 2 and 1 assigned respectively. These values were added and divided to obtain a mean score of 2.5 which served as the cut-off point. Challenges associated with the use of e-extension as ascertained by the smallholder vegetable farmers were measured on a 5-point Likert type scale with response categories of strongly agree, agree undecided, disagree and strongly disagree. The values of the responses were 5, 4, 3, 2, and 1 respectively. These values were added and divided by 5 to obtain a mean score of 3 which served as the cut-off point. In addition, a focus Group Discussions (FGDs) was also conducted to augment information collected. Data were analyzed using descriptive statistics (frequencies, percentages and means) and correlation analysis. The study targeted vegetables (tomato, onion and pepper) along the KRIP.

A total of 55 out of 60 questionnaires were found suitable for data analysis as distributed in the study area giving a response of 92% in table 1.

Distributed questionnaires	Treated questionnaires	Proportion (%)
60	55	92

It was asserted that a response rate of greater than 50% is valid for any social research analysis (Amin, 2005). This study therefore used 55 questionnaires for results analysis.

## 3. RESULTS AND DISCUSSION

### 3.1 Socio-economics Profiles of the Smallholder Vegetable farmers

The socio-economic variables identified include the age, sex, marital status, level of education, years of experience, farm size and income level respectively of the vegetable farmers. These variables are presented in table 2. The results of the study in table 2 revealed that majority (52.7%) of the vegetable farmers were within the age of 31-40 years. The mean age of the farmers was 38 years. This implies that most of the farmers were within their active age capable of undertaking all the mental and physical activities needed for producing the crops. These findings corroborate on their studies of postharvest management strategies and found the mean age of vegetable farmers in Kano State, Nigeria was 36years (Wazis et al., 2020). Furthermore, they fall within the age that would enhance accurate, prompt and effective decision making (Shu'aib et al., 2017). Also, 100% of the farmers were male. This implies that vegetable production in the study area was male dominated. The tedious nature of farming activities that require strength and vigour coupled with religious and cultural belief in the area may be the reason for male domination in the vegetable production. Furthermore, 27.3% of the farmers were single while 72.7% were married. The mean farm size of the vegetable farmers in table 2 was 2.65ha.

Variables	Characteristics	Frequency	Percentage	Mean( $\bar{x}$ )
<b>Age:</b>	18-20	3	5.5	38years
	21-30	7	12.7	
	31-40	29	52.7	
	41-50	8	14.5	
	≥51	8	14.5	
<b>Sex:</b>	Male	55	100	
<b>Marital Status:</b>	Single	15	27.3	
	Married	40	72.7	

**Table 2 (Cont.):** Socio-economic characteristics of the vegetable farmers (n = 55).

<b>Educational Level:</b>	Non-formal	34	61.8	
	Primary	7	12.7	
	Secondary	11	20.0	
	Tertiary	3	5.5	
<b>Vegetable Farming Experience:</b>	1-10	30	54.5	14years
	11-20	5	9.1	
	≥21	20	36.4	
<b>Farm Size:</b>	0.5-2	29	52.7	2.65ha
	>2	26	47.3	
<b>Annual Income (₦'000):</b>	<100	7	12.7	305.8
	101-200	8	14.5	
	201-300	19	34.5	
	301-400	10	18.2	
	≥401	11	20.0	
<b>Contact with Extension Service:</b>	Poorly	49	89.1	
	Moderately	6	10.9	
	Highly	0	-	
<b>Awareness of e-extension activities:</b>	Yes	38	69.1	

Source: Field survey, 2022

The educational level of the vegetable farmers allows them to easily understand and apply new practices and techniques in the production processes. The higher the level of one's education, the faster the rate of application of an innovation (Shu'aib et al., 2017). A high percentage of the farmers had non-formal education (61.8%), and are classed as vegetable farmers with low educational status, followed by primary education (12.7%) which are classified as medium educational status farmers while vegetable farmers with secondary education and more (25.5%) were categorized having high educational status. Since the level of formal education attainment of the vegetable farmers was low, and then definitely they might not apply and utilize new technologies properly. This finding is in similar vein with who posited in their study that 60% of vast majority of vegetable farmers interviewed were informally trained in the Quranic education (S4C, 2020).

Years of experience refers to the length of time over which the vegetable farmers spend in the production and postharvest activities. Anticipatedly, the longer the years of experience, the more the farmers acquire good managerial skills and subsequently improves on the efficiency of production. The means farming experience of the vegetable farmers was 14 years. More than half of the farmers (72.7%) can be categorized as

higher income earner (earning ₦201,000 and above). Their average income was ₦305,800 and the income level recorded may play a significance role in the adoption of e-extension. The average income of ₦305,800 was quite lower than the values obtained by (Shu'aib et al., 2017) who got higher amount among farming households of N460, 567. The contact with the extension service was poorly as expressed by majority of the farmers (89.1%).

Table 3 below indicates the farmer's expression on their rate of satisfaction about postharvest loss management technologies and information availability. The satisfaction rates stretched from whether a farmer is highly satisfied, moderately satisfied, low satisfied, very low satisfied, and dissatisfied at all with regarding types of postharvest technologies and information services available. The majority of farmers perceived to have very low satisfied (58.2%), dissatisfied at all (32.7%), low satisfied (5.5%) and moderately satisfied (3.6%) concerning availability and accessibility to postharvest information and technological services. The majority of farmers claimed that both postharvest management information and technological communication are strongly needed for agricultural performance and show high level of dissatisfaction with the status quo.

**Table 3:** Farmers' Level of Satisfaction Regarding Postharvest Management Information and Technologies Availability (n = 55).

Satisfaction Rate	Frequency	(%)
High	0	-
Moderate	2	3.6
Low	3	5.5
Very Low	32	58.2
Not at all	18	32.7
<b>Total</b>	<b>55</b>	<b>100</b>

### 3.2 Information and Technology Needs of Vegetable Farmers

The smallholder vegetable farmer's information and technology needs were displayed in table 4. The table revealed the farmers' expressions on the type of information and technology services needed for their farming activities. The results depicted storage information and technologies (31.7%) as the most strongly need. The farmers stressed on the inadequate of good storage method as a major concerned to their farming

activities. On the Production aspect, 29.6% farmers stressed majorly needs on production technological services applied in vegetable farming to include seeds, pesticides, machinery, pest's management strategies, fertilizer, and cultivation methods. Other need preferences shown by farmers extended from need to information on available markets (24.6%) to needs of information and technologies for processing (14.1%) i.e. value addition.

**Table 4: Information and Technology Needs of Vegetable Farmers (n = 55).**

Variables	Most strongly need	Need	Not need	Polled Need	
	Frequency	Frequency	Frequency	Frequency (%)	
Production	5	37	13	42	29.6
Storage	45	-	10	45	31.7
Marketing	30	5	20	35	24.6
Processing	9	11	35	20	14.1
<b>Total</b>	<b>89*</b>	<b>53*</b>	<b>78*</b>	<b>142*</b>	<b>100</b>

**Note:** \* Multiple response

The provision of information and technologies will substantially influence vegetable farmer's performance. It is expected that smallholder farmers adopt certain indigenous management practice to efficiently manage production output. However, seeking of information on good practice knowledge on improve postharvest technologies can substantially boost production which has a good reflection on their earning income. Attributed to the current development of electronic devices such as radio, television, and mobile phones which could be easily accessible to disseminate information from one farmer to another (Yaseen et al., 2016). This study stressed on adoption of e-extension services to provide information on best post-harvest handling practices that will enhance the quality of farmers output.

As farmers display different behaviors regarding the type of information and technologies required, the research further captured an in-depth opinion or views of some key informants on the use of mass media tools i.e. e-extension toward production activities in Kano, as a need to change the agricultural practices in vegetable production. The Focus Group Discussion (FGD) yield similar views and the response were summarized as follows:

*"...We have always had problems with our production especially in area of pest control, we believed the implementation of e-extension will not only ease our postharvest loss but also increase our earning income ...."*

*"... our major production and storage need technologies include improved seed, pesticides, fertilize and good storage facilities such as cold room, ventilated basket, plastic crates etc. ..."*

### 3.3 ICTs/media tools mostly utilized by the vegetable farmers as a source of Information

Table 5 shows the various ICTs or media tools that vegetable farmers utilized. In sourcing for vegetable related information, 85.5% of the farmers often utilize their mobile phone with substantial number of, especially older farmers rarely make calls. 65.5% utilize radio as their cheap source of information while 16.4%, 7.3% and 3.6% received information through the use of social platform, TV and Web based technologies respectively. The findings collaborate with on their studies of willingness for improved ICTs amidst Covid-19 and reported 97.5% of the fish farmers uses mobile phone (Omega et al., 2022). To vegetable farmers, it shows their wills and extent of utilizing various e-technologies to augment their face-to-face interaction on various activities as related to vegetable production. This called for advocating on e-extension; as relying

on government extension officials face to face interaction has proved an inefficient way of timely information dissemination for the dispersed rural farmers some of the information provided by the agents is expensive, and unless farmers are linked or subscribed to the respective groups, they won't receive the required information on time (Neha et al., 2018; Khan et al., 2019).

**Table 5: ICTs/Media Tools Utilized for Sources of Information by Vegetable Farmers (n = 55).**

Mass media Utilized	Frequency	Percentage
Mobile phone	47	85.5
Social media	9	16.4
Web/Internet	2	3.6
Radio	36	65.5
TV	4	7.3
<b>Total</b>	<b>98*</b>	<b>100</b>

**Note:** \* Multiple responses

Further in-depth view of respondents stated *"...we use our phone at least once a day to connect with our love once, business partners either by SMS or by call..."*

### 3.4 Perceived Benefit/Impacts and Challenges Associated with E-extension

#### 3.4.1 Perceived benefit/impacts

Result in table 6 show that Cutting cost in seeking postharvest information ( $\bar{x} = 3.71$ ), fast information sharing & delivery ( $\bar{x} = 3.31$ ) and provision of

information (e.g. through exposure to postharvest technologies and specialized training ( $\bar{x} = 3.27$ ) were the highly ranked benefits. Marketing support on vegetable produces through Linkages (3.71) and provision of reliable of market information (3.49) were also among the perceived benefit expected from the e-extension. This connotes that e-extension practice will play a vital role in addressing the huge postharvest loss incurred by the vegetable farmers.

Other benefit such as value addition ( $\bar{x} = 3.31$ ), and getting feedback/ quick responses ( $\bar{x} = 3.15$ ) were moderately derived benefits expected from the e-extension toward vegetable production in table 6.

**Table 6: Perceived benefits/Impact of e-extension (n = 55)**

S/no	Incentive Statements	Mean Score( $\bar{x}$ ) Rank	
1.	It will aid in the provision of information to directly reduce postharvest loss e.g. through specialize training on postharvest technologies	3.27	3 <sup>th</sup>
2.	It will enhance fast information sharing & delivery on regular basis e.g. such as information on pest control	3.31	2 <sup>nd</sup>
3.	It will help in cutting cost e.g. cost of transport in seeking information or advice on postharvest management	3.71	1 <sup>st</sup>
4.	It will assist farmer(s) in getting feedback/ quick responses on questions asked.	3.15	4 <sup>th</sup>
<b>Other expected support from e- extension e.g. marketing</b>			
i.	Linkage	3.71	1 <sup>st</sup>
ii.	Value addition	3.31	3 <sup>rd</sup>
iii.	Provision of reliable market information	3.49	2 <sup>nd</sup>

Note: Mean Score  $\geq 2.5$  = Agree

As such effective's information and linkages in general help smallholder vegetable farmers to formal market, and expose them to new set of buyers for their produce (Akinwale et al., 2021). Also, heavily stressed linkage to retail outlets has consequently increased farmers' ability and willingness to invest in technologies that enhance productivity e.g. Postharvest innovation (Rao et al., 2012). This implies that the use of e-extension will not only enhance with the rapid information for the reduction of postharvest loss (through skills provision to extending shelf life, improves productivity, increase marketing network, increase income, increase scale of production but also create a work friendly environment for extension workers to farmers and augment the face-to-face challenges.

The research further captured the opinion of some key informants:

For smallholder vegetable farmers to maximize profit there is need to venture into value addition of the produce to reduce postharvest losses. Those who practice stated that "... we practice the sun drying by cutting and drying out in order to reduce the losses to our vegetable crop, especially

tomato during glut".

Post-harvest sun drying requires time and the length of time needed for full drying of sliced tomato depends considerably on weather and atmospheric conditions.

### 3.4.2 Challenges Associated with E-extension

Factors that may limit or poses challenges to the uses of e- extension as expected as indicated in table 7 by the farmers were; required new knowledge & Skills (e.g. zoom, internet etc.) ( $\bar{x}$  = 4.71), network problems and poor infrastructural development ( $\bar{x}$  = 4.44), inadequate technical advice on how to use them e.g. use of smartphone ( $\bar{x}$  = 4.27), high data consumption and maintenance/ high cost of internet access ( $\bar{x}$  = 3.89) and problem related to group working ( $\bar{x}$  = 3.89), with the least delay in answering of questions by extension agent(s) ( $\bar{x}$  = 2.95). Omega (2020) stressed that, high transaction and maintenance costs have been a major challenge to ICT services adoption and usage by farmers in developing countries.

**Table 7: Challenges Associated to with use of E-extension (n=55)**

S/No	Perceived Challenge Statements	Level of Agreement					Mean ( $\bar{x}$ )	Rank
		SA F (%)	A F (%)	U F (%)	D F (%)	SD F (%)		
1	Delay in answering of questions by extension agent(s)	7(12.7)	16(29.1)	-	31(56.4)	1(1.8)	2.95	9 <sup>th</sup>
2	Information may lead to poor results (postharvest loss) even after using the advises, due to lack of physical demonstration i.e. face to face contact	5(9.1)	24(43.6)	15(27.3)	8(14.5)	3(5.5)	3.36	8 <sup>th</sup>
3	Require new knowledge & Skills	39(70.9)	16(29.1)	-	-	-	4.71	1 <sup>st</sup>
4	Limited or lack of incentives	9(16.4)	24(43.6)	23(41.8)	-	-	3.81	5 <sup>th</sup>
5	Problem related to group working	16(29.1)	24(43.6)	8(14.5)	7(12.7)	-	3.89	4 <sup>th</sup>
6	Network problems and poor infrastructural development	24(43.6)	31(56.4)	-	-	-	4.44	2 <sup>nd</sup>
7	High data consumption and maintenance/ high cost of internet access	16(29.1)	24(43.6)	8(14.5)	7(12.7)	-	3.89	4 <sup>th</sup>
8	Inadequate technical advice on how to use them e.g. use of smartphone	31(56.4)	16(29.1)	-	8(14.5)	-	4.27	3 <sup>rd</sup>
9	Inadequate knowledge of technology uses e.g. WhatsApp, Telegram, Emails, SMS, Facebook etc.	18(32.7)	24(43.6)	-	8(14.5)	5(9.1)	3.76	6 <sup>th</sup>
10	The technology is too difficult to understand e.g. Zoom	17(30.9)	8(14.5)	24(43.6)	6(10.9)	-	3.65	7 <sup>th</sup>

Noted: SA= Strongly Agree, A= Agree, U=Undecided, SD= Strongly Disagree and D=Disagree

The need for new knowledge & skills for the farmers depict the general state of their literacy level. These findings agree with who stressed that there is need to educate and support farmers with new knowledge and skills which enhance in their acceptance of innovation and technologies (Antwi-Agyei et al., 2021).

### 3.5 Hypotheses Testing

The Correlation analysis in table 8 showed that educational level ( $p=0.125>0.05$ ) was not significantly associated with the of information needs. It implies that educational level did not influence level of information need in vegetable farming activities. However, there was a significant relationship between age ( $p=0.042<0.05$ ), farm size ( $p=0.002<0.01$ ), annual income ( $p=0.018<0.05$ ) of the smallholder vegetable farmers and the information needs. This suggests that age, farm size and annual income influence the level of information needs on production, postharvest storage and marketing.

**Table 8:** Result of the Relationship Between the Selected Socio-economic Characteristics and the Level of Information Needs of the Smallholder Vegetable Farmers

Variables	Correlation value (r)	P-value
Age	0.276*	0.042
Educational level	0.209 <sup>NS</sup>	0.125
Farm size	0.411**	0.002
Annual income	0.318*	0.018

\* Sig. @ 0.05 level, \*\* Sig. @ 0.01 level.

#### 4. CONCLUSION AND RECOMMENDATIONS

The concept e-extension is a fast means of information and communication technology (ICT) that will enhance traditional extension approaches/practices. The tools have got a wider application in different area of agricultural activities. For instance, in Nigeria the e-wallet has benefits many farmers in the purchasing of agricultural inputs without hurdles. Also, the new Covid-19 pandemic has had effect on farmer's input, output, market, revenue, and contact with extension agents. To reduce the growing effect, e-extension has become necessary as farmers can get easy access to extension agents and monitor farm activities while reducing exposure to the virus. Therefore, the perceived benefit of e-extension services is that, it will; aid in disseminating and receiving fast and timely information on new postharvest technologies; provision of reliable market information; exposed farmers to new skills & training on essential value addition; and keep farmers with update postharvest extension operation. It is therefore recommended that governmental agencies saddled with the responsibility of postharvest research and value addition technologies such as Nigerian Stored Products Research Institute (NSPRI), National Agricultural Extension and Research Liaison Service (NAERLS) etc. among others should try and establish an e-extension approaches & platforms( e.g. database equipped with audiovisual), farmers centers that will assist farmers in getting regular postharvest information; conducting of workshops to adequate trained farmers on the economic benefits attached to the use of the tools in enhancing food security and income. Others include training support to the extension workers since they are key players in the chain; service providers should provide cheap and affordable data plans which will enable more farmers to subscribe; and lastly, government should support in the establishment of adequate internet facilities in rural areas.

#### ACKNOWLEDGMENT

The authors of this study would like to acknowledge and thanks the Chairmen of Vegetable farmers along the Kano River Irrigation Project (KRIP) for their valuable support.

#### DECLARATION OF CONFLICT OF INTEREST

The authors declared no conflict of interest.

#### REFERENCES

Aboloso, P. F., Ogunjimi, S. I., and Abulosoro, S. A., 2014. Farmers' perception on the strategies for increasing tomato production in Kabba-Bunu Local Government Area of Kogi State, Nigeria. *Agrosearch*, 14(2), Pp. 144–153.

Akinwale, J. A., and Oyeyemi, O. V., 2021. Effectiveness of linking vegetable farmers to formal markets in Lagos State, Nigeria. *Journal of Agriculture and Natural Resources*, 4(2), Pp. 273–283. <https://doi.org/10.3126/janr.v4i2.33920>

Amin, 2005. *Agriculture: Its importance and development*. Africana Publishers Nigeria.

Ugur, A., Gok, Y., and Gok Ugur, H., 2014. Impact of socio-cultural and economic factors on vegetable consumption behaviours: Case of Giresun Province, Turkey. *Food Science and Technology (Campinas)*, 34(4), Pp. 688–693.

Getahun, A. A., 2020. Challenges and opportunities of information and communication technologies for dissemination of agricultural information in Ethiopia. *International Journal of Agricultural Extension*, 8(1), Pp. 57–65. <https://doi.org/10.33687/ijae.008.01.3069>

Iliyas, S., 2015. Impact of information technology in agriculture. *International Journal of Food, Agriculture and Veterinary Sciences*, 4(April), Pp. 1–7.

Kansiime, M. K., Alawy, A., Allen, C., Subharwal, M., Jadhav, A., and Parr, M., 2019. Effectiveness of mobile agri-advisory service extension model: Evidence from Direct2Farm program in India. *World Development Perspectives*, 13(February), Pp. 25–33. <https://doi.org/10.1016/j.wdp.2019.02.007>

Muhammed-Lawal, A., Omotesho, O. A., and Falola, A., 2009. Technical efficiency of youth participation in agriculture: A case study of the Youth-in-Agriculture Programme in Ondo State of Nigeria. *Journal of Agriculture, Food and Environment*, 5(1), Pp. 20–26.

Neha, P., 2018. Assessing the farmer's opinion towards usage of mobile phone SMS service: A study of Uttar Pradesh, India. *Plant Archives*, 18(1), Pp. 507–511. [http://www.plantarchives.org/PDF%20181/507511%20\(PA3%204092\).pdf](http://www.plantarchives.org/PDF%20181/507511%20(PA3%204092).pdf)

Rao, E. J. O., Brümmer, B., and Qaim, M., 2012. Farmer participation in supermarket channels, production technology, and efficiency: The case of vegetables in Kenya. *American Journal of Agricultural Economics*, 94(4), Pp. 891–912.

Selorm, O., Esther, E. E., Adebote, P. K., Omega, S. A., and Omitoyin, A. S., 2022. Fish farmers' willingness to pay for improved information and communication technologies during COVID-19: A case of Ibadan, Nigeria. *Journal of Agricultural Science*, 14(2), Pp. 113–121.

Seeds for Change (S4C), 2020. Technical report: Baseline study on vegetables in Kano State, Nigeria (2019–2021). S4C.

Yaseen, M., Xu, S., Yu, W., and Hassan, S., 2016. Farmers' access to agricultural information sources: Evidence from rural Pakistan. *Journal of Agricultural Chemistry and Environment*, 5(1), Pp. 1–9. <https://doi.org/10.4236/jacen.2016.51B003>

