Proclivity to use interactive voice response as information and communication technology tool for extension service delivery in Lagos state, Nigeria

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ABSTRACT

The Interactive Voice Response (IVR) system is an automated telephone technology that employs a computer-generated voice to engage callers' input. It holds significant global recognition as a potent Information and Communication Technology (ICT) tool, particularly in facilitating communication between farmers and extension service providers worldwide. In Nigeria, despite the notable deficit in extension agent-farmer interaction, IVR as an alternative for extension service delivery remains largely unused. Thus, extension agents' proclivity to use interactive voice response as an ICT tool for extension service delivery was investigated. Using multistage sampling procedure, a total of 97 Extension Agents (EAs) were used as samples for the study. Data were analysed using percentages, means and Pearson's product moment correlation at $\alpha_{0.05}$. Respondents' age was 46±0.91 years, the majority were married (80.4%), had Bachelor's degrees (53.6%) with professional experience of 13.7±8.2 years, and were mainly in the senior cadre (46.4%). Airtel was the primary service provider for internet connection of IVR ($\bar{x}$ =1.60). A larger (51.5%) proportion of the respondents had a favourable perception towards IVR use in Extension Service Delivery (ESD) and the IVR perceived benefits were high for 60.8% of the EAs. More than half of the EAs expressed high proclivity to use IVR. Respondents' age (r= -0.156) and years of experience (r= 0.262). were significantly related to proclivity to IVR. A significant relationship existed between respondents' perception and proclivity to use IVR (r = 0.424). Extension agents in Lagos State showed a positive inclination toward using IVR for extension delivery systems. To harness its benefits, stakeholders should prioritise IVR integration to improve the effectiveness and efficiency of agricultural extension services, fostering better outcomes for farmers.

Keywords: Interactive Voice Response, Extension Service Delivery, Information and Communication Technology, Proclivity to use

INTRODUCTION

Prior to Nigeria's oil boom, agriculture was the cornerstone of the economy, supporting most Nigerians and contributing significantly to foreign exchange earnings (Food and Agriculture Organization, 2020). Approximately 35% of the Nigerian population was employed in the agricultural sector in 2020, and it contributed around 29.25% to the Gross Domestic Product in the third quarter of 2019 (World Bank, 2020; National Bureau of Statistics, 2019). Agriculture also supplied raw materials for local industries and served as the primary source of both export and domestic food (Food and Agriculture Organization, 2020).

The effectiveness of the agricultural sector is heavily reliant on its information system, ensuring the seamless flow of information from researchers to producers and consumers, and from facilitators to users of agricultural knowledge, information, and technologies (Rahman et al., 2020). Advancements in Information and Communication Technologies (ICTs) have further revolutionised how agricultural information is acquired, processed, stored, transmitted, and retrieved, adapting to contextual realities (Ayim et al., 2022). With the utilisation of ICTs in extension services, barriers to agricultural information transfer to farmers are being dismantled, thereby enhancing the efficiency of extension services (Ayim et al., 2022). A notable example of this is the use of Interactive Voice Response (IVR) technology, which delivers location-specific messages to farmers regarding various aspects of agriculture such as crop varieties, livestock breeds, soil management, weather conditions, market prices, and more, thereby revolutionising agricultural information delivery through ICT (Ayim et al., 2022).

Interactive Voice Response (IVR) technology enables the delivery of information via audio recordings through any type of phone, allowing users to provide feedback by selecting options using the keypad (Sahel Consulting, 2020). The IVR serves as an automated telephone system that interacts with callers, provides information, collects data, and directs calls to the appropriate recipient (Sahel Consulting, 2020). This ICT solution enables callers to access pre-recorded messages and navigate menu options without speaking to an agent, using touch-tone keypad selection or speech recognition (Sahel Consulting, 2020). The IVR operates on basic feature phones, making it accessible to a wide range of users (USAID, 2016) and has been widely deployed, reaching millions during the

COVID-19 pandemic, and 6.8 million globally for vital information dissemination (Viamo, 2020). In Nigeria, IVR was employed by USAID and Airtel Networks Limited for COVID-19 containment efforts, while Union Bank utilised it for customer service (USAID, 2020; Union Bank, 2020). Moreover, IVR is increasingly utilised in public health programmes and agriculture, exemplified by Airtel Networks Limited and HNI's "3-2-1" Service, which provides agricultural information in multiple languages (Viamo, 2020).

The agricultural extension system in Nigeria, primarily facilitated by Agricultural Development Programmes (ADP) alongside various public, private, and civil society entities, plays a pivotal role in rural development (Adedotun, 2022). However, the traditional top-down approach lacks context-specific solutions, resulting in a weak linkage between extension, research, and farmers (Davis *et al*., 2018). This deficiency hinders farmers' access to critical information, impeding agricultural productivity and rural development efforts in Nigeria (Yusuf *et al*., 2021). Communicating vital agricultural information to farmers is crucial for innovation uptake and rural development (Sennuga, 2019). Integrating IVR with digital tools offers a solution to enhance extension services and boost agricultural productivity (Feed the Future, 2017). Interactive Voice Response is increasingly being used in agricultural extension services across countries like India, Ethiopia, Malawi, and Madagascar and has demonstrated effectiveness in overcoming language and literacy barriers (Feed the Future, 2017). Despite its potential, evidence of IVR's use in Nigeria remains limited, highlighting a gap in research and implementation. Investigating extension agents' inclination towards IVR adoption in Lagos State is therefore crucial to understanding its potential impact on extension service delivery.

The main objective was to ascertain extension agents' proclivity to use interactive voice response as an ICT tool for extension service delivery, while the specific objectives were to:

1. describe the socio-economic characteristics of extension agents in the study area.
2. identify the available IVR service providers in the study area.
3. determine the respondents' perception of IVR in extension service delivery in the study area.
4. Identify the perceived benefits of IVR among respondents in the study area.
5. Identify the perceived constraints to the use of IVR in extension service delivery in the study area.

METHODOLOGY

The study was carried out in Lagos state, Nigeria which covers 3,577 km^2 with a population of approximately 12.5 million (National Bureau of Statistics, 2017). The state features tropical swamp forests and mangrove swamps, influenced by its double rainfall pattern, making it a wetland region. The economy relies on industries like fishery, farming, and livestock, with three main agricultural zones: Badagry, Imota, and Epe.

Primary data were collected through structured questionnaire administered to extension workers. A two-stage sampling method was employed in picking sample for the study. In the first stage, a list of 120 extension workers was generated across three agricultural zones in Lagos state: Imota (43), Epe (38), and Badagry (39). Subsequently, 80% proportionate sampling was conducted in each zone, resulting in a total sample size of 97 extension agents for the study.

The independent variables in this study included respondents' socioeconomic and professional characteristics, service providers of IVR, extension agent's perceptions towards IVR, perceived benefits and constraints to the use of IVR. The dependents variable was extension agent's proclivity to use IVR for extension service delivery.

The perception of Interactive Voice Response (IVR) was assessed by presenting respondents with a list of 20 statements regarding IVR. They were asked to indicate their level of agreement with each statement using a five-point Likert-type scale of Strongly Agree, Agree, Undecided, Disagree, And Strongly Disagree, with corresponding scores of 5, 4, 3, 2, and 1 for positively worded statements, while and negatively worded statements were scored in the reverse order. Scores ranged from 20 to 100, with a mean score of 73.2±11.5. This mean score was used to categorise perceptions into favorable and unfavorable dispositions towards the use of IVR in the study area for extension service delivery.

Proclivity to use IVR was measured at the interval level. Respondents rated their willingness to use IVR for extension service delivery on a two-point scale: "willing" (scored as 1) and "not willing" (scored as 0). Scores ranged from 0 to 13, with a mean score of 12±2.4. Respondents were then categorised based on their proclivity scores. All respondents with scores below the mean score were classified as having low proclivity, while those equal to or above the mean were classified as having high proclivity to use IVR for extension service delivery.

RESULTS AND DISCUSSION

Table 1 reveals that most extension workers in Lagos State were middle-aged, with 57.8% being above 40 years old, indicating their potential receptiveness to innovations like IVR (Olaoye *et al.,* 2023). Gender distribution shows a marginal mix, with 51.5% female and 48.5% male extension agents, facilitating broader outreach to farmers (Washington, 2008; Manir, 2013; Idiake-Ochei *et al.*, 2016). Most respondents held Bachelor's degrees (53.6%), indicating their literacy and capacity for effective knowledge transfer (Onwubuya *et al.*, 2015). This educated demographic suggests a higher potential for IVR adoption, consistent with previous findings linking education levels to innovation adoption intentions (Diaz *et al.*, 2021 and Kabbiri *et al.*, 2018).

The majority (80.4%) of respondents were married, suggesting a responsible and committed workforce in the extension service system (Ferrari *et al.*, 2022). Additionally, 46.4% of respondents were in the senior cadre, indicating a wealth of experience among extension personnel (Ferrari *et al.*, 2022). This demographic composition implies that extension agents in the study area possess the qualities of reliability, trustworthiness, and expertise crucial for effective extension service provision.

The study further reveals that 60.8% of extension agents in Lagos State had over ten years of work experience, with a mean of 13.7±8.2 years, indicating a highly experienced workforce (Vasa and Trendov 2020). This extensive experience may impact extension workers' inclination to utilise IVR technology.

Table 1: Socio-economic characteristics of respondents

Variable	Freq.	%	Mean /SD
Age			
21-30	13	13.4	46±0.91 years
31-40	28	28.9	
41-50	41	42.3	
51-60	15	15.5	
Sex			
Male	47	48.5	
Female	50	51.5	
Educational qualification			
OND	5	5.2	
HND	21	21.6	
BSC	52	53.6	
MSC	19	19.6	
Marital status			
Single	14	14.4	
Married	78	80.4	
Separated	1	1.0	
Widowed	4	4.1	
Grade of level			
Entry-level	15	15.5	
Mid- level	37	38.1	
Senior level	45	46.4	
Number of years worked as an extension officer			
1-10 years	39	39.2	13.7±8.2
11-20 years	34	35.1	
21-30 years	23	23.7	
Above 30 years	1	1.0	

Source: Field survey, 2021

Perception towards the use of IVR for agricultural extension delivery

The analysis from Table 2 shows that extension agents had a favorable perception of IVR in extension service delivery, with a grand mean of 3.70. Among the 20 items, respondents expressed positive attitudes toward 11 aspects of IVR. They believed that IVR could efficiently forward farmers' calls to specialists ($\bar{x}$ = 4.41), overcome language barriers ($\bar{x}$ = 4.34), and target diverse farmer groups based on location and crops grown ($\bar{x}$ = 4.33). This indicates that IVR has the potential to facilitate prompt responses to farmer challenges, enhance communication between agents and farmers, and overcome distance barriers ((Ayim *et al.*, 2022).

In addition, extension agents perceived IVR as user-friendly ($\overline{x}$ = 4.32) and conducive for feedback ($\overline{x}$ = 4.30), indicating its potential to disseminate technology to farmers effectively (Abishek 2014, Okoroma *et al*. 2015). However, they expressed concerns about IVR's challenges, such as its novelty in sharing agricultural information ($\overline{x}$ = 2.43), potential time-consuming nature due to waiting queues ($\overline{x}$ = 2.47), and the perceived high cost of implementation ($\overline{x}$ = 3.06), suggesting these factors could hinder its adoption (Amoussohoui *et al*., 2024). This indicates unfavourable perception among extension agents regarding the practicality and limitations of IVR in agricultural extension services.

Table 2: Extension agents' perception of IVR in extension service delivery

Statements	SA	A	U	D	SD	Mean
IVR being voice-based means, only relies on the most basic phone feature to function.	23.0	28.9	15.5	7.2	15.5	2.43
Integrating IVR into other ICT channels for disseminating agricultural information might likely create unhealthy competition.	6.2	16.5	16.5	29.9	3.9	3.63
IVR essentially allows for extension to move from its top-down approach to a more interactive or targeted knowledge exchange system.	27.1	35.1	8.2	3.1	16.5	3.73
IVR requires more advanced technical input when creating it since it is a more dynamic type of calling system.	16.5	22.7	14.4	18.6	27.8	3.19
The process involved in creating an IVR system for disseminating agricultural information can be quite costly.	15.5	24.7	20.6	16.5	22.7	3.06
IVR makes it possible to broadcast messages to a large population of farmers simultaneously.	51.5	25.8	13.4	7.2	2.1	4.18
Different types of farmers can be targeted with messages based on their location and crops grown.	51.5	35.1	9.3	3.1	1.0	4.33
IVR is a pretty new idea in terms of sharing agricultural information; hence it is bound to have several challenges	14.4	41.2	33.0	9.3	2.1	2.43
IVR allows those that you send out messages to be able to give back feedback.	48.5	39.2	6.2	6.2	0	4.30
IVR helps to overcome language barriers as messages can be broadcast in different languages.	55.7	29.9	9.3	3.1	2.1	4.34
Even illiterate farmers can benefit from IVR through listening to voice prompts and messages and then choosing a key message then to listen to	53.6	3.9	7.2	5.2	3.1	4.27
Farmers cannot choose their own time, place, and subject to get information on their phone when under IVR.	11.3	23.7	14.4	30.9	19.6	3.23
IVR would enable farmers to access timely services such as labor and transportation	40.2	36.1	14.4	7.2	2.1	4.05
Mobile network providers/operators may not be willing to sign up to IVR, given that the system allows individual farmers a handful of free calls	6.2	18.6	23.7	21.6	29.9	3.51
IVR would give room for sufficient opportunity for interaction necessary to internalized information disseminated	40.2	44.3	8.2	6.2	1.0	4.16
IVR is not appropriate and adequate as other communication platforms for facilitating behavioural changes	12.4	26.8	14.4	17.5	28.9	3.24
IVR can be described as user friendly	50.5	37.1	8.2	2.1	2.1	4.32
IVR as a means of disseminating information is not genuine	5.2	15.5	5.2	32.0	42.3	3.91
IVR system could be time-consuming as farmers have to wait in the queue when all extension agents are busy online	33.0	21.6	18.6	18.6	5.2	2.47
Farmers calls can easily be forwarded to a subject matter specialist to meet his or her needs via the IVR system	51.5	43.3	1.0	3.1	1.0	4.41

Grand mean: 3.70. Source: Field Survey, 2021

IVR service providers

Table 3 highlights that Airtel Networks Limited (1.60) and MTN (1.54) emerged as the leading internet service providers for IVR services, likely due to their

extensive coverage compared to other providers. In contrast, Orange Telecom and Vodacom ranked among the least utilised internet service providers for IVR services in Lagos State.

Table 3: Service providers of IVR

Service providers	Always	Sometime	Never	Mean
Airtel	61(62.9%)	31 (32.0%)	5 (5.2%)	1.60
Vodacom	9 (9.3%)	9 (9.3%)	79 (82.4%)	0.28
MTN	62 (63.9%)	22 (22.7%)	23 (13.4%)	1.54
9 Mobile	23 (23.7%)	25 (25.8%)	49 (80.05%)	0.73
Orange Telecom	1 (10%)	4 (4:1%)	92 (94.8%)	0.06

Source: Field survey, 2021

Perceived benefits of IVR among extension personnel

Table 4 illustrates the perceived benefits of IVR among respondents, with timely access to extension services ($\bar{x} = 1.79$) ranking highest, followed closely by quick feedback on advisory services ($\bar{x} = 1.74$). This suggests that IVR facilitates informed decision-making for farmers and enables efficient communication between extension agents and farmers (Anteneha and Melak, 2024). Additionally, perceived benefits included improved extension worker/farmer relationships ($\bar{x} = 1.73$), effective time management ($\bar{x} = 1.72$), and enhanced marketability of farmers' produce ($\bar{x} = 1.71$), highlighting the multifaceted advantages of IVR in agricultural extension services. Generally, the totality of the results of perceived benefits suggests a substantial willingness among extension agents to utilise IVR for improved service delivery, given its potential benefits in overcoming resource limitations and enhancing communication with farmers (Dione *et al.*, 2021).

Table 4: Distribution by perceived benefits of IVR among extension personnel

Benefits	Large extent	Little extent	Not a benefit	Mean	
IVR can facilitate access to timely extension services	81.4	16.5	2.1	1.79	1st
Quick feedback from farmers on advisory services rendered	73.2	19.6	3.1	1.74	2nd
Improves extension worker/farmer relationship	77.2	18.6	4.2	1.73	3rd
Effective in time management	72.2	27.8	0	1.72	4th
IVR can enhance the marketability of farmers' produce	74.2	22.7	3.1	1.71	5th
IVR help buyers access available farm product	73.2	20.6	6.2	1.67	6th
Increases efficiency among extension personnel	73.2	18.6	8.2	1.65	7th
Reduces operational cost of extension service delivery	68.0	27.8	4.2	1.64	8th
Increases customer satisfaction	68.0	37.8	4.2	1.64	8th
Increases professionalism	68.0	22.7	9.3	1.59	10th

Source: Field survey, 2021

Perceived constraints to use of IVR for extension service delivery

Table 5 highlights the likely constraints to IVR use in extension service delivery by extension agents. High abandonment rates ($\bar{x} = 1.15$) and cumbersome IVR menu navigation ($\bar{x} = 1.03$) ranked highest. Other prominent constraints included the absence of IVR provision at the office ($\bar{x} = 0.98$) and technical difficulties in setup ($\bar{x} = 0.91$). Conversely, factors like lack of trust ($\bar{x} = 0.62$), scheduling adaptability ($\bar{x} = 0.62$), external distractions ($\bar{x} = 0.80$), and inconsistency ($\bar{x} = 0.82$) were ranked least impactful. Addressing issues related to IVR navigation and technical complexities is crucial for enhancing IVR's effectiveness in extension service delivery, considering the recognized gap between ICT challenges and effective extension services (FAO and ITU, 2022).

Table 5: Distribution of respondents by perceived constraints to use of IVR among extension agent

Constraints	Severe	Mild	Not a constraint	Mean	Rank
High abandonment rates (farmers dropping out of customer service rather than self-servicing or waiting to be put through to a human agent)	41.2	33.0	25.8	1.15	1st
Navigating an IVR menu is sometimes cumbersome when you have many data	35.1	33.0	32.0	1.03	2nd
No provision is made for IVR at the office	29.9	38.1	32.0	0.98	3rd
Technical difficulty/complexity in setting up IVR	25.8	39.2	35.1	0.91	4th
No facial expressions	24.7	40.2	35.1	0.90	5th
Illiterate or semiliterate characteristic of most farmers	25.8	37.1	37.1	0.89	6th
Telephony nature of IVR can be costly	27.8	26.8	45.4	0.82	7th
Lack of consistency	21.6	37.1	41.2	0.80	8th
External distractions	22.7	35.1	42.3	0.80	8th
Schedules of work are not adaptable to IVR use	15.5	30.9	53.6	0.62	10th
Lack of trust in message	15.5	30.9	53.6	0.62	10th

Source: Field survey, 2021

Proclivity to Use of IVR for Extension service delivery among extension personnel

The findings presented in Table 6 indicate a strong inclination among respondents towards utilising IVR for various agricultural extension purposes. The majority (91.8%) expressed readiness to employ IVR for disseminating information on best agricultural practices, including fertilizer application and pest management, to a large audience simultaneously. Similarly, 91.8% expressed willingness to utilise IVR for delivering information on credit sources and agricultural inputs. Moreover, a notable proportion (86.6%) expressed their intent to use IVR for offering farm and business advisory services to farmers and rural communities, while 81.4% indicated their readiness to utilise IVR for human resource development through training services for farmers. These results underscore the potential of IVR technology in enhancing agricultural extension services and empowering rural communities with valuable information and resources (Dione et al., 2021).

The survey findings revealed that majority of respondents expressed their willingness to utilise IVR for various agricultural extension services. Specifically, 79.4% were inclined to use IVR for disseminating information on seed varieties and treatments, while 76.3% showed readiness to employ IVR for providing production and market support services to farmers. Additionally, 75.3% expressed their willingness to utilise IVR for offering information and communication support services on weather and climate change, as well as enhancing linkages between farmers and researchers. These results underscore the potential of IVR technology to address key challenges in agricultural extension and advisory services, as noted by Dione et al. (2021) in their study on extension agents in Uganda.

Table 6: Distribution of respondents by proclivity to use IVR for extension service delivery among extension personnel

Extension Services	Willing	Not willing	Rank
Information on best agricultural practices such as fertilizer application, weed, pest and disease management, can be passed across many farmers at the same time using IVR; Are you willing to use IVR for this?	89 (91.8)	8 (8.2)	1st
How willing are you to deliver information on sources of credits and inputs via IVR?	89 (91.8)	8 (8.2)	1st
Farmer to farmer link can be established by extension agent using IVR. Are you willing to create this using IVR?	61 (62.9)	36 (37.1)	2nd
Farm and business advisory services can be provided to farmers and the rural populace using IVR; how willing are you to use the IVR for this?	84 (86.6)	13 (13.4)	3rd
Are you willing to use IVR for human resource development by providing training services to farmers using it?	79 (81.4)	18 (18.6)	4th

Extension Services	Willing	Not willing	Rank
Are you willing to provide information on seed varieties and seed treatments to farmers using IVR?	77 (79.4)	20 (20.6)	5th
Production and market support services can be provided to farmers using IVR; how willing are you to use IVR for this?	74 (76.3)	23(23.7)	6th
Will you be willing to provide information and communication support services on weather and climate change to farmers using IVR?	73 (75.3)	24(24.7)	7th
With IVR, farmers can be linked with research or subject matter specialist; Are you willing to use IVR for this?	73 (75.3)	24(24.7)	7th
Are you willing to deliver information on government-related announcements via IVR?	73 (75.3)	24 (24.7)	7th
IVR can be used to disseminate information to farmers on better livestock control; will you be willing to do this using it?	69 (71.1)	28(28.9)	11th
Information about farmers' health can be provided using IVR; how willing are you to deliver this information using IVR?	67 (69.1)	30 (30.9)	12th
IVR can be integrated with other digital tools for optimum performance of extension service; will you be willing to integrate this tool for extension service delivery?	61 (62.9)	36 (37.1)	13th

Source: Field Survey, 2021

Relationship between respondents' perception of IVR and proclivity to use IVR for extension delivery

Table 7 reveals that there was a significant correlation (r = 0.424, p ≤ 0.05) between respondents' perception of IVR and their proclivity to use it for extension service delivery. This implies that as extension personnel hold a more positive view of IVR, their likelihood of utilising it for extension services increases. This is in tandem with Ajayi, Alabi, and Akinsola (2013), who found a similar relationship between perception of ICT tools and their utilisation for extension services among agents in Ondo state. However, there was a significant negative correlation (r= -0.278, p ≤ 0.05) between respondents' perceived constraints to IVR usage and their proclivity to utilise it for extension service delivery. This indicates that as extension agents encounter more constraints, their proclivity to use IVR diminishes. This aligns with Ojo *et al.*, (2024) in the study that investigated the constraints limiting the effectiveness of extension agents in disseminating climate-smart agricultural practices among rice farmers in north-Central Nigeria.

Table 7: Relationship between respondents' perception of IVR, perceived constraints and proclivity to use IVR for extension service delivery

	r	p	Decision
Perception vs. proclivity to use IVR delivery	0.424	0.000	Significant
Constraints and Proclivity to use IVR	0.006-	0.278	Significant

Source: Field survey, 2021

CONCLUSIONS AND RECOMMENDATIONS

The research revealed a positive and high proclivity among extension personnel in Lagos state to utilise IVR for delivering extension services. However, challenges such as high abandonment rates, data processing complexity, lack of office provisions for IVR, and technical difficulties were identified as impediments to its effective implementation. The study recommends training and retraining exercise for extension agents in Lagos state on the use of IVR to address technical complexity and ensure practical implementation. Additionally, the government should facilitate internet access for extension workers and supply necessary IVR tools like phones.

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