ADVANCEMENT OF ICT IN AGRICULTURAL EXTENSION PRACTICE

Reality of Integration in Nigerian Public Extension Services

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ABSTRACT

ICT in agriculture has greatly made agricultural extension services more responsive to the needs of rural farmers not only in the developed but also in developing countries. A desk review of ICT usage in extension service delivery in some of the developing countries showed revolutionary applications of the technology for the development of specialised agro-based information hubs, namely, aAUQA) Lifeline; e-Sagu (e-cultivation); VERCON; AppLab; AFRRIand video integration; for fast-tracking extension service delivery to rural farmers. Similarly, the integration of ICT platforms such as *HelloTractor, FarmCrowdy, Agrikore, ProbitFarms, e-wallet, Releaf.NG, Compare-The-Market*, in the Nigerian agricultural system for the provision of agro-based information and support services for improved productivity. However, the ICT-based support services in the Nigerian context largely served the modern farmers or the Agripreneurs who have what it takes patronise the services of the ICT-based agro-service providers largely because of the ICT-Tech services are provided by private agro-agencies with the primary purpose of profit-making. Patronage of the ICT-based agro-services by the rural farmers, however, remains daunting as the farmers lacked resources such as android phones and internet services to patronise most of the ICT-based agro-services, with exception of e-wallet service which is run by the Federal Government of Nigeria and made compatible with the simple mobile phones. Consequently, the need for a strong partnership between the private ICT-based agro-supporting agencies and the public extension agencies is emphasised for enhanced and prompt responsive extension services to rural farmers.

Keywords: ICT, extension service delivery, innovative ICT applications, ICT appropriation, developing countries, and reality of Nigeria's situation

INTRODUCTION

Agricultural extension plays significant roles in agricultural development through the provision of technical information and/or worthwhile technologies to the farmers for application in their context and farming situation. Appropriate implementation of the dispensed

information or technology by farmers often results in improved production performance and their socioeconomic status. Highlighting the impact of extension services on-farm production among the Ethiopian farmers, Dercon et al. (2008) indicated that access to extension visit by the farmers reduced their headcount poverty by 9.8% and increases consumption growth by 7.1%. In the same vein, extension intervention on drought vulnerability of the Mabote farmers in Mozambique brought about increased productivity and quality farm produce (bigger maize spikes, fuller and heavier millet spikes, and higher number and fuller groundnut pods) to the farmers (Tomo, 2010). On this account, agricultural extension service, as posited by Jones and Garforth (1998), remains a significant social innovation that is crucial to enlarging and improving the abilities of farm people to adopt more appropriate and often new practices and be able to adjust to changing conditions and societal needs. Consequently, most countries have geared a lot of effort toward strengthening their extension service provision to farmers. One of the ways by extension delivery is being enhanced in today's world is by the integration of Information and Communication Technology (ICT) in the extension service redelivery. Anoj Chhetri (2016) has reported that farmers in Nepal using AgICT in Farming activities have increased 5.91 per cent of their farm productivity.

ICT, as described by the World Bank (2011), refers to any device, tool or application that permits the exchange or collection of data through interaction and transmission. It entails electronic devices by which the gathering, deposition, processing, retrieval, display, dissemination, and exchange of information can be facilitated (Lawal-Adebowale, 2009). Specific examples in this regard ranged from simple ICT such as radio, television, video and audio recorder/player, telephone, and camera; to complex devices as computer, internet, telex/fax, Geographic Position System (GPS), Geographic Information System (GIS), remote sensing and satellite. Based on the utility and dynamics with which ICT functions, the information, and communication driven technologies have had wide applications for data collection and management, as it were in core agricultural research, and for information dissemination and exchange, as it were in extension service delivery, not only in the developed countries but also in the developing countries. According to Saravanan (2010), integration of ICT in agriculture has proven to be an impetus to extension service delivery;complementing the traditional extension system for knowledge resource delivery to the small and marginal farmers such that they become empowered with right information at the right time for improved and efficient production. In the light of this, the question that readily comes to mind includes: what specific ICT devices have found application in extension service delivery in the developing countries? In what dimensions has the ICT device been applied for extension service

delivery in the developing countries? What impact has the integration of ICT had on extension service delivery of the developing countries? What is the status of ICT in extension service delivery in Nigeria? What lessons could Nigeria's agricultural system learn from the experience of selected developing countries? Answers to these questions are reflected in this manuscript.

METHODOLOGY

This paper was developed to establish the status of ICT integration in the Nigerian agricultural extension services in comparison to that of other countries of Asia and sub-Saharan Africa. To accomplish this task, a qualitative research approach was adopted for quality ICT-based information generation and a narrative explanation of the gathered information about each of the raised questions as an issue for research. Specific steps in this regard were an extensive review of printed and online publications on ICT usage in extension service delivery in developing countries and Nigeria; field observation of ICT application in the Nigerian agricultural system; interaction with extension personnel and other stakeholders in the Nigerian agricultural system on ICT usage in agriculture.This research approach is drawn from qualitative research approaches such as field observation/diary study, cultural probe, Experience Sampling Method, and Mobile User Experience. The mobile phones/communication technology and field observation/diary study were used to capture environmental features of the study domains, such as type of ICT in use, internet network services, and available tele-centers. The Experience Sampling Method and Mobile User Experience, on the other hand, were used to retrieve information on the current use of ICT in the Nigerian agricultural system from stakeholders in Nigeria's agricultural system.

RESULT AND DISCUSSION

Field observations and desk review of publications on ICT integration in agricultural extension practice show a great deal of success in several developing countries, with outstanding experiences in India, Bangladesh, Egypt, Uganda, Tanzania, Ghana, Mali, and Malawi, etc. Commonly deployed ICT in extension service delivery as highlighted in this paper are mobile phones, internet, digital camera, radio broadcast, video integration; and the applications for agricultural extension practice have taken different dimensions as highlighted below:

almost All Questions Answered (aAUQA): is an internet-based question and answer query system that functions as a multilingual, multimedia agricultural portal for disseminating information to the grassroots or rural farmers in the Indian agricultural community (Ramamritham et al, 2005). The package is characterised by agro-information in the form of text,

images, audio, video, and animation. With this electronic communication technology, individual farmers with internet access, either personally or at telecenters, could post and access related agricultural questions and answers (Toyama, 2011). In addition to this, the system package allows community members (a group of users) to create their content, though with the assistance of the telecenter or kiosk operators, such that members become empowered to be active content creators beyond being a passive user (Saravanan, 2010). As indicated by Ramamritham et al (2005), aAQUA provides a communication framework for rural users to get their problems solved. Solutions are shared by a larger community and are provided by either person(s) having similar experiences or by an agricultural expert(s).

Lifelines: This is an information exchange system that mainly depends on the telephony (fixed or mobile phone) application (Toyama, 2011). In this wise, farmers could call in by phones to lay their bare queries on related agriculture issues, such as pest management, weather information, inter-cropping, handling drought, irrigation methods, crop diseases, and cycle, for a solution. According to Saravanan (2010), the call at first reaches the Interactive Voice Response System (IVRS)where the query is registered by a voice menu and stored as a voice clip in the database server. The calls or queries are later retrieved through a web interface by an agricultural resource person who then logs in the raised question(s) to the database for an answer(s) to source for solution. With this, the caller is then text-messaged the number to dial for the answer. Where the answer is not immediately available, a resource person or an expert is consulted for the raised question(s) after which the technical information by the expert as the answer is entered into the database. Through this process, the database is developed with more questions and answers for further use. According to Saravanan and Bhattacharjee (2014), the Lifelines platform aims to provide grassroots communities with access to wide information and knowledge pool, content, and capabilitythrough aphone-basedservice.

e-Sagu (e-cultivation): is an ICT-based personalized agro-advisory system by which agricultural experts' advice is timely delivered to individual farmers. According to Reddy (2006), the e-Sagu aims to improve farm productivity by delivering high quality personalised (farm-specific) agro-expert advice promptly to each farm, and are extended to improve the performance of agricultural extension workers. As indicated by Saravanan (2010); Toyama (2011), a field coordinator who is well associated with a group of farmers, and with the experience of basic data entry skills visits designated farms on weekly basis and take digital photographs of farm conditions - crop status, soil condition, water resources and collect other vital information on pest-resistant, water requirement, weather situation, etc, for onward transmission, in the form

of text and photographs, to agro-scientists for diagnoses. Generated solutions and recommendations are explained to the concerned farmers or printed out for them by the e-Sagu coordinator. With this process, the coordinator, who could be an agricultural expert with a diverse background in agronomic practices or educated and experienced farmers, can build a database of the farming environment of his catchment area in a computer system and the skills to providing farm-specific advice. According to Ramaraju and Reddy (2009), this development provided the farmers' proactive advice at regular intervals, right from the pre-planting operations to the post-harvest handling or precautions.

Virtual extension and research communication network (VERCON): is an interconnectivity-based ICT established by the Egyptian Government, with the support of FAO's Technical Cooperation Programme (TCP). The project aims at addressing the particular needs of small-scale Egyptian farmers through the exchange of information between agricultural research and extension, and indirectly the farmers themselves. The inter-linkage technology, which emphasises the integration of the human and technology for agricultural development, connects geographically dispersed people, facilitates two-way communication, manages large volumes of data, and rapidly collects, process and disseminates information in a variety of forms. As indicated by FAO (n.d.), VERCON is accessed either through the Internet, or a combination of CD-ROM and Internet, depending on specific situations (e.g, the reliability of the Internet connection). The Internet's multi-media capabilities facilitate the development, sharing, storage, retrieval and dissemination of a range of information and support communication in forms of e-mail, discussion lists, chat forums, etc. These capabilities allow network members to inform each other and engage in two-way horizontal communication to address problems, discuss solutions and coordinate local, regional and national agricultural activities.

AppLab: is a telephone-based application put in place by Grameen Foundation to help the poor break the cycle of poverty through accessibility and utilisation of life-changing information. As indicated by Grameen Foundation (2012) AppLab integration in Ugandan agriculture provides the rural farmers accurate, timely and relevant information for best agricultural practices and improvement of their living conditions. This telephony-based solution application, built with the support of agricultural research organisations and other experts, and intermittently reviewed by an Expert Review Board for regular update, contains more than 35,000 real-time tips on 35 crops, 7 livestock animals, weather, market prices, transport directories, input locations, and mobile-money agent locations as database from which the farmers are served with the needed information. Such information is text-messaged to the farmer in

question through the mobile phone by the Community Knowledge Worker (CKW). The resultant effect of the AppLab application is that farmers are empowered to make important decisions and improve their practices, thereby enabling them to increase their yields and earnings.

Farm Radio initiative: refers to a radio broadcast that is specifically designed for meeting the needs of the farm families through the broadcast of agricultural and other rural issues. Although radio has been an excellent medium of information communication to a wider range of people, it has the limitation of interaction between the presenters and listeners not on till the revolution of modern ICTs such as internet and mobile phones which have certainly remove this shortcoming of radio broadcast. With the integration of the modern ICTs in a radio broadcast, the provision has created a platform for extension message delivery efficiently and cost-effectively. Experience in this regard is the African Farm Radio Research Initiative (AFRRI) and Farm Radio International (FRI) partnership with 25 radio stations in five African countries, namely Tanzania, Uganda, Mali, Ghana, and Malawi, for enhanced farm radio programming (FRI, 2011). The initiative supported by Bill and Melinda Gate Foundation provided the radio stations with ICT such as desktop and internet access, portable digital recording and editing equipment, wireless networks, call-in and call-out facilities, and satellite terminals. With this application, agricultural broadcast not only become timely and far-reaching (in terms of number people per unit area) but also accurate and demand-driven broadcasters or presenters can search for the right agro-information from the internet, record information from the farmers on the field for playback and connect a resource person for live presentation of issues via the phone. Also, farmers could call-in for participation in a live programme and shape the on-air discussion. This pattern goes for television broadcasts as well. Binita Rani (2016) reported that there is a remarkable impact of Radio in empowering farm women. On listening talks on Radio, 55 women at Borh Local Area of Patna-Bihar in India started Oyster Mushroom production at the surroundings of their hut and enhanced their livelihoods by selling surplus Mushroom.

Video integration: video is an electronic device that allows for recording of field events and with the aid of editing suite, the recorded events are packaged into a viewing format. With this, the video could be played back for educational or training purposes. An initiative on the use of video as an information dissemination tool by the Digital Green is the production of agro-based video whereby the one-to-one extension teaching of the farmers and the farmers' actual demonstration of the learned agricultural practice are recorded and later on packaged for viewing (Toyama, 2011). In the same vein, Agro-insight, in conjunction with the Global Forum for Rural Advisory Services (GFRAS), the Sustainable Agricultural Initiative

(SAI) and the Sweden Agency for Development and Cooperation (SADC), shows that video production constitutes a useful training tool for farmers who watch the documented agricultural programme over time for better understanding and application in their farms. This becomes more effective when packaged in the farmers' local language (Agro-Insight, 2011). An assessment of the impact of video training on women farmers in Bangladesh shows that more than 70% of them that had to watch the video improved their seed drying for better shelf live, 91% gained the knowledge of how to expel air from their storage with no observable change in the control villages (van Mele et al., 2007). Besides, video-mediated training stimulates reciprocal sharing of new knowledge and skills within groups of farmers and service providers.

ICT status and applications in the Nigerian agricultural extension practice

Based on the revolution of the telecommunication sector in Nigeria, the country's agricultural system has had the opportunity of harnessing the emerging ICT for fast-tracking agricultural practices and agro-information management. Commonly deployed ICT for agricultural extension service delivery in the country largely include radio and television broadcast, video and audio recorder/player, telephone, camera and to some extent, internet (Apantaku and Lawal-Adebowale, 2009). However, the value of ICT is not in the technology's complexities or simplicity but its appropriation for effective utilisation and application for the socio-economic benefits of the end-users. With this, field interaction with extension personnel in this regard reveals that ICT in extension service delivery takes the pattern. LAWAL- Adebowale (2015) found that application of mobile phones, laptops, and multimedia projectors combine enhanced quality time usage in reaching out stakeholders in agriculture, reduced the risks of travelling, and enhanced social interactions.

Radio and television broadcast: Radio and television constitute an age-long traditional ICT in the Nigerian agricultural system and as such are largely deployed for extension message delivery to the rural farmers. For instance, on the Nigerian radio and television stations, especially the government-owned media broadcasting stations, are agricultural programmes run by the State Agricultural Extension Agencies, commonly referred to as Agricultural Development Programmes (ADPs), across the country. According to Lawal-Adebowale (2009), the public extension agencies aired extension programmes such as *Agbelere* (farming is profitable), *Agbeafo'kosoro*(crop farming), *Agbeeleranosin* (Livestock farming) on Ogun State-owned radio and television stations weekly. In the vein extension programmes such as *Boluyo* (Feed the nation),*Agbeloba* (Farmer is king) and *Ejekaroko* (let's go farming) on Oyo State-owned

radio and television stations. On Radio Benueare extension programmes such as *Tom Sule* (profitable farming) and *EkoliHeho* (farming world) (Okwu et al., 2007). These extension programmes generally run for 15 minutes and 30 minutes on radio and television stations respectively across the states. Studies on farmers' accessibility to these extension programmes showed that they readily accessed programmes from the radio broadcast based on the wide availability of transistor radio to the farmers. Studies (Adeniji and Ega, 2006; Omoregbee, 2011) on the impacts of these extension programmes showed that the programmes are beneficial to the farmers in the terms of having access to information with which they guide their farm enterprise production and as such have their productivity improved.

Video integration: an alternative to the rare cases of agricultural programmes on television broadcast is the integration of video packages for extension message delivery to the rural farmers in Nigeria. Interaction with the public extension personnel reveals that the use of video production for relaying extension messages to the rural farmers in their respective catchment areas has become an integral part of their strategies for service delivery. This task is conscientiously enhanced by the information repository units of the extension agencies which have made it a point of duty to develop video documentaries on ways and methods to efficiently manage and improve and increase farm enterprise production. Examination of some of the developed video packages on playback includes instructional education on fish production, with emphasis on use of earthen and concrete ponds; honey production from bee culturing; small ruminant and poultry production/disease management; improved postharvest handling of crops such as cassava for commercial *fufu* production; dry season vegetable farming/production. Further interactions with extension personnel reveal that the video production is often showcased to the farmers at the village square or community centers at a pre-determined date, though within the regular visiting periods to the farmers. In addition, the videos are purported to have significantly impacted on enhanced knowledge and productivity of the farmers concerning a particular farm enterprise.

Mobile telephony in extension service delivery: with the rural penetration of the mobile phone communication network, the device had proven to be a worthwhile means of communication between the farmers and extension personnel such that farmers' information needs are readily provided by the extension personnel without having to travel between the rural farm and the urban desk of the extension personnel. The launch of the Agricultural Transformation Agenda (ATA) is the introduction of e-wallet service with which farmers could be readily mobilised for direct access to provided agro-inputs by the public extension agencies. With the e-wallet,

all the interested farmers in the ATA programme had their phone numbers registered under the Agricultural Growth Enhancement Scheme (AGES) for creation of the farmers database and based on the demand of a farmer for any agro-inputs provided by the scheme, such a farmer is text messaged on when and where to collect the inputs.

Internet-based extension service delivery: Unlike the recorded experiences of e-sagu, aAQUA and VERCON as observed in India and Egypt, Nigeria's public extension agencies are yet to develop similar specialised internet-based information hub for agricultural development in the country. The extension personnel, and of course all other stakeholders in agriculture, have largely been using the internet in its general sense of global information repository. That is, extension personnel and stakeholders in agricultural development mainly surf the net for useful information on agricultural practice with which to guide farmers' on-farm enterprise production or guide research development by the agricultural researchers.

ICT-based agro-support services in Nigeria: Alternation to the public extension system

Against the basic application of ICT by the extension agencies in Nigeria is the emergence of internet-based agro-support services by the private agro-agencies in the country. Among these is the *HelloTractor, FarmCrowdy, Agrikor, ProbitFarms, Relief.NG, Compare-The-Market, XtraLargeFarms*, Agrikore, etc. Each of these ICT-based AgriTech platforms provides support services to farmers in the range of tractor hiring to technical guide on-farm enterprise production and management with financial backing. The *HelloTractor* is an online and mobile app access base to tractor hiring and provision services whereby tractor owners and farmers are connected for tractor services. With this, interested farmers access the services of the *HelloTractor* by registering and requesting the needed service with the provision of details of the farm. The service administrator of the *HelloTractor* platform thus responds to the required service(s) by providing information of the day and time that the tractor will unfailingly be available to the farmer for use.

The *XtraLargeFarms, FarmCrowdy, and ProbitFarms* provide technical training and financial support services to farmers using the sourced funds from farm sponsors to support the smallholder farmers and as well guide their marketing of the farm produce to ensure profitability. While the downloading of *FarmCrowdy* App is necessary to access the service, *XtraLargeFarms* and *ProbitFarms* required registration on the internet platform. Besides, the *ProbitFarms* platform provides a crop database, referred to as Farm Doctor, to diagnose and provide responsive information to the logged-in query as an answer to the information

sourcing farmers. The *Redleaf.NG* is an online marketplace service provision that connects buyers and sellers of agribusinesses to trustworthy customers to relieve the farmers and agro-produce consumers of the pervading uncertainties in the agricultural sector. With this *Releaf.NG* platform, sellers will have to register and indicate the farm produce they have to sell and as such are presented with a list of verified buyers to contact for the produce. According to Akinosun (2017), unlike conventional B2B models where sellers post what they sell and wait for buyers, the Releaf.NG platform allows sellers to bid for active buyer contracts with chances of ensuring a 90% response rate from clients.

The *Compare-The-Market* platform is an internet-based platform designed to facilitate comparison of daily prices of food crops and animals by both farmers and buyers in Nigeria. In light of this, the platform provides up-to-date market and daily market prices of farm produce. This achieved by regularly tracking the local food markets and have the site updated daily with both retail and wholesale prices. This service provided the farmers with the opportunity to price their goods competitively. The ***Agrikore,*** **which is a mobile phone-enabled agro-support platform, provides technical guidance on how farmers could** access quality agro-inputs, productivity-enhancing technologies, financial services, and markets for their produce.

CONCLUSION

Given the emerging ICT and its integration in agriculture on a global scale, different countries are fast catching up with the potentials of information-driven technology for the development of their agriculture and enhancement in extension service delivery. Although, the private ICT-based agro-supporting agencies are driving Nigerian agriculture through the internet and mobile app platforms, the design, and services largely target the modern farmers and/or Agripreneurs who have the means to afford android phones and internet services. The public extension agencies in the country, which are in the frontline of relating with the rural farmers, has a partnership with the private ICT-based agro-supporting agencies and as such have largely relied on reaching out and interacting with rural farmers through basic ICT such as radio and television broadcast, audio and video recordings and mobile phones. Apart from e-wallet ICT platform which mainly serves the means to ensure direct farmers direct access to government's subsidised seeds and fertilizer, the potentials of the mobile phone have not been exploited for effecting interactive and responsive extension service delivery as observed in the context of the aAQUa, e-Sagu, VERCON, AppLab, and Lifeline. Also, Nigeria is yet to have dedicated radio and/or television stations to agricultural and extension services, similar to AFRRI despite the widespread government and privately-owned radio and television stations

across the country. The existence and operational functions of ICT in Nigeria, however, suggest that the Nigerian public extension system has the potentials to have its service delivery enhanced and be promptly responsive to the needs of rural farmers. To achieve this, it becomes essential for the Nigerian public extension agencies to partner with the emerging and pervading private ICT-based agro-supporting agencies to jointly build local contents and database will readily address the production, management, marketing and financial needs of the rural farmers. This should however be made to be compatible with the use of the simple mobile phone to have the rural farmers integrated in the ICT-based Agro-solution. Alternatively, here is the need for establishment of extension personnel manned-ICT-solution hubs within the reach of the rural farmers. Also, there is a need for dedicated radio and/or television stations or increased periodic slots on the existing privately and government-owned radio and television stations primarily to the course of agriculture and extension service delivery and making such an interactive communication with the rural farmers through the mobile phones.

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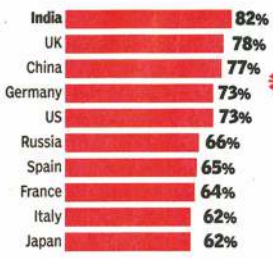
CAN'T LIVE WITHOUT THE INTERNET? ASK INDIANS

The digital revolution has taken the world by storm and everybody is just loving it. So much so that more than **two-thirds of the people in a global survey** say they **cannot imagine** a life **without the internet.** Surprised? It turns out the largest proportion of such respondents was in India, where 82% said it is no life without the worldwide web, behind even the US, where 73% said it's impossible to live without the www...

Where people can't live without the internet

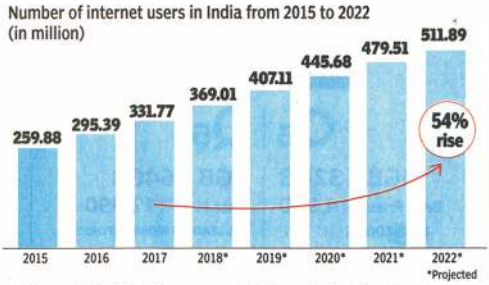
Share of respondents who can't imagine life without the internet



The survey covered 18,180 people in 23 countries

More than 500m Indian internet users by 2022

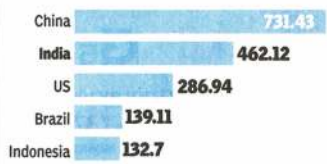
Number of internet users in India from 2015 to 2022 (in million)



- The majority of India's internet users are mobile phone internet users
- They rely on cheap alternatives to expensive landline connections that require desktop PCs and infrastructure
- 323m people accessed internet through mobile phones in 2016, about 24.3% of India's population

India already 2nd largest internet market

Countries with the highest number of internet users (in million)



- Despite large base of internet users, only 26% of Indian population accessed internet in 2015
- But that's a big leap from the internet penetration rate in 2011, which was about 10%
- Men dominate internet usage in India at 71% to women's 29%

SO, WHAT DO INDIANS DO ONLINE?

- Like internet users the world over, Indians too passionate about social media
- By 2021, it is estimated that there will be around 358.2m social network users
- Share of population accessing social networks to jump from around 16.3% in 2016 to over 25%
- India has the largest user base in the world of Facebook, the most popular social networking site in the country
- There were about 195 million Facebook users in India in 2016. Other popular networks include WhatsApp, Google+, and Skype
- Online shopping is also a popular activity. Retail e-commerce sales stood at $16bn in 2016; projected to surpass $45bn in 2021

Source: Statista