

ICT Use in Agricultural Extension Service Delivery: A Case Study of the Edo State
Agricultural Development Program (ESADP), Benin-City, Edo State, Nigeria.

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Dissertation submitted in fulfilment of the academic requirement for the degree

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ABSTRACT

Due to the ever-evolving nature of ICTs, studies have continuously shown that their use plays a very significant role in a country's economic development, and the agricultural sector is not left out. This survey describes perceptions on using ICTs by field-level and office-based agricultural extension workers at the Edo State Agricultural Development Program (ESADP), Benin-City, Edo state, Nigeria. This research investigates the awareness, roles, benefits and challenges of using ICTs among office-based and field-level agricultural extension personnel employed by the ESADP. An online questionnaire was pre-tested and released to the target group using Survey Monkey. Responses were digitized, and descriptive analysis was used to identify patterns in the data. The target group was a non-random purposive target of 100 extension staff meeting the criteria of access to and utilization ICTs in their line of work. Ninety-five of those responded. The results indicated that most (98%) of field-level and (94%) office-based respondents were aware of using ICTs for agricultural extension service delivery. Ease of use and access to timely and accurate information were the main reasons why extension workers use ICTs. However, the study observed that the challenges encountered were erratic power supply, delayed response from the service providers, and discrepancies between the desire to use and the provision/maintenance of the resources needed for access. Based on the findings from this study, a need to fill the gap between the desire to use ICT devices and accessibility gave rise to the following recommendations: that more agricultural extension workers be recruited and trained to balance the farmer:extension worker ratio and to address the technological gap that currently exist in the system, that best practice is to provide an enabling environment that will encourage and support software licensing, provide suitable hardware, and that infrastructural development should also be given immediate attention in order to alleviate the issue of poor services rendered to the people.

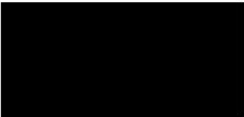
Keywords: Information and communication technologies (ICTs), Agricultural extension service delivery, Agricultural Development Program (ADP).

DECLARATION OF ORIGINALITY

I Courage Efeomo Uahomo hereby declare that:

1. The entirety of the work contained in this dissertation is my original work, except where otherwise stated.
2. The dissertation or any part of it has not been submitted for any degree or examination at another university.
3. Where other sources have been used, they have not been copied and are properly acknowledged.
4. This dissertation does not contain text, graphics or tables copied and pasted from any source unless specifically acknowledged detail provided.

This dissertation was written between April 2020 and September 2022 using survey data that was collected from an online survey questionnaire. It was originally planned as face to face interviews, but online became the best option during the Covid-19 Pandemic.

Signed:  Date: 25/07/2022

Courage Efeomo Uahomo (Masters Candidate)

As the supervisor for this candidate, I agree to the submission of this dissertation.

Signed:  Date: 03/10/2022

Dr. K. Caister

DEDICATION

This thesis is dedicated to Deaconess (Mrs.) Philomena Izebe Izuyon (Nee Osamaye Okpeku), my maternal grandmother for her unending love and support.

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ABBREVIATIONS

ICTs – Information and communication technology.

ESADP – Edo state Agricultural Development Program.

AE – Agricultural extension.

PA – Precision agriculture.

LGAs – Local Government Areas of origin.

IS – Information system.

MRP – Maximum retail price.

MPAs – Mobile phone applications.

RRIN – Rubber research institute of Nigeria

NIFOR – Nigeria institute for oil palm research.

GDP – Gross domestic products.

FSC – Farmers service centres.

T&V – Training and visit systems.

UAS – Unmanned aviation systems.

AI – Artificial intelligence.

SSCM – Site specific crop management.

NAERLS - National Agricultural Extension and Research Linkage System

SMSE - Small/Medium scale enterprises.

CHAPTER 1 The Problem, Setting and Design

Information Communication Technology (ICT) has intervened in all spheres of human endeavour. As the new form of literacy, very soon, anyone who cannot use such devices will be considered illiterate. In Nigeria, digital information and communication technologies (ICTs) are considered a recent phenomenon. Ever improving, the sector has moved from analogue such as telegrams and telephones in the Colonial era (c.1886-1960s) to digital in the 1970s when the first international satellite telecommunication gateway was established (Olaoluwa, 2019). In 1992, the Nigerian Communications Commission (NCC) deregulated the telecommunication sector. This provided space for liberalization, competition and private sector participation (Chidozie, et al., 2015). In 2001, Airtel, under the original name of Econet, launched the first Mobile Telephone Network (MTN) (Chidozie, et al., 2015). By 2022, Nigeria had 51% of her population able to access the internet (Kemp, 2022).

The paradigm shift toward ICT use has occurred in Agriculture (Agholor, et al., 2021). For example, Resing (2007) reported that the IT revolution had brought mobile phone/apps and internet services into the hands of Australian dairy farmers, who routinely assessed their use in precision agriculture. The paradigm shift can help the agricultural extension personnel solve location-specific barriers to agricultural development, such as improving access to agricultural information, connecting the markets, reducing waste and saving time (Nyarko and Kozári, 2021). The scope for collecting, analysing and using digital information cuts across multiple fields affecting the distribution and production of fibre, fuel and food in relation to scarce resources (FAO, 2017).

For the extension professional, the use of ICT devices aids in gathering information on different issues in the agricultural sector such as crop and animal science, input management, improving market efficiency/effectiveness, minimizing waste and analyzing pollution-related issues (Kansiime, et al., 2019). Studies by the World Bank (2011) showed that at a personal level, using ICTs in agricultural extension service delivery has helped reduce individual travel costs to different locations and markets to collect data and other opportunity costs, such as saving time and travel-related emergencies (World Bank, 2011).

1.1 Background of the study

Although about 23% of sub-Saharan Africa's Gross Domestic Product (GDP) comes from agriculture and more than 60% of the population, there are smallholder farmers, Africa's full

agricultural potential is still unrealized (Goedde, et al., 2019). The use however, of ICTs, has been shown to offer opportunities for economic growth and poverty alleviation (Ayim, et al., 2022; Chavula, 2014).

With regard to extension services in developing countries like Tanzania, Mtega and Msungu, (2013) found that the issues of accessibility and usability have been a concern to the extent to which the use of ICTs was helping to transform agricultural production and agribusiness. Koyenikan and Ohiomoba, (2021) found that in Edo State mobile phone applications (MPAs), among other ICTs, were helpful tools for improving the performance of field-level workers by making it easier for them to collect and disseminate information used to deal with acclimatizing and alleviating the effects of climate change. Sennuga and Fadiji (2020) found that accessibility significantly influenced the use of ICT devices by 204 village extension agents (VEAs) in North Eastern Nigeria.

Less encouraging is the research by (Yekinni, et al., 2019). They reported low benefits derived from the use of ICTs among 230 rural farmers in Northeast Nigeria. Barriers were identified as the high cost of maintenance of devices, high call tariffs and language barriers. Researched recommendations to the Ministry of Agriculture, Nigeria, pointed out barriers to the use of ICT including the need for improved ICT infrastructure in their establishments to improve the access to e-resource by staff (Uddin, et al., 2019). At this point in time, lack of infrastructure facilities, poor connectivity, low technical knowhow and power supply were major constraints (Uddin, et al., 2019). The researched findings of accessibility and usability raise concern about the extent to which the use of ICTs is helping to transform agricultural extension service delivery in development contexts.

The use of ICTs in agricultural extension service delivery is not a remedy for all agricultural problems. Even though these factors for change and progress are valued and viable, the use of information and communication technology (ICT) in agricultural extension service delivery has many obstacles. If the use of ICTs in agricultural extension is not well integrated and properly coordinated, opportunities that would have led to precision agriculture and the inclusion of rural farmers into the formal economy might become foreclosed (Fu and Akter, 2016). This will make it difficult for agricultural extension service delivery to support commercial farming in the long run.

Few studies have reported on the use of ICT in Extension Service delivery in Edo State. Koyenikan and Ohiomoba (2021) postulated that in Edo State, the effective use of ICT devices such as radio, television, mobile phones, computers and the internet have the potential to transform the agricultural sector. While Uddin et al., (2019) reported constraints within Edo for the use of ICT. However a report by the ESADP (2020) states there has been a marked increase in the use of ICT in agricultural extension in Edo state through the efforts of the ADP. In response to this claim, the use of ICTs in agricultural extension service delivery at the Edo State Agricultural Development Program (ESADP), are investigated to look at the benefits, challenges and perceptions.

1.2 Research question

The survey in this research was driven by the following question. Is the use of ICT in the Edo State Agricultural Development Program (ESADP) transforming the delivery of extension services in Benin City, Edo State, Nigeria? This central question gives rise to the following sub-questions.

1.2.1 How is the use of ICTS influencing agricultural extension service delivery?

1.2.2 What role(s) do the use of ICTs play in agricultural extension service delivery?

1.2.3 What are the benefits/challenges in using ICTs in agricultural extension service delivery and the way forward?

1.3 Importance of the study

This study identifies the location-specific challenges for a paradigm shift to ICT use in agricultural extension in Edo State, Nigeria. The findings add to the documented cases of extension professionals' experiences such as Uddin, et al., (2019) with shifting to ICT use in development contexts such as Benin City, Edo State, Nigeria

1.4 Delimitations

The delimitations for this study include using a case study approach. The impact of this on knowledge is that it is case specific rather than generalisable. Replications to compare this case with other similar contexts are made possible through the trail of evidence provided. As an exploration of reality, the scope did not include in depth probing typical of field research and recommendations for further research around these gaps such as preferred sources of

information for participants. The focus was on the roles played by the use of ICTs, the benefits of using these devices and the challenges encountered from the use of these which will help to suggest a possible way forward.

1.5 Knowledge Production (Methodology)

To understand how the use of ICTs affects the current employees of the ESADP, this investigation used an online survey to collect perceptions from two employee groups; those working with an office focus and those working with a field focus. The respondent group was deliberately invited across all three Agricultural Zones/senatorial districts of Edo State. Data collection focused on three themes: the demographics of the two groups, the use of ICT within the context of their work, and the challenges around the use of and perceptions of the future of ICT in relation to their work. Descriptive statistics were used to present patterns in the data. From this, insight into how ICT is influencing the work they do, the tensions involved in using ICT and perceptions of a way forward could be communicated. The knowledge, therefore, is descriptive and located in the context of a case study and is therefore not generalizable.

1.6 Study assumptions and constraints

Only employees of the ESADP were included in the study and were drawn from all three agricultural zones in Edo State. One hundred employees targeting a mix of 50 office and 50 field personnel were invited to respond. There was a 95% response rate. The selection included only those personnel who had access to an ICT device in the course of discharging their duties, were computer literate and willing to participate in the survey. While the respondent group attracted employees of the ESADP from across Edo State, the results are still not assumed to be representative of all extension service employees. Therefore, it can be assumed that the sample is a purposive non-random volunteer sample for a context-specific descriptive analysis.

Originally, the research design included the option of follow up focus group discussion on topics arising from the survey questionnaire. However, the Covid-19 pandemic restricted travel, trapping the research in South Africa without the capacity to conduct focus group discussion. The questionnaire distributed online therefore, was relied upon as the main data collection tool.

This research assumed that all respondents would be honest in answering the questionnaire and would not withhold any information that could impact the results. It was further assumed that

all participants would reliably remember all issues relevant to the study such as the type of devices used, their roles/functions, and the benefits/challenges encountered while using such devices. However, it is also acknowledged that a known and accepted limitation in survey research lies in a respondent saying they do or have done one thing when in fact they actually have done something else.

A master's investigation is always limited to the maximum semesters allowed to complete and report on an investigation. Unfortunately, the Covid-19 Pandemic restricted movements during the time frame allowed for this study. In line with the national concern to stop the spread of Covid-19 through unnecessary contact, the data collection process was shaped as an online survey questionnaire. Further future engagement with empirical observation relevant to emerging questions could provide additional insight and accuracy

To mitigate the assumptions and limitations of an online questionnaire above, a pilot test of 10 respondents was used to reflect on the readability and response interest. This resulted in minimal adaptations for the questionnaire. It was assumed that in the conversion of the pilot questionnaire from a hard copy to an online version, there was little to no loss in clarity for the respondent.

1.7 Context for study

This study was carried out at the Edo state Agricultural Development Program (ESADP), Benin-City, Edo state, Nigeria. Edo state is divided into three (3) agricultural zones/senatorial district. These are Edo North, Edo South and Edo Central zones Ekpebu, et al., (2013) as shown in Figure 1.1. The Edo North zone is further subdivided into six (6) blocks viz; Akoko Edo, Etsako West, Etsako East, Etsako central, Owan West and Owan East. The Edo South zone is subdivided into eight (8) blocks: Egor, Ikpoba-Okha, Ovia South West, Irrua, Oredo, Ovia North East, Orhionmwon and Uhumwode. The Edo central zone is subdivided into five (5) blocks: Igueben, Esan West, Esan central, Esan North-East and Esan South-East, respectively. These blocks make up Edo state's eighteen (18) Local Government Areas (LGAs). Benin-City is located at GPS coordinates of latitude 6° 20' 17.34" N and longitude 5° 37' 32.70" E (LatLong.net, 2020). The geology of Edo state is generally marked by top reddish-brown sandy laterite and experiences a humid tropical climate which alternates between the wet and dry seasons. Edo state has been described as a great site for agricultural cultivation in the South Western region of Nigeria. Surface and underground water are this region's main sources of

water (Ikhile, 2016). The state was created in 1991 from the then Bendel state and its capital is Benin-City (McKenna, 2018). Agriculture is her mainstay, and subsistence crops such as yams, cassava, potatoes, rice, maize and beans are mainly produced. Cash crops such as rubber, fruit trees such as (cashew, guava, orange and mango), oil palm and timber are also cultivated. Mineral resources such as limestone and lignite also abound in the state. The Rubber Research Institute of Nigeria (RRIN) and the Nigeria Institute for Oil-palm Research (NIFOR) are all located in Edo state (McKenna, 2018).

The first Agricultural Development Program (ADP) was launched in 1972. The goal focused on increasing food production and raising the income generation of small-scale farmers Auta and Dafwang, (2010). By 1984 the programme had expanded nationwide as a result of the success recorded from the pilot schemes in the late 70s. The projects were to be funded under a tripartite agreement involving World Bank 66%, Federal Government 20% and state government 14%. This also included payment of salaries of local staff (Auta and Dafwang, 2010). According to Adegboye (1991), the benefits of the ADPs were to be realized through: A re-coordinated and restored agricultural expansion framework that consolidates extension workers preparing/visiting and guaranteeing a two-way communication among farmers and researchers; A functional farm inputs conveyance framework which works through an organization of Farmer Service Centers (FSC) ensuring that required farm inputs are provided close to the farms; A network of distributors, retailers and marketers who help to purchase farmers' produce as well as to deliver farm input to them. A free ADP board that is deprived of the standard unbending methods and in this manner have manageability to rapidly take the executives choices and stay aware of the requests for idealness in rural activity; A thorough observing and executives framework that gives required administrative data and guarantees that blunders in a single venture are not carried in to another task; Joint - State - Federal obligation both in project planning, execution and course of action which has local agricultural programming fundamentally at a state level.

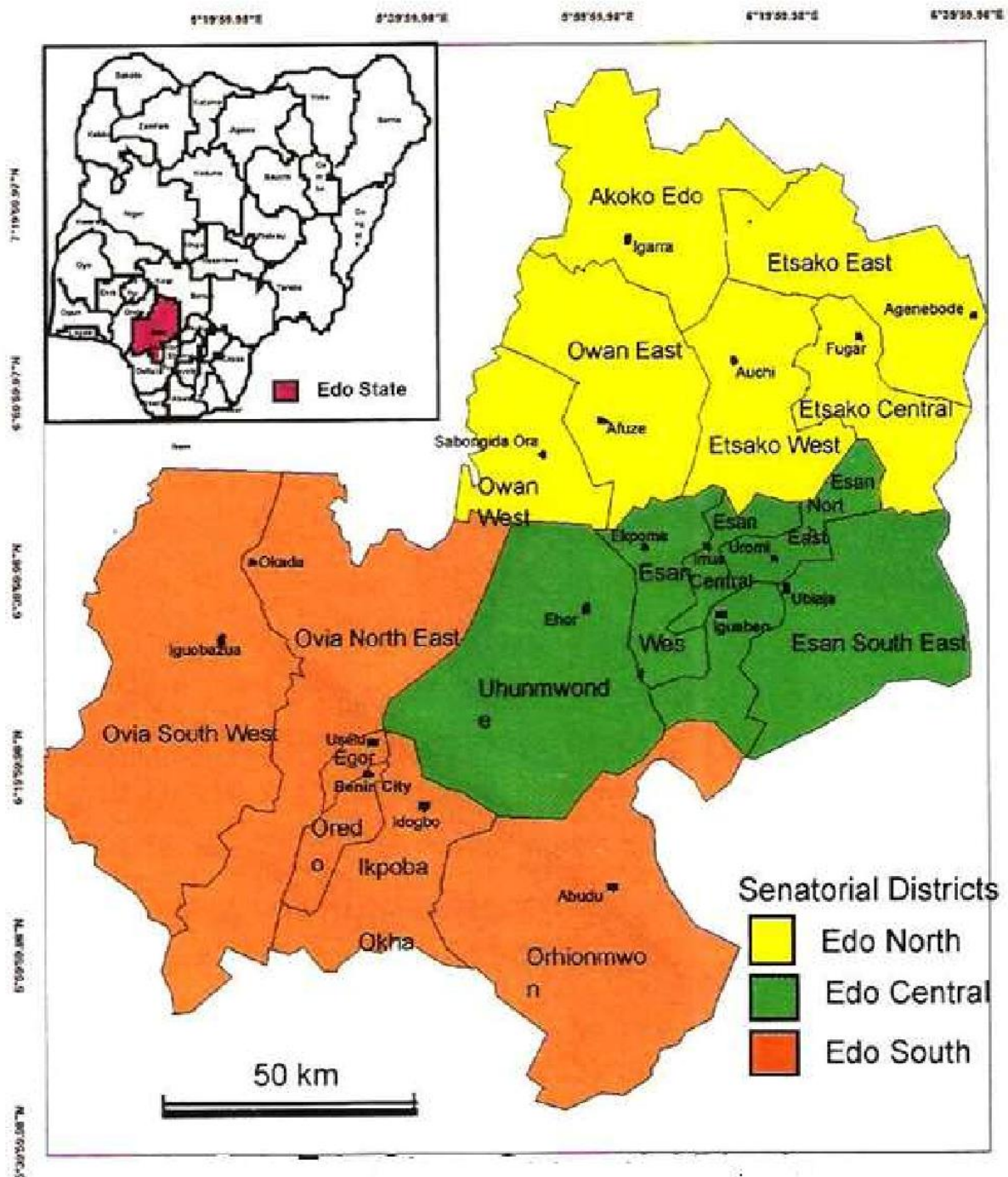


Figure 1.1 Map of Edo State showing the three senatorial zones (Orjiekwe et al., 2014, p.2584).

1.8 Definition of terminology

ICT – refers to the integration of information, devices, networking components, applications and systems that allow people and organizations to interact in a digital world (Techopedia, 2022). ICTs are an expansive subject. Ideas are developing to cover any item that will store,

recover, control, communicate, or manage information electronically through a computerized device (e.g., personal computers, advanced television, email, or robots).

Agricultural Extension- is the process of applying scientific research to agricultural practices through farmer education. Though the definition of agricultural extension has evolved since the Training and Visit (T&V) system. The focus was majorly on the transfer of technology to improve productivity, especially for staple crops. However, Ikenwa, (2019) and Affiong, et al., (2022) imply that the concept of technology transfer is still relevant. Also, Fu and Akter, (2016) defined agricultural extension as a process of transferring knowledge to farmers, advising and educating them in their decision-making, enabling them to clarify their own goals and possibilities thereby stimulating desirable agricultural development. For the purpose of this study, agricultural extension with its associated services is defined as a major catalyst needed to boost agricultural productivity and to improve rural livelihoods.

e-Extension: In agriculture, being digital relies on tools such as satellites, sensors, robots, Unmanned Aviation Systems (UAS), and advanced machinery that gather, store, scrutinize and share electronic information or potential information along the agricultural value chain. Data is collected frequently and accurately and combined with external sources such as weather information. Such data is analysed and interpreted for optimum decisions with greater accuracy through Artificial Intelligence (AI) and human knowledge systems for improving agricultural productivity and anticipating resource vulnerabilities. Where electronic information and interactive platforms combine, agricultural extension personnel, farmers and other stakeholders in the agricultural value chain can meet and transact. This facilitates productivity, profitability, rural livelihood improvement and global competitiveness, thereby promoting agriculture as an engine of pro-poor economic growth (AFGRI, 2016).

An example of the access and relevancy of this combination can be seen in the example of AFGRI.co.za who also link data collection and distribution on their online platform to promote precision agriculture across Africa (Figure 1.2).

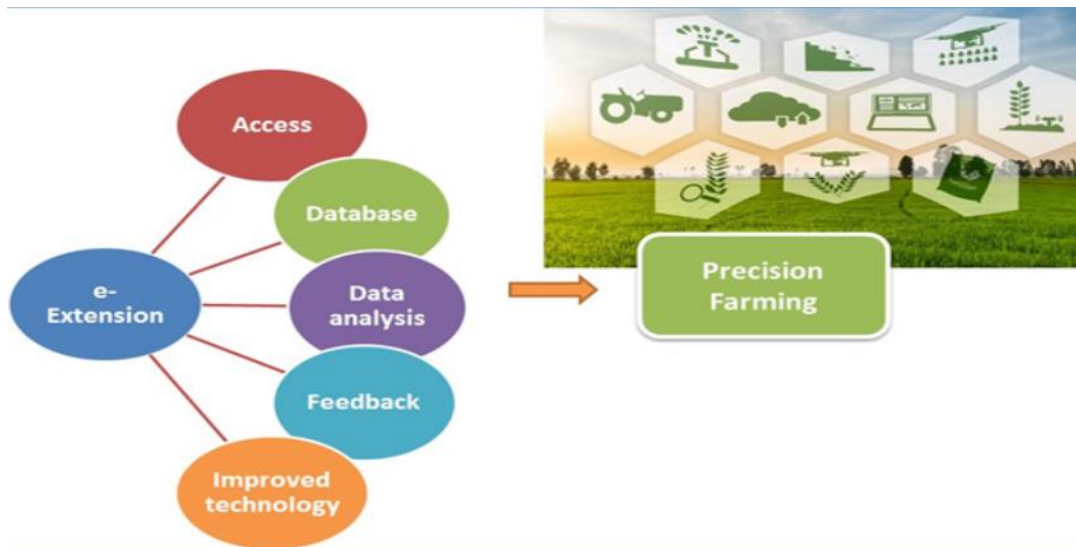


Figure 1.2 E-Extension, as an influence on precision agriculture. (Bhattacharyya, et al., 2018 p.124).

Precision Agriculture: Precision Agriculture (PA) also known as smart farming, satellite agriculture, as-need farming and Site-Specific Crop Management (SSCM). This approach to farm management utilizes Information Technology (IT) to ensure that agricultural produce and topsoil get what they accurately require for their welfare and proficiency. Precision agriculture aims to guarantee maximum productivity, supportability and security of the environment.

Smallholder Farmers: The definitions for Smallholder farmers reflect context and current academic conversation. For this study, a Smallholder farmer is defined as those that manage very small pockets of land. Smallholder farmers are also called household farmers because most agricultural activities carried out on the farmlands are mostly traditional and at a subsistence level. Of the two objectives of the ADPs, one of them is to raise the income generation of small-scale farmers.

1.9 Presentation of dissertation

This dissertation is comprised of five chapters. Each chapter plays a specific role in demonstrating mastery over the research process and reports on the investigation.

Chapter 1 The Problem and its setting provided an argument for why the research was relevant, presented the research focus and assumptions for knowledge production. It also located the study area.

Chapter 2 Review of Literature explains the awareness and use of ICTs, including their roles in agricultural extension service delivery. It also contains the theoretical and conceptual framework for this study.

Chapter 3 Methodology describes the process of the research, information related to implementation and credibility of the knowledge produced.

Chapter 4 Analysis and findings are presented as a selection of the data sets collected under the three data collection tool themes: Characteristics of the respondent group, the work environment, benefits/challenges and the way forward. These analyses are specifically presented to demonstrate patterns in the data that relate to the research sub questions. They identify patterns relevant to the roles and responsibilities of the extension service in connection with the practical challenges of using both digital and internet-based information. Cross tabulations and correlations were also included to show relationship between the variables under investigation and to test the null hypothesis.

Chapter 5 Discussion of findings is specifically arranged to reveal patterns in the data that show influences on the use of ICT, what challenges there are and what these extension staff perceive as the way forward. The research sub questions are used as themes to guide the discussion and answer the research question itself. Concluding this chapter is a drawing of conclusions about how the knowledge produced contributes to an understanding of whether the use of ICT in the ESADP is transforming the delivery of extension services in Benin City through the ESADP. The discussion draws conclusions about ICTs, how they are being used, what roles they are playing and what benefits and challenges they offer.

The appendices are cross-linked to the narrative in this report as a trail of evidence for the process and authenticity of knowledge production in this research.

CHAPTER 2: Literature Review

2.1 Introduction

Literature reveals that a number of studies have been carried out concerning the use of ICTs in agriculture in different countries/regions and at various times. This chapter examines this literature in an attempt to answer the key research question while studying all the key relationships and variables that are being investigated in this study.

The use of ICTs can effect a dynamic change in the agricultural sector if brought into the extension service delivery system in Edo (ESADP, 2020). This kind of opportunities abound in other aspects of agriculture including forestry, apiculture, fishery, sericulture crop and animal science, food security, market participation, crop insurance, tragedy and natural resource management, climate and market data, input management, accessibility or availability.

2.2 Awareness and use of ICTs

A review of opportunities and challenges in development countries by Saidu, et al., (2017) examined the roles and use of ICTs in development contexts. The review selected specific case studies and initiatives mainly with regards to impact on overall agricultural development and the living standard of the people (rural livelihood) in the communities where the projects were implemented among others through their contributions to the growth and development of the agricultural sector. They found that lack of facilities, personnel, infrastructure, inadequate harmonization of knowledge; power supply and farmer's perception are some of the barriers to a successful implementation of ICTs for agricultural growth.

Empirical studies, Fu and Akter (2016) in India, Yekinni, et al., (2019); Sennuga and Fadiji, (2020) both in North-eastern Nigeria, and Wole-Alo and Oluwagbemi (2020) in Ondo state, assessed the overall impact of ICT initiatives on agriculture and found that there is a significant relationship between the attitude of their respondents and their use of ICTs. They therefore suggested that practitioners should continue to use ICTs to disseminate information to their target audience. Omoregbee and Ajayi, (2010) suggested a need for regular training of extension agents, especially the new recruits, to determine their areas of preparedness and where they needed further training. Omoregbee and Ekpebu, (2013) studied the organization characteristics and commitment of extension workers in the Edo state ADP and concluded that

the majority of the extension workers exhibited high commitment to the extension service. Banmeke and Ajayi, (2006) investigated job satisfaction of extension workers in Edo state Agricultural Development Program (ESADP) and found extension training as an important factor affecting workers' job performance. They therefore suggested the need for regular training of extension workers to bring them up to speed with recent developments.

It has been argued by Chavula, (2014) that investing in ICTs could raise agricultural production, as seen in his study of the role of ICTs in agricultural production in Africa. He found that using ICTs, including telephones, plays a significant role in enhancing agricultural production. His findings, therefore, proposed that certain financial qualities, such as tertiary education level and advanced skills, are essential for effective improvements in the agricultural sector as they are interconnected with the acceptance and use of new technologies. He suggested that the African government should invest in technological capability, especially in tertiary education, to transform, develop and propagate new technologies and technical techniques to boost agricultural production. He further recommended the expansion and improvement of broadband technologies in order to ensure reasonably priced and unfailing ICT access to almost all corners of each country because most farmers are based in rural areas. He also recommended proliferation in productive investments such as agricultural research, technologies and rural infrastructure rather than committing more resources to direct farm subsidizations.

In Nigeria, currently, the Global System of Mobile (GSM) communication has an enormous market size that cuts across both the urban and rural areas. In 2020, almost 43.62% of Nigerians had mobile phones (Statistica, 2022). By 2021, the percentage would have grown to 48.12%, and it is projected to increase to 59.7% by 2026 (Statistica, 2022). At the introduction of GSM into Nigeria, the target market was the major cities, but with the installation of masts connecting all areas together, service providers have successfully introduced their networks into the villages. The accessibility of linkages in rural areas, have improved the use of mobile phones by rural dwellers who are largely farmers (Cruz and Guillaume, 2018). Similarly, Ogunniyi and Ojebuyi, (2016) found definite profits among farmers in South West Nigeria who use mobile phones for their agricultural business. These included a rise in farmer's income/their farm yield and a decline in operation/carriage cost. However, difficulty with electricity supply is a major challenge when using these devices.

Chukwunyere, (2019) studied the awareness on the use of ICTs by agricultural extension agents in North-eastern Nigeria using a multistage-stage random selection method. Data was collected from 254 agricultural extension agents. The study discovered that majority of the agricultural extension agents were between the ages of 41–50 years, male (70%) and married (91%). All (100%) of the agricultural extension agents in the study area had a recognized education. Those with a Degree or Higher National Diploma (HND) were in majority (45.7%) with 1.57% had a Master's Degree. All (100%) of the agricultural extension agents were aware of the use of one form of ICTs or another in carrying out their duties. The study, therefore, recommended that all agricultural extension agents must have verified skills in the use of ICT devices like computers and the internet while calling for in-service training on ICT applications for all staff in all organizations. He further advised agricultural institutions to launch their own websites and link up with others for sharing of information and tailor-made in-service training on using ICTs for agricultural extension agents (Chukwunyere, 2019).

In Malaysia, farmers confirmed that they received information from extension workers through the use of their ICT devices. 33.3% confirmed that they received information from the extension workers about disaster prevention, 22.2% acknowledged that they received information pre and post recovery, 23.1% received information about market prices during disaster and 38.6% asserted that they received other information such as pest and disease, food shortage, relocation of livestock and more (Ali, et al., 2018). In India for instance, extension workers were carefully chosen to demonstrate to farmers how to use internet facilities. The farmers did not reluctant to garner data pertaining to how to use ICT devices to get information about agrochemicals and market statistics (Abdul, et al., 2014).

The benefits of using ICTs to gather price information gave rise to a growth of 36% in farmers'/traders' income, in African countries like Kenya, Ghana, Uganda and Morocco (Williams and Vogt, 2011). Subsistence farmers in Swaziland demonstrated that the use of ICTs led to manufacturers saving smallholder farmers from the hands of middlemen to prevent price inflation (Dlamini and Worth, 2019). In the same vein, ICTs were used to improve on research outcomes amongst stakeholders which gave rise to more favourable harmonization between research and extension for the prosperity of farmers (Dlamini and Worth, 2019). An online marketplace was created by the "Ethiopian Commodity Exchange" to allow access by phone or through short message systems (SMS). This platform allowed for clarity in terms of demand, supply, market prices and farmers' share of profits.

Abdul, et al., (2014) posited that, the television played a dynamic role as a tool for agricultural information dissemination in India and Ethiopia because farmers could get straightforward information by watching agricultural programs and shows. Their study found that the internet, mobile phones, radio and television were essential tools of communication which provided awareness and statistics to farmers about agricultural forecast. Radio was the most common communication tool in secluded areas that aired many agricultural programs. The use of mobile phones led to a decrease in the gap between agriculturalists and consumers. Farmers could communicate one-on-one with customers and set market value-related prices. Farmers were able to acquire up-to-date information from agricultural metrological subdivisions for weather conditions before applying pesticides in their farms.

A study by Omotesho, et al., (2012) shows that “the introduction of ICT devices during the past twenty (20) years has afforded people a range of choices when it comes to collecting, storing, processing, transmitting and presenting information in several blueprints to meet their different conditions and expertise”. Similarly, Durojaiye, et al., (2014) reported that, villagers who used the internet, found the responsiveness and ease of use of an “ICT-enabled agricultural centre” (IAC) in adopted villages in Nigeria by NAERLS (National Agricultural Extension and Research Linkage System) led to the emergence of more knowledgeable farmers who keep record of the progress made through the application of the internet and other related ICT facilities. And Egbule, et al., (2014) stated that, agricultural extension agents in Enugu State, Nigeria are highly aware of the use of major ICT tools.

In the same vein, Mlozi, et al., (2012) found that in Tanzania, the use of ICTs by farmers was related to yield, revenue generated, type of crop available for sale and gender. The study revealed that farmers who used ICTs achieved higher prices than farmers who did not use ICTs for retrieving market data.

A study conducted by Oladele, (2015) in the North West Province of South Africa, revealed that agricultural extension officers had high awareness of the influence of ICTs on agricultural information access. Fourteen (14) statements were observed by the extension officers as having an influence on refining information access. He therefore suggested that the limitations to the use of ICT tools by extension officer be removed and the use of ICT tools by agricultural extension officers be upgraded. There was also a need for the educational level of agricultural extension officers to be improved upon through the attainment of more related qualifications.

He further recommended that e-readiness (a combination of affordability, convenience, user-friendliness, know-how and usage of ICT tools) by extension officers be boosted through effective strategies/programs and to ensure satisfactory provision of ICT tools.

For 131 farmers in Svosve-Wenimbi, Marondera district of Mashonaland East province in Zimbabwe, owning a mobile phone and using same in farming has the possibility of changing the production and sales of agricultural products (Masuka, et al., 2016). The study also concluded that high mastery of the device and mobile phone ownership of 95.32% and 94.45% respectively could be responsible for a future agricultural boom. While 16% of these farmers were already receiving agricultural extension services through their mobile phones; 51.1% made use of different mobile phone services, including gaining access to market statistics on inputs and produce, offers and promotional services available, advisory services, weather data, mobile phone money transfers for transactions, pest and disease infestation, and crop insurance. By using mobile phones farmers made calculated decisions and saved time and transport costs. The use of mobile phones in agriculture can stimulate better agricultural production and marketing, ensure food security, improve rural livelihoods and prompt more farmers to adopt the technology as a result of the benefits they have seen from the testimony of others.

Pavan, et al., (2019) reported that mobile phone usage enabled farmers to check with agricultural extension workers and veterinary specialists on a daily basis in emergency situations like when their animals get sick. In Zimbabwe, for example, farmers carry out transactions and insure crops using mobile services (Econet). By consulting virtually via their mobile phones, they can get to request for supplies, products, market prices, and advice. By using mobile financial transactions, these farmers save time and resources that otherwise would have been spent on transportation and other logistics (Masuka et al., 2016)

Techopedia, (2022) studied the ease of use and distribution of information to farmers using mobile phones by public extension agents in Delta state, Nigeria. He found that most (98.4%) of the extension agents were not provided with institutional mobile phones to assist in information diffusion to farmers. while, about 97% of the respondents asserted that they possess personal mobile phones, which they use to communicate with farmers. Dealings with farmers were mainly through phone calls (84.4%) and short message services (SMS) (71.9%). The study, therefore, recommended the need for the public extension service to work in partnership with network providers in broadcasting short programmed messages or calls that

are useful to the farmers. In addition, creating a hotline desk that would voluntarily provide answers to the direct needs of farmers to simplify and realise the transformation desired.

2.3 The Roles of ICTs in Agricultural Extension Service Delivery.

As a result of the gap in demand and productivity worldwide, there is a need to increase agricultural output through comprehensive agriculture. The use of ICTs in agricultural extension service delivery can play an important role in increasing agricultural yield through comprehensive agriculture (Masinde, et al., 2019).

The use of ICTs in agricultural extension service delivery can help to inculcate indigenous knowledge and cultural values of the people into the apps, methods, models and solutions that they intend to build (Kumar, et al., 2017). That is; assessment of indigenous knowledge and traditional communication methods of the people and including such in their prototype because one of the rules of extension is that it must start from where the people are (Salawu, et al., 2008). So in order to develop a lasting ICT model, the need to start from what the people know before progressing to introduce an innovation cannot be overemphasized as there is no “best” extension tool/method nor a “One size fits all” model. Therefore, a mix of both traditional (print: assorted Extension Publications & electronic: Radio, television and traditional ICTs) and modern or digital/electronic tools and methods (Mobile phone and Internet) will be employed to meet the various needs of the different actors in the agricultural value chain.

Another role played by the use of ICTs in agricultural extension service delivery is the elimination of middlemen. Some researchers argue that the functions of intermediaries cannot be completely eliminated. This is because of physical processes such as packaging, storing, transportation, financing, pricing, insurance and market information that take place between production and consumption (The United Nations University, 1994). However, it is also believed that in this global information era, transactions can take place without a third party being involved through the use of ICTs Salawu, et al., (2008), giving the farmers power to own their negotiations and bargain for favourable and profitable prices, build a relationship with their suppliers and consumers, save money, gain customer information, avoid price-hike caused by black-marketing and hoarding, offer full benefits such as samples and price cut to customers, avoid manipulation of local taxes extra and sales at prices higher than the Maximum Retail Price (M.R.P). Producers can also get feedback directly from their consumers.

The use of ICTs in agricultural extension service delivery provides a more detailed, practical, audience-focused, interactive and demonstrative atmosphere for learning/teaching. The involvement of pictures through Microsoft PowerPoint slides, videos, text, audio-visuals, animations, beautiful graphic designs, documentaries, interviews, success stories, feedback and more create interest. This catches the attention of both the instructor and the learners because the user interface is simple and friendly.

Using ICTs in agricultural extension service delivery will help overcome the limitations experienced with the earliest forms of innovation. For example, newspapers tend to be concentrated in urban areas and require literacy to grasp the information contained therein. While internet access, on the other hand, is low and scarcely accessed in rural areas. Television and radio have limited information ranges and provide one-way communication (Tersoo, 2018). Another important challenge is that most farmers live in rural areas where the technical and economic feasibility of fixed-line infrastructure is limited. The penetration of ICTs is widely available and less inhibited by traditional barriers such as infrastructure, electricity, literacy and language because the information is usually presented in audio and visual formats in diverse styles and different languages.

To generate a more accurate and reliable database, either empirically or by narratives, the validity and reliability of such collated data can be analysed, which can be used for decision-making. Using ICTs in agricultural extension service delivery will encourage data banking, also called archiving. This involves the careful keeping or storage of processed information (evidence or knowledge) to avoid doubts and for easy access to such data whenever the need arises. Stored data can also be used for research purposes or for forecasting.

Bridging the information gap is another role played by the use of ICTs in agricultural extension service delivery. Information gaps directly impede agricultural development, hence the need to overcome them. Information gaps exist everywhere, such as between researchers, farmers, development agents, policymakers, rich and poor, men and women, young and old. This can be caused by different factors such as physical location, education, access to ICT tools, language, economic factors such as no money to buy a cell phone, newspaper and access to internet facilities and many more. Socio-cultural/traditional beliefs such as a male extension agent not being permitted to work together with a female farmer, give information to only men,

leaving the women in the dark. The aforementioned issues can be addressed through the use of ICTs because the tools do not inherently retain gender or cultural bias.

The application of ICTs in agricultural extension service delivery can help to achieve one of the intended results of Worth's Agriflection model which is "to nurture a team of inventive farmers who have the ability and expertise to continue revolutionizing, whose farming systems are more lucrative and viable, and who instead of being the objective of extension are a primary part of extension" (Worth, 2006). Worth proposed that "continuous and defensible wealth can be achieved if we can come up with a suitable approach to agricultural extension service delivery". The researcher is of the opinion that the use of ICTs is one of many options available to achieve that goal (Dlamini and Worth, 2019).

Using ICTs in agricultural extension service delivery speedily combines global communication networks and international trade with consequences for people in developing countries. ICTs can empower, fortify or substitute existing information systems and networks (Williams and Vogt, 2011). The use of ICTs supports and allocates new and existing farming information and knowledge communicated within the agricultural sector since information is necessary to assist agricultural and rural development and bring about collective and profitable changes (Nyarko and Kozári, 2021). He further suggested that the introduction of community-based telecentres proposes a way of providing affordable access to ICT services in remote areas, thereby assisting agricultural extension officers in circulating the required farming information to boost agricultural productivity (Nnaemeka, 2021). Using ICTs in agricultural extension service delivery can contribute to a decline in uncertainty in agricultural businesses. Such influence can thwart the extent to which information inconsistencies can be abused by the relatively informed to dominate the relatively uninformed when transacting with them.

Farming is the primary occupation of the rural population, serving also as the major supplier of produce to secondary agricultural industries that depend on agricultural produce for raw materials (Tadesse, 2017). It is essential to raise awareness and encourage the use of ICT platforms among the field-level agricultural extension personnel to deliver up-to-date information.

In Nigeria, Nwabugwu, et al., (2019) drew policymakers' attention to the low adoption of e-resources in extension service delivery in Anambra state. Therefore, they suggested that the government provide enabling technological environment and training opportunities for

extension personnel. Wole-Alo and Oluwagbemi, (2020) reported on the adoption and utilization of ICT through farmers, finding a significant relationship between socioeconomic characteristics and technology adoption in Ondo State, Nigeria. They recommended the facilitation of the use of ICTs among farmers to ease knowledge sharing. Also, Ekeanya et al., (2018) found that pig farmers in Orlu Local Government Area (LGA) of Imo state utilize television, radio, newspaper, video player, DVD/CD, internet, pamphlets and magazines. However, there was a significant relationship between access to ICT facilities and the use of ICT facilities. Affiong, et al., (2022) found in Cross River State, Nigeria that marital status had a positive influence on the use of ICTs among extension workers, but that a shortage of extension services workers, poor funding, unemployment and understaffing affected extension service delivery. The use of ICTs in agricultural extension service delivery also makes the field-level agricultural extension personnel more aware of their duties and how to discharge them (ESADP, 2020).

In agricultural extension service delivery a new term has emerged called “extension-plus.” The shift from technology transfer to broader aspects of agricultural extension is what led to the term “extension-plus” or “e-extension” (electronic extension) and is characterized by: a more pluralized/decentralized approach to agricultural extension service delivery, access to multiple streams of information and in different formats/languages, reducing vulnerability and amplifying the voice of the rural poor, establishment and development of small/medium scale enterprises (SMSE) and lots more (Omorogbee and Ekpebu, 2013). ICT tools now have so many rich features that they can be very useful in data capturing. This helps save time, reduce drudgery and provide standard information which can be used for research, forecasting and more.

In summary, the use of ICTs in agricultural extension service delivery can help in many ways, such as to increase the understanding of farming activities, make agricultural information to be available in different languages and formats (i.e. audio, video, pictures), improve quality of information and data management, improve application of research and makes research relevant, improve access to farm implements and agricultural markets, improve access to financial institutions and agricultural events/news, enhancing decision making and giving a voice to the voiceless, reducing rural-urban digital gap, rich-poor digital divide, male-female digital gap, to prevent relocation from rural to urban areas, improving cultural compatibility of agricultural issues and social tolerability of agricultural issues, improving record keeping, a

reduction in the cost of transactions among stakeholders, enhancing capacity building, consolidating research-extension linkages, ensuring timely feedback from the lab (research) and land (farmers) and transforming the overall functions of agricultural extension service delivery. All these reasons and many more are why agricultural extension service delivery is said to be the “heart” or “pump” of the agricultural value chain.

2.4 Theoretical Framework.

The theoretical framework for this research is based on the updated DeLone and Mclean information system (IS) success model Begona (2010) which was published in 2003, ten (10) years after their first contribution to the IS system model. The updated model consists of six (6) integrated dimensions of IS success model (DeLone and Mclean, 2003). The IS success model identifies and describes the relationship among six (6) critical dimensions of information system success which are; information quality, system quality, service quality, system use/intentions, user satisfaction and net benefits (2.1).

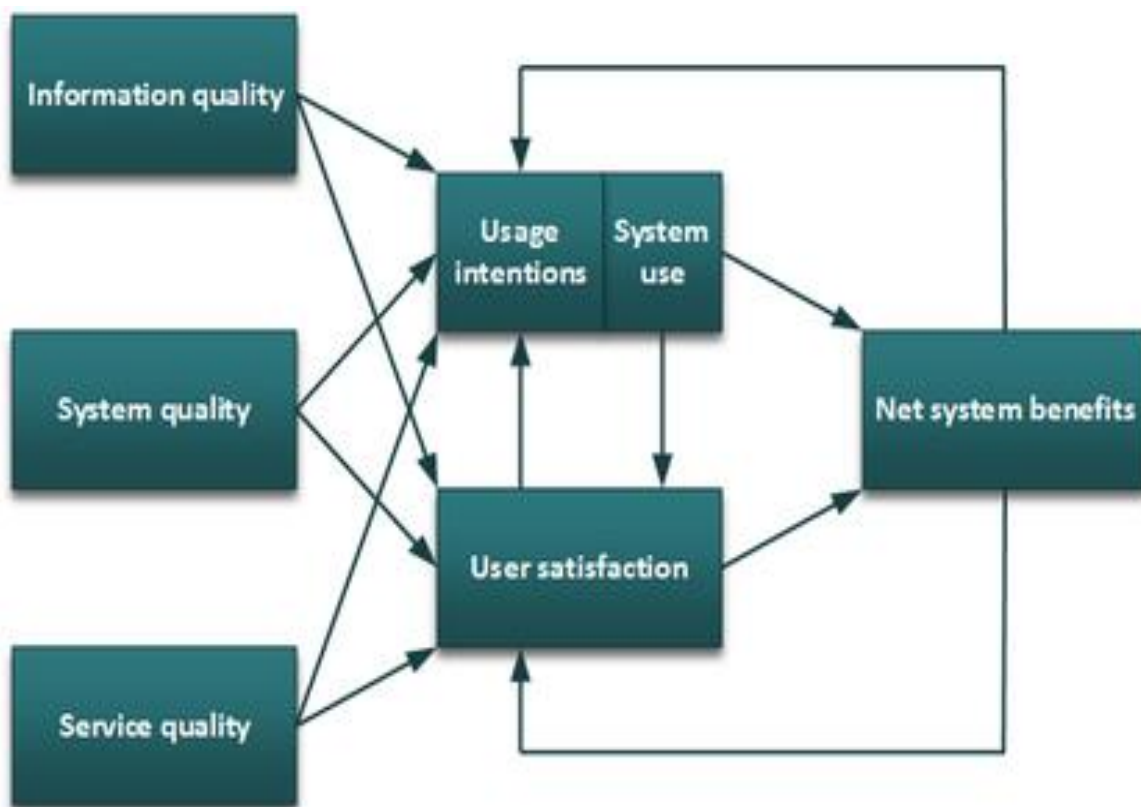


Figure 2.1 DeLone and Mclean updated IS model (DeLone and Mclean, 2003, p.24).

2.5 Conceptual framework.

The conceptual framework for this research was modelled on DeLone and Mclean’s work. It focuses on a useful meaning for the transformation experienced in agricultural extension service delivery as a result of the use of information and communication technologies (ICTs). To find the best fit (meaning) for “transformation” as used in this context, the research will examine and investigate the awareness/perceived use of ICTs, the roles/influence of the use of ICTs, the benefits/challenges encountered in the process of using ICTs and make recommendations on the way forward.

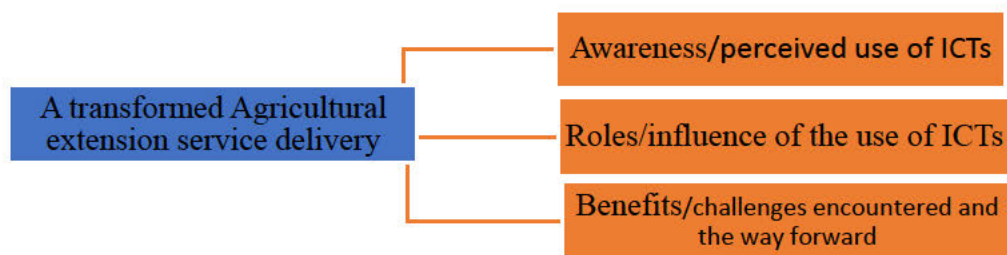


Figure 2.2 Conceptual framework for this research.

Table 2.1 shows the specific set of variables in the questionnaire that were measured with each of the constructs in the conceptual framework of this research.

Table 2.1 Construct and variables

| Construct | Variables (used in Questionnaire to collect data around these constructs) |
|------------------------------------|--|
| Awareness/perceived use of ICTs | The researcher will ask questions about awareness, ownership and use of certain kind/type of device and the purpose for which these devices are used. As can be seen in the questionnaire (Q5-Q12) in the appendix. |
| Roles/influence of the use of ICTs | Questions relating to how extension workers use ICTs in their work environment will be asked her as can be seen in questionnaire (Q13-Q26) in the appendix. |
| Benefits/challenges encountered | The “why” questions will be asked here to enable the researcher better understand the reason(s) why extension workers do or do not use ICTs. These questions will help to better understand the benefits and issues associated with the use of ICTs as can be seen in Q27-Q39 in the appendix. |
| The way forward | Based on the response from the participants in the above questions, solutions and recommendations will be made in Q40-Q43 as seen in the questionnaire in appendices 3.2 &3.3 |

2.6 Approaches to agricultural extension service delivery

A range of approaches have been used for agricultural extension service delivery in various forms and they have been offered to farmers with the aim of increasing productivity and farmers' income (Kromah, 2016). Though the success of agricultural advisory services is to see that farmers gain knowledge, and adopt best practices which will be profitable to their yield and income but a comparison between the similarities and differences in the kind of approach led to the realization that to experience a more strengthened agricultural extension service delivery, the best practice is to employ a combination of both traditional extension information transfer and the use of technologies as seen in Table 2.2 below.

Table 2.2 A table showing the traditional method of extension, the use of ICTs, their similarities/differences and best practice/approach.

| Agricultural extension services | Traditional extension information transfer and exchange | Use of ICTs | Similarities | Differences | Best practice |
|---------------------------------|---|--|--|---|--|
| Technology transfer | Linear approach, Training and visit (T&V) system | Innovations quickly gets to the end users and to a wider audience. | Adoption of the technology on offer. | It does not take account of farmers' needs/demands and it treats farmers as end-users and not as partners. | A combination of both traditional extension information transfer and exchange + (ICT) devices. |
| Advisory | Farmers wait for the next visit of the extension personnel before they can have solutions to their problems. | Farmers can reach the extension directly either through a phone call, text message, email, or any of the social media platforms. Also, farmers can get help by searching the internet. | It provides problem specific advice | The use of ICTs saves time and it is easier. | |
| Facilitation | Farmers with common interest are grouped into clusters and are taught by the extension officer in order to achieve both individual and collective goals | These groups of farmers can receive messages directly from the extension personnel either through a phone call, email, SMS, or social media. | It assists farmers to learn and to become experts of their enterprise thereby encouraging them to be independent by relying on their own observations, knowledge and ability to make concrete decisions instead of relying on traditions and external inputs. | The traditional method is time consuming to conduct and achieve any meaningful result because the process might spread over months before results are recorded. | |
| Learning | Traditionally, farmers learn through information handed down by their forbears and by observation. This method of learning does not benefit other stakeholders in the agricultural value chain. | Encourages distance learning. | The main focus is farmers' learning. And this helps to develop and build the capacity of farmers, giving them greater equity and synergizing the relationship between policy makers, researchers, extension workers and farmer. Thereby improving the sustainability of farmers' livelihood. | Unlike other approaches to agricultural extension service delivery, this method specifically addresses three aspects of orientation; which are: the clients (farmers), the process (learning process) and the appropriate placement of technology (ICTs). | |

CHAPTER 3: Methodology

Edo State has participated in the Agricultural Development Program since 1972 when they were launched in Nigeria to increase food production and raise the income of small-holder farmers (Auta and Dafwang, 2010). This study contributes to a perspective from the employees on how they perceive the use of ICT in support of agricultural extension service delivery and the benefits/challenges associated with its use. To achieve this, an online questionnaire was used to collect data from ESADP employees in Benin-City, Edo State. The design was a purposeful volunteer sample of one hundred (100) employees involved in either office support or field work for agricultural extension service delivery.

3.1 Selection of respondent group.

A respondent group of one hundred (100) employees was targeted for inclusion in this study. There were fifty (50) office workers and fifty (50) field workers invited to participate. There was a 95% volunteer response rate with fifty (50) office workers and forty-five (45) field Workers across Edo state responding to the invitation. The Edo state Agricultural Development Program (ESADP) was chosen as a case study for this research based on ease of online access to staff. The researcher was already familiar with the office and was able to pursue a relationship facilitated access to extension staff. In this study, the ESADP was welcomed as an opportunity for carrying out research inspite of Covid-19 limitations on travel and contact, financial and time constraints. Also, this study is investigating the challenges, benefits and perceptions of the use of ICTs on agricultural extension service delivery to support other studies in this field such as Koyenikan and Ohiomoba (2021); Uddin et al., (2019).

The researcher approached the ESADP office in Benin-City, who indicated their support through a letter of permission to access staff. An invitation to cooperate, including the letter introducing the research and implications of consent (Appendix 3.1) was generated and distributed. The researcher created an online survey and sent the link to the project manager, who then sent it to the respondents via their emails and WhatsApp group. The researcher was not granted access to the emails because the project manager stated that he was trying to avoid a breach in data because email addresses are not owned by the ESADP but the individual participants. Stating that as of now, the ESADP is yet to host a website that will accommodate the work emails of all staff member hence, their privacy must be respected. The WhatsApp group on the other hand was a reliable communication platform as almost all extension workers

had an android phone with WhatsApp installed on it and they all interacted via the group chat. The researcher received completed questionnaires via email through the survey monkey platform, and responses were downloaded in the form of an excel spread sheet.

One hundred (100) frontline staff (office-based and field level) were invited to participate in order to probe the devices, apps and platforms available for use and their efficiency. No deliberate choices were made with reference to targeting grades of an employee, area of specialization, local government area of origin, educational qualification or any other variable in the questionnaire. Return of questionnaire was assumed as consent given (Appendix 3.1). At this stage, no secondary data has been identified for use in this study. Ethical clearance was obtained (Appendix 3.2), and the process of data collection began.

3.2 Collection and analysis of data

When the Covid-19 pandemic struck, restrictions on travel and physical contact to achieve data collection were imposed. Because of the uncertainty and expense of travel with associated quarantining to the remote and widespread corners of Edo State and the researcher being trapped in South Africa during the Covid-19 Pandemic, an online survey tool was designed from the questionnaire approved by the HSSRC. The link was sent to the potential respondents. This platform was used because a link to the questionnaires could be shared, its interface is user-friendly, so all the participants could easily access the questionnaire. Their subscription was also cheaper than other platforms.

3.2.1 Data collection tool: Questionnaire.

Ten (10) general agricultural extension personnel participated in the pre-test survey through the online route after receiving ethical approval for this study. This enabled the researcher to review the questionnaire, thereby editing and adjusting questions that were not clear enough to understand the respondents or any questions that may be offensive or deemed too personal. The researcher took cognizance of their feedback and used it to edit and adjust the research instrument while retaining the original meaning of the questions (Appendix 3.3 shows the questionnaire pre-test Summary).

The pre-test questionnaire was tested amongst ten general agricultural extension workers at the ESADP who had accessed to and used ICTs and were willing to share their depth of knowledge through experience by sending the link to them and the feedback received from the respondents,

included; a suggestion to split the data collection tool (questionnaire) into strata to enable the researcher ask more specific questions pertaining to their work environment and experiences because initially, the questionnaire was supposed to be meant for all agricultural extension personnel in general. This suggestion enabled the researcher to split the data collection into two (office workers and field-level agricultural extension personnel). This gave rise to more specific questions such as what is your area of specialization. (Q8) What devices do you use in the field/office? (Q12), means of communication while in the field or office (Q14-Q16), kind of information available in the field/office (Q17), how they collect and share information (Q25 and Q26), access to the internet (Q28-Q31) and who provides the devices/information? (Q32 and 34). See appendix 3.4 and 3.5).

Between the time the data collection tool was designed and tested, the Covid-19 pandemic had restricted movement. The final online survey utilised Survey Monkey platform for sending and receiving questionnaires from the respondents and it took one month to complete this process. Two questionnaires were presented in English as this is the official working language spoken by all employees. One questionnaire was aimed at the office employee (Appendix 3.4) and the other at field workers (Appendix 3.5). Each survey was organised around three sets of observations: demographic information, benefits and challenges of using ICTs within the work environment, perceptions of the work environment and the way forward. It took 6-7 minutes to complete the questionnaire and once it is completed, the researcher will receive an email notifying her of a new response from survey monkey.

3.2.2 Data Handling.

Information retrieved from the completed questionnaires on survey monkey were downloaded and saved as an excel spread sheet, during which they were cleaned and coded. In Appendix 3.6, an example of coding, demonstrating how affirmative responses were represented as 1, negative responses as 0 and non-responses as “nr”. A full set of the responses grouped by field and office extension worker has been included in Appendix 4.1 Table 1 as a trail of evidence. SPSS was used to explore correlations (Appendices 4.2.1, 4.2.2, 4.2.3) as back ground to descriptive analysis (Tables 4.3-4.5, Tables 5.1,5.2). Qualitative answers (Appendix 4.1 Table 2) were also collected for some questions. These were grouped into saturated themes allowing a deeper perspective on participant’s behaviour. For example, from open-ended questions and responses for other options which were not listed in the questionnaire (Q4, Q7 and Q8) and the

names of apps/physical platforms where agricultural extension workers get access to information (Q19 and Q21) and how often they meet (Q22). It also explains the reasons for the answers provided (Q24 and Q48) as to why agricultural extension workers believe that the use of ICTs is either transforming or influencing agricultural extension delivery or not (Q47). While this data set has been archived electronically, for the purpose of this research, only relevant patterns in data are presented in support of findings in the presentation of results (Chapter 4).

In the Table 3.1 below, the specific relationships analysed from the results are presented in relation to the Sub questions asked.

Table 3.1 Conceptualising the Data Analysis

| Context | Variables/relationships being analysed (Descriptors calculated from counts) | Source of Data (survey) |
|---|---|---|
| General description of respondent group | Characteristics of respondents (demographics) | Q1-Q5 |
| What is/are the role(s) played by the use of ICTs in agricultural extension service delivery? | This relationship has been defined using work related variables such as roles which include; area of specialization, awareness of use of ICTs for agricultural extension service delivery, kind of device owned and purpose of use of such devices. | Q8-Q12 |
| How is the use of ICTS influencing agricultural extension service delivery? | The patterns /comparisons that will define this relationship include; examining where agricultural extension personnel get information for their work, describing the means they use for communication while at work and how they collect and share information, the benefits and challenges associated with the use of ICTs and possible way(s) forward. | Q13- Q26 Q27- Q39 Q40- Q43 |

3.3 Defence of Method

3.3.1 Ethics of the research design

In 2021, the researcher approached the Edo State Agricultural Development Program (ESADP) in Benin-City by email, requested to engage with agricultural extension personnel in a survey, and was granted permission (Appendix 3.7: Gatekeepers letter). In addition, the project manager of the agricultural extension department of the ADP assisted the researcher with identifying a purposeful sample of staff with whom the link to the survey was shared. A

proposal for the research, including the data collection tool, was presented and approved by the Human Sciences Research Council (HSSRC) generating a traceable ethical clearance for the study HSSRC/00003053/2021 (Appendix 3.2). All who were invited to participate were voluntary and not related to any evaluation of work performance or other reward.

The act of responding to the online survey and submitting it indicated an individual's consent to the intentions of the research (Appendix 3.1). Through the cover letter, the researcher informed the respondents that participation in the survey was voluntary and that they have a right to withdraw at any time without any consequences. This allowed the participants to decide on whether to participate or not. Submission therefore, of a response to the survey was considered as consent given. Participant's responses and personal data were never shared with a third party in order to ensure confidentiality.

3.3.2 Credibility and Defence

This study used a purposeful sampling method (ResearchArticles.com, 2020) of a specific group of employees. This method involves using certain criteria or purpose to select the sample which will provide rich data to answers the research questions that is in line with the aims and Objectives of the study. The researcher chose this research design because it fits the theoretical and conceptual framework of this study therefore, it will help to select the respondents who possess the right qualities such as their work environment, use of ICT devices, access to internet, computer literacy, workload and willingness to share from their in-depth knowledge and experience about their awareness, roles, benefits and challenges of the use of ICTs. The advantage of this purposive non-random sampling technique is that it is both cost and time effective (Dudovskiy, 2022). Its drawbacks were mitigated through the use of a questionnaire and the invitation to both dimensions of service – office and field staff, and the sharing of the link to the WhatsApp group. This did limit the invitation to employees on the WhatsApp group or email list which of course was a key criterion for inclusion – access to the internet and a device. Also, findings from this kind of research cannot be generalised. This is so because the study uses location specific information to arrive at its conclusion, but the researcher has provided a trail of evidence to enable this research method to be replicable elsewhere. Some respondents may not be willing to share information or be open to it (ResearchArticles.com, 2020). This disadvantage was addressed during the pretesting (Appendix 3.3) stage of the

research design and questions which were seen as either too personal or vague were adjusted by the researcher.

Because the investigation used a structured questionnaire, all individuals in the respondent group were presented with exactly the same online experience. The respondents are trained agricultural extension personnel hence a high level of accuracy is expected from their responses. The pretesting process provided an opportunity to improve on the data collection tool to ascertain if the responses would be usable for answering the research question and sub-questions.

3.3.3 Data analysis and treatment

Responses retrieved from the questionnaires were digitised. Patterns and trends were identified using descriptors such as percentages, frequencies and clustering of information (Chapter 4). Analysis presented a picture of the characteristics of respondents (demographics) and the description of their work environment in relation to their awareness, use, benefits and challenges encountered while using ICTs and suggestions towards a way forward was recommended.

CHAPTER 4: Analysis and Results

This chapter presents the analysis and results from the questionnaire. The digitised data has been selected and arranged to communicate patterns using the progressive logic of the Questionnaire as identified in the section headings. In the next chapter (Chapter 5. Discussion of Findings and Conclusion), these patterns are interpreted as findings, discussed under the thematic focal areas provided by the research sub questions to answer the central research question.

4.1 Characteristics of the respondents

A total of 95 agricultural extension personnel responded to the survey. The distribution demonstrates how the respondents were spread across the three Agricultural Zones covered by the ESADP extension services. Participants indicated where they represent in terms of their Local Government Area of origin. Owan East Local Government Area had the highest representation with 12% office workers and 20% field workers, followed by Esan West with 10% Office workers and 11% field workers and Irrua with 8% office workers and 6% field workers who voluntarily participated in the study as shown in Figure 4.1. This result does not depict that Owan East LGA has the highest number of extension workers currently employed at the ESADP rather, it shows the number of extension workers who willingly participated in the survey as at the time.

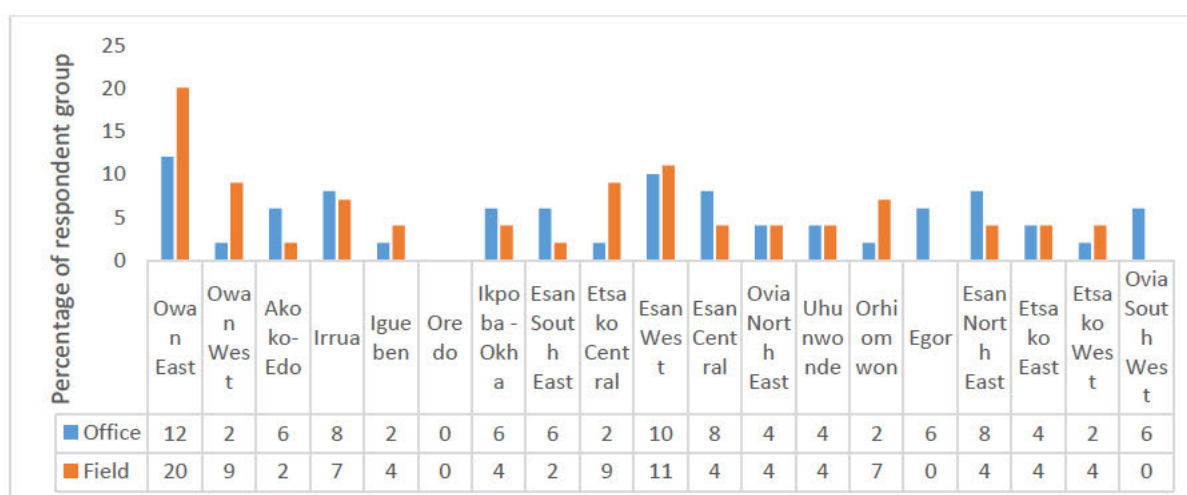


Figure 4.1 Percentage distributions of respondents across Edo State LGAs from 45 field and 50 office-based workers. N=95 Source: (Field Data, 2021).

Participants' demographic data for age, gender, relationship status and educational qualification were collected (Appendix 4.1, Table 1). Observations from participant's responses show that the majority (as shown by percentages) of the office workers in this study are mostly male (54.0%) and fall within the age group of (25-35), have an educational level of at least a Bachelor's degree in Agriculture (30%), and are married (36%). However, a larger number of office workers possess a master's degree (42%). While a majority of field workers in this study are also largely male (55.56%), mostly single (44.44%), and within the age range of 25-35 years (46.67%) and possess either a Bachelor's or a Master's degree in agriculture (35.56%) as seen in Table 4.1. Other educational qualifications (Appendix 4.1 Table 2) listed by respondents include Ordinary National Diploma (OND) and Higher National Diploma (HND). This portrays an active workforce consisting of young people who are educated. This agrees with the work of Omoregbee and Ekpebu, (2013), who found that 84% of the 119 extension personnel randomly selected for their study were married, and about 60% of them had a tertiary school certificate. Also, Omoregbee and Ajayi, (2010) in their study found that more than half of their respondents 55.3% possessed a National Diploma (ND). Analysis of the group of respondents shows that the Mean age for field workers = 42.12, Median = 40.5 and Mode = 26 while for office workers, Mean age = 41.64, Median = 40 and Mode = 30. The age range is between 25 - 68.

Table 4.1 Cross tabulation of demographic profile of the respondent group. N=95. Source: (Field Data 2021).

| Demographics | | Office workers | Field workers | Total |
|----------------|----------|----------------|---------------|-------|
| Age | 25-35 | 36.0% | 46.67% | 41.3% |
| | 36-46 | 26.0% | 22.22% | 24.1% |
| | 47-57 | 26.0% | 24.44% | 25.2% |
| | 58-68 | 12.0% | 6.67% | 9.3% |
| Gender | Male | 54.0% | 55.56% | 54.8% |
| | Female | 46.0% | 44.44% | 45.2% |
| Marital status | Single | 34.0% | 44.44% | 39.2% |
| | Married | 36.0% | 37.78% | 36.9% |
| | Divorced | 24.0% | 6.67% | 15.3% |
| | Widowed | 8.0% | 11.11% | 10.0% |
| Education | B.Agric | 30.0% | 35.56% | 32.8% |
| | Masters | 42.0% | 35.56% | 38.8% |
| | PhD | 18.0% | 22.22% | 20.1% |

4.2 Description of the work environment

While all employees report to the central ESADP head office in Benin-City, respondents in this study represent two basic work environments—those who work mainly in an office environment and those who work primarily in the field. The roles identified as relevant for this study for field workers are conducting research and or consulting with or advising farmers. Office workers' roles are involved with administrative functions, pensions/accounts department, technical support and conducting research in laboratories. While structured questions (Appendix 3.4 and 3.5) asked about specific areas of specialisation, each respondent was offered the opportunity to add other roles and responsibilities (Appendix 4.1 Table 2). Other roles described by the field workers include peace and conflict resolution between farmers and herders, while the office workers stated that they act as bridges between the government, policymakers, the research institute and other stakeholders in the agricultural value chain.

Agricultural extension workers send and receive information through a variety of structural platforms. These were identified as Agricultural Cooperatives, Cassava farmers' association, Catfish farmer's association, Cocoa Farmers association, Farmers Union, Herders association, Farmers cooperative, multipurpose society, Farmers Association, Neighbour to Neighbour, Plantain farmers' association and Rubber farmers' association among others. These associations meet either weekly, monthly, quarterly, twice a year or annually.

4.2.1 How is the Use of ICTs Influencing Agricultural Extension Service Delivery?

Participants were asked to indicate their level of awareness of the use of ICTs for agricultural extension service delivery. Respondents indicated that the mobile app which connects farmers, consumers, agricultural extension personnel and others in the value chain is called "Edo Agrovest or Agrovest". Office workers (94%) indicated that they are aware of the use ICTs in agricultural extension while in the field, 98% stated the same. This shows a high level of awareness of the use of ICTs for agricultural extension service delivery, as shown in Figure 4.2. This agrees with the work of Chukwunyere, (2019) who found that the agricultural extension agents were aware of the use of one form of ICTs or another in performance of their duties.

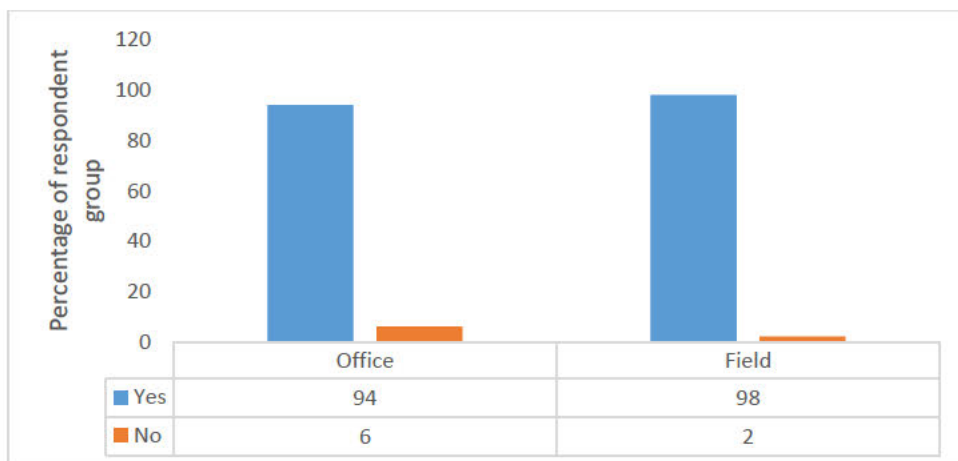


Figure 4.2 Percentage representation of the awareness of use of ICTs for agricultural extension service delivery N = 95 (45 field staff and 50 office staff) Source: (Field data, 2021).

While the data showed that 90% of Office workers indicated that they have access to internet at home and 82% at, Field workers indicated 100% access to the internet at home and 83% at work. This pattern shows that extension workers are so eager to use the internet that they are willing to purchase their own personal data bundles, acquire and use a family Wi-Fi or share data bundles with family and friends, as seen in Figure 4.3.

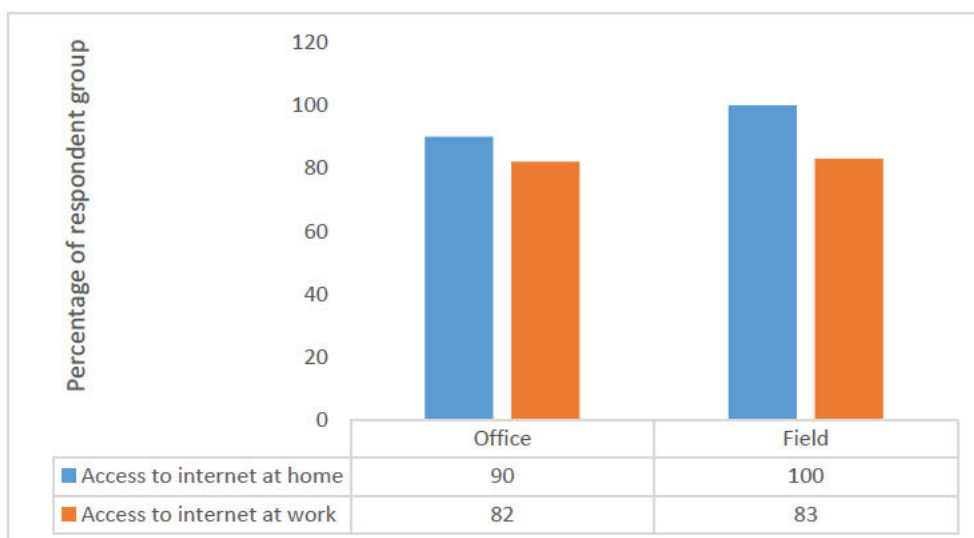


Figure 4.3 – Percentage representation of the relationship between access to the internet and the work environment. N = 95 (45 field staff and 50 office staff) Source: (Field data, 2021).

4.2.2 List/Type of ICT Devices Used by Participants.

Participants were asked to indicate the kind of devices they owned/use, and 91% of field workers indicated a mobile phone, 54% a laptop, and 34% a tablet. Office workers Indicated 88% ownership of mobile phones, 64% laptops, and 32% desktop/tablets, respectively. The percentage of use of mobile phones is higher among field workers (91%) (Figure 4.4). Phones are the most common gadget to use in the field. They are personal, lightweight, and relatively easy to carry around.

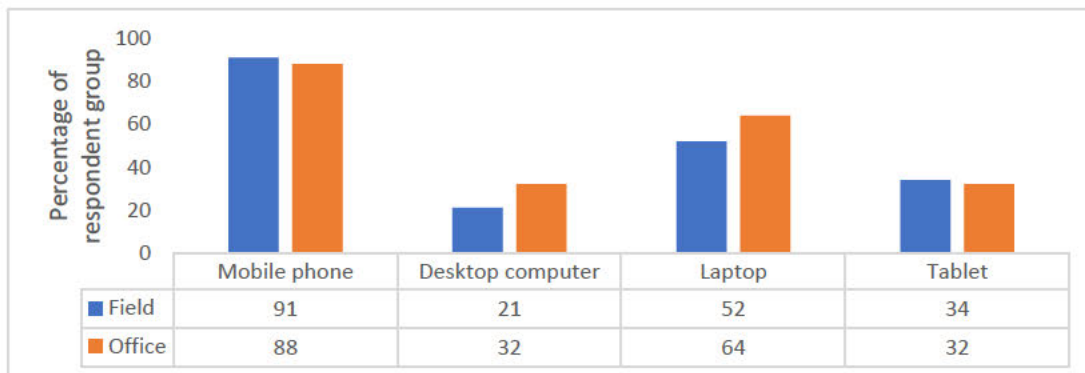


Figure 4.4 Percentage representation of relationship between devices owned and work environment N = 95 (45 field staff and 50 office staff) Source: (Field data, 2021).

4.2.3 Benefits of Using ICT Devices in Agricultural Extension Service Delivery.

Office-based agricultural extension workers used ICT devices because they were easy to use (81%), provided up-to-date information (65%), accuracy of information, reduction in time spent on the road and other logistics (63%) respectively and that ICT devices were fast and super convenient (60%). On the other hand, field workers indicated ease of use (76%) as well as faster and super convenient (69%), including accuracy of information and reduced time spent on the road and other logistics. What we see in the following analysis (Figure 4.5) is that both field and office workers share similar reasons as to why they use ICT devices while carrying out their duty. This is similar to the findings of Saidu, et al., (2017) who found that improvement of market activities, exchange of information, networking and conducting research were part of the reasons for the use of ICTs in the agricultural sector. Similarly, World Bank, (2011) found that at a personal level, using ICTs in agricultural extension service delivery helped reduce individual travel costs to rural areas and different markets in different

locations to obtain information and other opportunity costs, such as saving time and travel-related emergencies.

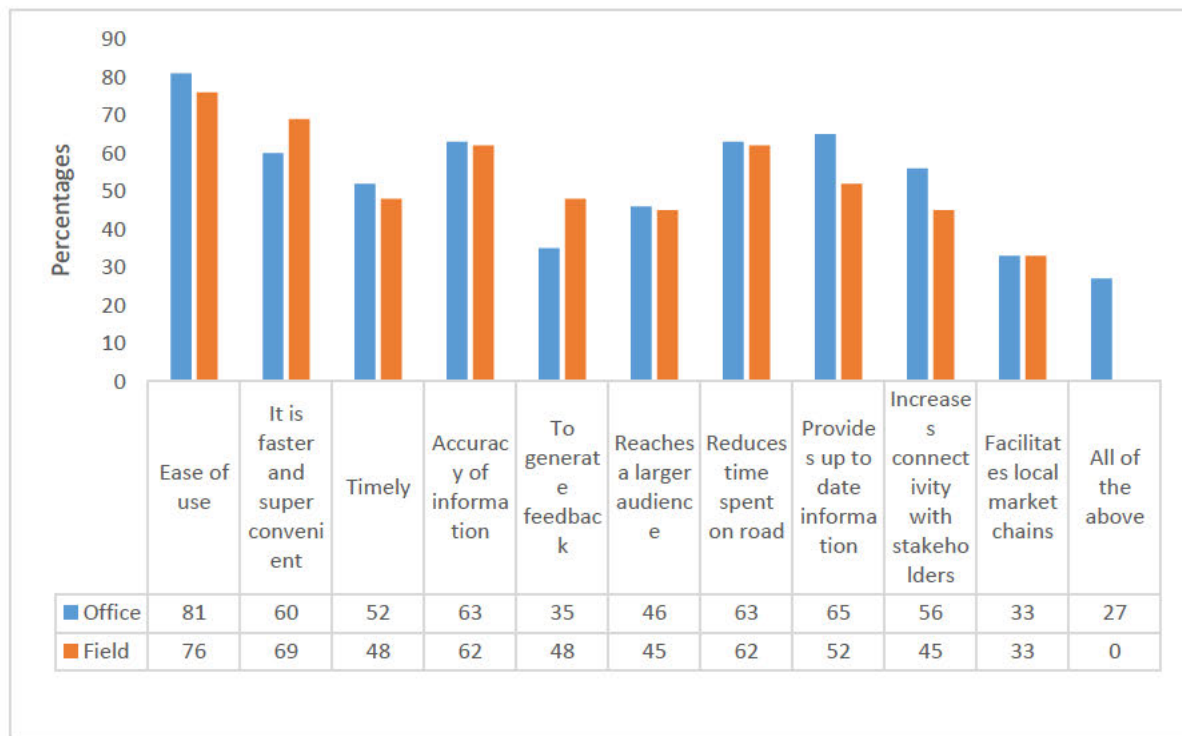


Figure 4.5 Percentage representation of the benefit(s) of using ICT devices in relation to work roles N = 95 (45 field staff and 50 office staff) Source: (Field data, 2021).

Respondents were asked to indicate the various platforms where they get information or distribute information for their field/office work. 58% of office workers chose the Radio/television, 52% indicated conferences, books and study materials, while 48% identified cooperatives. Field workers indicated emails (59%), journals (57%) and books/study materials (52%). The majority of this information exchange is done digitally (through electronic or print media), while others such as emails (59%) and (44%) are internet based (Figure 4.6). This shows that the use of ICTs resulted in a reduction of face-to-face means for sending and receiving information with options such as colleagues rated as 32% for office workers and 25% for field workers (Figure 4.6). A study by Ayim, et al., (2022) found that radios were still widely used to circulate agricultural information to rural farmers, while researchers primarily used computers.

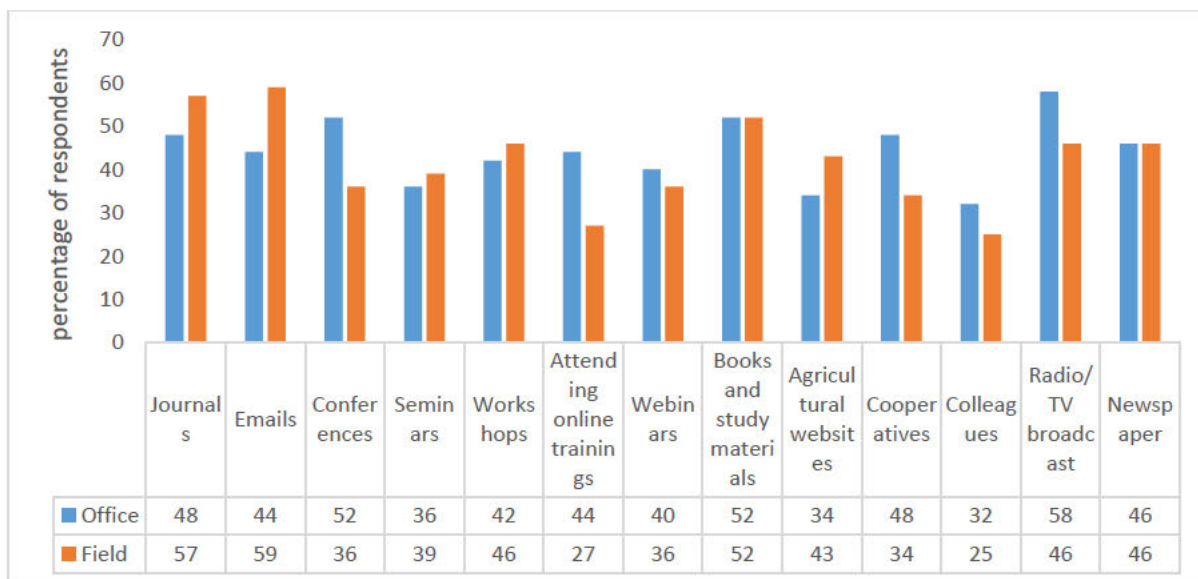


Fig 4.6 Percentage representation of platforms where agricultural extension workers exchange information. N = 95 (45 field staff and 50 office staff) Source: (Field data, 2021).

The source of devices in responses shows a discrepancy between the desire of agricultural extension workers to use a smart device and the provision for it by the work environment. Eighty-eight (88%) of devices used in the field are owned by the agricultural extension personnel, while the ADP and government supply 60% and 26%, respectively. On the other hand, office workers indicated that the ADP supplies 88% of the devices they use in their work environment, while 57% state government-owned and 57% are personal devices as shown in Figure 4.7. This pattern/trend is so because office workers have access to stationeries such as desktop computers, printers and photocopiers for their work while field worker do not. They therefore called on the government and ESADP to help alleviate this plight. This agrees with Techopedia, (2019) who observed that (98.4%) of their respondents did not have access to institutional mobile phones to disseminate information to farmers. while 97% of the extension workers confirmed that they use their own mobile phones to disseminate information to farmers

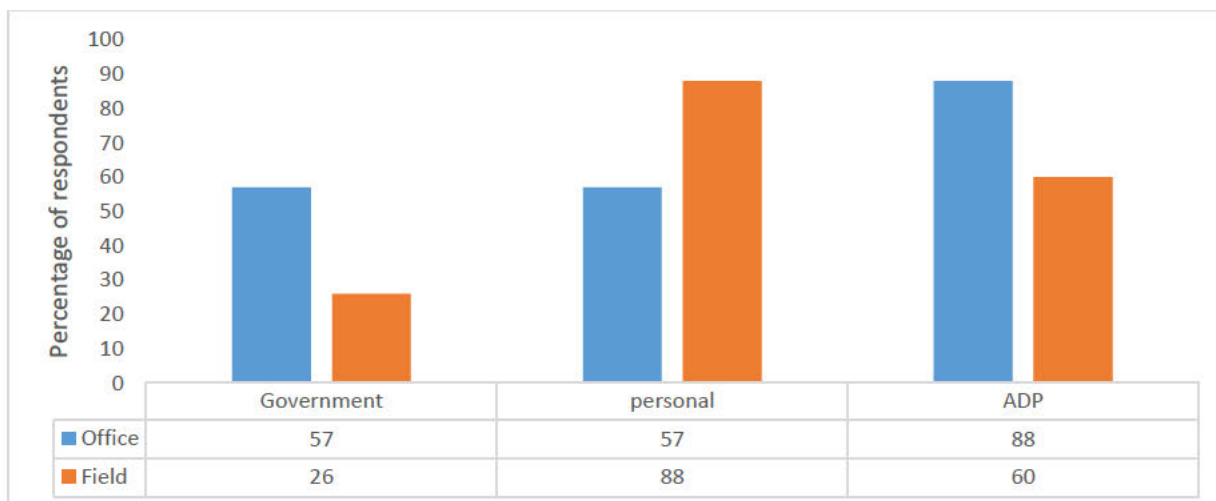


Figure 4.7 Percentage representation of the relationship between device provision and work environment. N = 95 (45 field staff and 50 office staff) Source: (Field data, 2021).

Participants were asked to indicate how they are able to access the internet and 70% of office workers indicated sharing a data bundle with colleagues, 67% chose the personal data bundle option, 57% claimed to use office Wi-Fi while 30% selected the official LAN. 83% of field workers indicated that they use a personal data bundle to access the internet while 40% indicated sharing data bundle with colleagues, 23% and 17% selected the official LAN and office Wi-Fi as shown in figure 4.8. This pattern shows that staff members are so motivated to use the internet both to access and share information that they are willing to pay for their own internet access. This is not surprising when we already know that 360 farmers in Malaysia use ICT devices for risk management and as a platform to seek agricultural information (Ali, et al., 2018). Similarly, Chima, (2012) found that in Nigeria the internet, mobile phones, radio and television were the main tool of communication that provided agricultural knowledge and data.

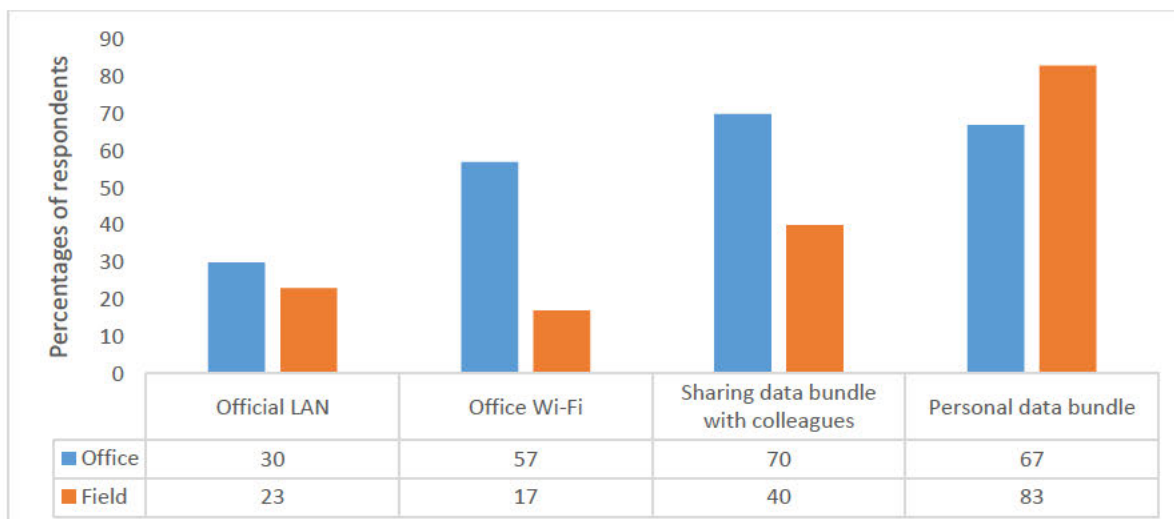


Figure 4.8 Percentage representation of internet access in the work environment N = 95 (45 field staff and 50 office staff) Source: (Field data, 2021).

4.3 Challenges and perceptions with ICT

Both field and office workers, 84% and 71% respectively, face bad network service as their most significant hindrance to using ICT devices. Furthermore, field workers indicated high charges on internet services (65%), inaccessibility to recharge vouchers (63%) and lack of location-specific information (63) factors strongly militating against carrying out their day to day activities. Office workers, on the other hand, indicated inaccessibility to recharge vouchers (59%) and non-availability of location-specific information (59%) as issues encountered while using their ICT device(s) (Figure 4.9) This is in line with research in Nigeria around ICT adoption by (Agwu and Uchechi, 2019)

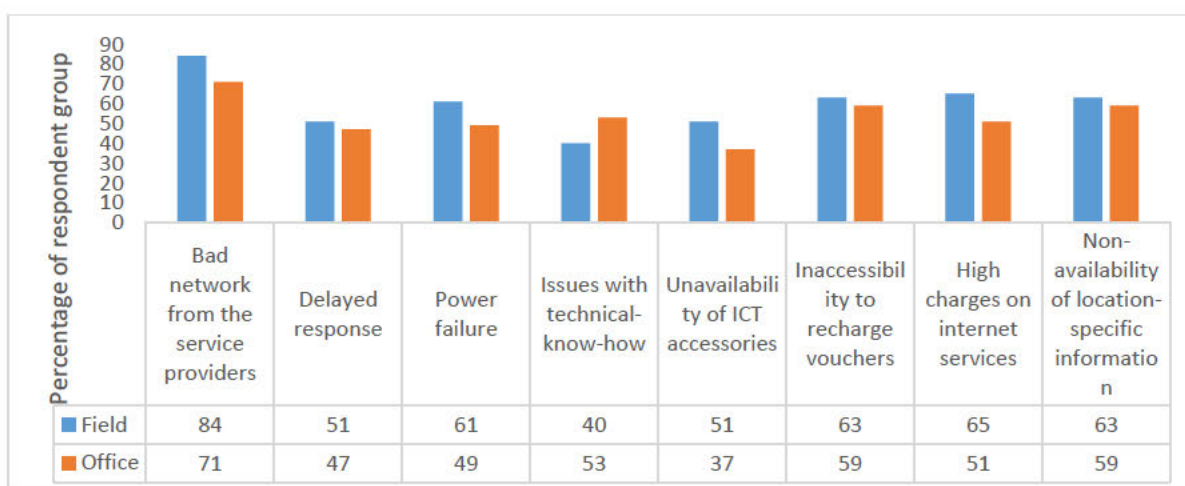


Figure 4.9 Percentage representation of issues encountered while using ICT devices. N=95 (45 field staff and 50 office staff) Source: (Field data, 2021).

4.4 Possible solutions to the challenges encountered while using ICTs.

A selection of solutions to the challenges encountered while using their ICT devices was presented. Respondents were asked to indicate their sentiment levels (level of agreement or disagreement) on a 5-point Likert scale: strongly agree, agree, neither agree nor disagree, disagree to disagree strongly. The total response for each work was computed and divided by the number of respondents to get the average. Then the overall average was computed to get the sentiment score ($2+2.2+2+2.2+1.98+2.2 \div 6 = 2.08$) shown in (Table 4.2). Rounding down to 2 showed that both office-based and field-level agricultural extension personnel agree to the suggestions that would bring a solution to the challenges they face in their work environment. However, Office staff were more in favour. This is similar to the work of Omoregbee and Ajayi, (2010) and Banmeke and Ajayi, (2006) who suggested a need for regular training of extension agents, especially new recruits to determine their areas of development after studying the task performed by extension agents and areas where they needed further training. Other suggestions include that basic computer skills should be a pre-requisite to enlisted as an extension worker, that government should recruit more extension workers, to reduce the cost of internet service to encourage usage of more technology, improve power supply and sponsor more policies to support software licensing and usage.

Table 4.2 Percentage representation of possible solutions suggested to the challenges encountered while using ICTs N = 95 (45 office staff and 50 field staff) Source: (Field data, 2021).

| Government needs to do more to ensure the provision and usage of modern-day technological devices for agricultural extension service delivery. | | | | | | | |
|--|--------------------|-----------|--------------------------------|--------------|-----------------------|-----------|---------|
| | Strongly agree (1) | Agree (2) | Neither agree nor disagree (3) | Disagree (4) | Strongly disagree (5) | Total (%) | Average |
| Office | 83 | 17 | 0 | 0 | 0 | 100 | 2 |
| Field | 66 | 32 | 0 | 0 | 2 | 100 | 2.2 |
| Adequate measures should be put in place to ensure in-service training of extension workers | | | | | | | |
| Office | 63 | 25 | 8 | 2 | 2 | 100 | 2 |
| Field | 48 | 50 | 0 | 2 | 0 | 100 | 2.2 |
| Computer-related courses should be taught in schools in order to prepare students for the work environment as an extension personnel | | | | | | | |
| Office | 65 | 20 | 10 | 2 | 2 | 99 | 1.98 |
| Field | 52 | 41 | 7 | 0 | 0 | 100 | 2.2 |

4.5 Cross Tabulations.

Cross tabulations were used to describe relationships existing between different variables that underpin this study. Cross tabulation according to Aprameya, (2019) provides the means to delve into the research findings and evaluate the different variables to make judgments or inferences. This study used a Chi-square test to determine if there is a significant independent relationship between variables in the cross tabulation. According to Bryman and Cramer (2011) a Chi-square value greater than 0.05 (Pearson value, $P > 0.05$) implies that no significant relationship exists between the variables under examination. On the other hand, a “P” value less than 0.05 ($P < 0.05$) indicates that there is significant relationship between the variables under consideration. For this study, the cross tabulations of frequencies for the different variables were presented and the P value was observed to determine if a significant relationship exists between variables being tested.

In addition, it is important to note that the cross tabulation analysis for this study only focused on the kind of gadgets/devices owned by extension workers, platforms where extension workers get agricultural information and the level of accessibility to the internet and agricultural information while using these devices. This is because majority of the extension workers agree that they have awareness of ICTs and that they own a certain type of device/gadget. Similarly, majority of extension workers agree that they get agricultural information from online sources, this means that they have been exposed to use of ICTs in the course of discharging their duties.

4.5.1 Cross tabulation between age and device owned

Cross tabulation between respondent’s age and the kind of device/gadget owned (Table 4.3) depicts that of the 100 extension workers invited to participate in this study, a majority of them (41.3%) are between the age of 25 – 35 years and they own a mobile phone (89.5%). Similarly, the chi-square results (Appendix 4.2.1) obtained ($P = 0.00$) implies there’s a significant relationship, ($P < 0.005$) between respondent’s age and the kind of device that they own. It can be deduced that the younger the extension worker, the more likely it is that they own an ICT device.

Table 4.3 Cross tabulation between age of respondents and devices/gadgets owned.

| Age * Devices Owned | | | | | | | |
|---------------------|---------------|----------------|---------|------------------------|---------------|----------------|---------|
| Age | Field workers | Office workers | Average | Devices Owned | Field workers | Office workers | Average |
| Ag1(25-35) | 46,67% | 36.0% | 41.3% | Dmp(Mobile phone) | 90.91% | 88.00% | 89.5% |
| Ag2(36-46) | 22,22% | 26.0% | 24.1% | Ddc (Desktop computer) | 20.45% | 32.00% | 26.2% |
| Ag3 (47-57) | 24,44% | 26.0% | 25.2% | Dlp (Laptop) | 52.27% | 64.00% | 58.1% |
| Ag4(58-68) | 6,67% | 12.0% | 9.3% | Dtb (Tablet) | 34.09% | 32.00% | 33.1% |

4.5.2 Cross tabulation between awareness of ICT devices/tools for extension service delivery and platforms where extension workers get information.

A cross tabulations of participant's awareness of ICT devices/tools for extension service delivery (Table 4.4) show that a majority of the participants (95.8%) are aware that there are devices/tools that can help them get access to agricultural information. Hence, 52.4% of the respondents agree that they get agricultural information from journals and 51.5% from emails. The Chi square result for this study shows that there is a significant relationship ($P < 0.005$) between awareness of ICT devices/tools for agricultural extension service delivery and the platforms where extension workers get agricultural information. Though 52.1% of respondents agree that they get their information from books, this shows that regardless of the high level of awareness (95.8%) of the use of ICTs for agricultural extension service delivery, there will always be individuals who prefer the traditional method of seeking information from books.

Table 4.4 Cross tabulation between awareness of ICT devices/tools for extension service delivery and platforms where extension workers get agricultural information.

| Awareness of ICT devices/tools * Platforms where extension workers get information. | | | | |
|---|---------------------------------|----------------|---------------|---------|
| | | Office workers | Field workers | Average |
| Awareness of ICT devices/tools for extension service delivery | (Auy) Yes | 93.88% | 97.73% | 95.8% |
| | (Aun) No | 6.12% | 2.27% | 4.2% |
| Platforms where extension workers get information. | (Pjo) Journals | 48.00% | 56.82% | 52.4% |
| | (Pem) Emails | 44.00% | 59.09% | 51.5% |
| | (Pco) Conferences | 52.00% | 36.36% | 44.18% |
| | (Pse) Seminars | 36.00% | 38.64% | 37.3% |
| | (Pwo) Workshops | 42.00% | 45.45% | 43.7% |
| | (Pao) Attending online training | 44.00% | 27.27% | 35.6% |
| | (Pwe) Webinars | 40.00% | 36.36% | 33.6% |
| | (Pbo) Books | 52.00% | 52.27% | 52.1% |
| | (Psm) Study materials | 34.00% | 36.36% | 35.1% |
| | (Paw) Agricultural websites | 48.00% | 43.18% | 45.5% |
| | (Pcp) Cooperatives | 32.00% | 34.09% | 33.1% |
| | (Pcl) Colleagues | 58.00% | 25.0% | 41.5% |
| | (Pra) Radio/TV broadcast | 46.00% | 45.45% | 45.7% |
| (Pne) Newspaper | 0.00% | 45.45% | 22.7% | |

4.5.3 Cross tabulation between the app/ online platform available at the ADP and level of accessibility to the internet and agricultural information.

Table 4.5 shows that majority of the extension workers (63.0%) confirm that there is an app/ online currently existing at the ESADP. However, it is interesting to note that the level of accessibility to agricultural extension information through this app/online platform is only

52.0%. This shows that only a few of the extension workers are able to access agricultural information through this app/online platform. In the same vein, the result of the Chi-square test ($P = 0.29$) implies that no significant relationship exists between the available app/online platform at the ESADP and the level of accessibility of agricultural information.

Table 4.5 Cross tabulation between the app/online platform available at the ADP and the level of accessibility to agricultural extension information.

| App/online platform available at the ADP * Level of accessibility to agricultural extension information. | | | | |
|--|------------------------|----------------|---------------|---------|
| | | Office workers | Field workers | Average |
| Is there currently an app or platform online at the Edo state ADP that provides the above | (Ay) Yes | 63.27% | 62.79% | 63.0% |
| | (An) No | 36.73% | 39.53% | 38.1% |
| Level of accessibility | (Lh) Highly accessible | 39.58% | 23.81% | 31.7% |
| | (La) Accessible | 39.58% | 64.29% | 52.0% |
| | (Ln) Not accessible | 20.83% | 14.29% | 17.56% |

CHAPTER 5: Discussion of Findings and Conclusion

5.1 Introduction

This chapter presents this study's findings in relation to the key research question and three (3) sub-questions. The main research objective presented in Chapter 1.2 was to explore whether the use of ICT in the Edo State Agricultural Development Program (ESADP) was transforming the delivery of extension services in Benin City, Edo State, Nigeria. This central question gave rise to the following sub-questions.

- 1.2.1 How is the use of ICTS influencing agricultural extension service delivery?
- 1.2.2 What role(s) do the use of ICTs play in agricultural extension service delivery?
- 1.2.3 What are the benefits/challenges in using ICTs in agricultural extension service delivery and the way forward?

For this investigation, the guiding question led to a survey of extension staff affiliated with the ESADP at the office and field level in order to gather factual information about what, how and why they use ICTs and to understand their perceptions.

- 5.1.1 How is the use of ICTs influencing agricultural extension service delivery?

Based on the data obtained, as shown in Figure 4.1, 100% of field workers agree that they have access to the internet at home and 83% at work, while 90% of office-based staff indicated that they have access to the internet at home and 82% at work. This trend shows the growing readiness and need for extension workers to have access to quality information through the use of their devices. Also, 91% of field workers indicated that they had a phone, 54% a laptop and 34% owned a tablet, while 88% of office workers owned a phone, 64% a laptop and 32% a tablet as shown in Fig 4.3. This shows that there is already a functional range of devices that staff rely on for communicating and accessing information. Present-day agricultural extension personnel utilize digital platforms such as Google, emails, webinars, eBooks, agricultural websites and open source journal to garner information. Similarly, most of the participants preferred the use of internet replacing the use of gongs, flutes and other traditional agricultural extension methods. The findings from this study also support several findings from previous studies by Masuka, et al, (2016), Agwu and Uchechi, (2019) and Oladele, (2015) who found

that the use of ICTs is gradually causing a decline in the use of these traditional extension methods.

5.1.2 What are the role(s) played by the use of ICTs in agricultural extension service delivery?

Patterns in analysis showed that most participants prefer to utilize technological devices such as a tablet or laptop and smartphones for communication while in the field or working at the office (Fig 4.2). This was perceived as beneficial for achieving accurate, timely and faster communications, facilitating local market chains, increasing connectivity with stakeholders, reaching a large audience and getting feedback from them (Fig 4.4). These trends agree with the studies by Ayim, et al., (2022), who posited that the ICTs used in the African agricultural sector are text and voice-based services especially mobile phones, radios and computers whose major target is to improve access to accurate and timely agricultural information.

5.1.3 What are the benefits/challenges in the use of ICTs for agricultural extension service delivery and the way forward?

Table 5.1 Cross tabulations of the benefits of ICT use between office workers and field workers.

| Benefits of ICT use among office workers * field level agricultural extension personnel | | | |
|---|---------------|----------------|-------|
| | Field workers | Office workers | Total |
| Ease of use | 76.19% | 81.25% | 78.7% |
| It is faster and super convenient | 69.05% | 60.42% | 64.7% |
| Timely | 47.62% | 52.08% | 50.0% |
| Accuracy of information | 61.9% | 62.50% | 62.2% |
| To generate feedback | 47.62% | 35.42% | 41.5% |
| Reaches a larger audience | 45.24% | 45.83% | 45.5% |
| Reduces time spent on road transportation and other logistics | 61.9% | 62.50% | 62.2% |
| It provides the latest up to date information | 52.38% | 64.58% | 58.5% |
| Increases connectivity with stakeholders | 45.24% | 56.25% | 50.8% |
| Facilitates local market chains | 33.33% | 33.33% | 33.3% |

Table 5.1 shows that ease of use is perceived by both field workers (76.19%) and office workers (81.25%) as the most beneficial reason why they use ICTs for agricultural extension service delivery and facilitation of local market chains (33.3%) respectively as the least benefit derived

from the use of ICTs for agricultural extension service delivery. That phones are not perceived as useful to access local market chains is in contrast to experiences in India and other parts of Africa (Ethiopia and Tanzania). There, the use of mobile phones has demonstrated higher access by farmers to production and market information. This shows that there is opportunity for improving the use of mobile phones for participation in the local market chains.

Table 5.2 Cross tabulations of the challenges encountered while using ICT devices between field workers and office workers.

| Challenges encountered while using ICT devices between field workers * office workers | | | |
|---|---------------|----------------|-------|
| | Field workers | Office workers | Total |
| Bad network from the service providers | 83.72% | 71.43% | 77.6% |
| Delayed response | 51.16% | 46.94% | 49.1% |
| Power failure | 60.47% | 48.98% | 54.7% |
| Issues with technical-know-how | 39.53% | 53.06% | 46.3% |
| Unavailability of ICT accessories | 51.16% | 36.73% | 44.0% |
| Inaccessibility to recharge vouchers | 62.79% | 59.18% | 61.0% |
| High charges on internet services | 65.12% | 51.02% | 58.1% |
| Non-availability of location-specific information | 62.79% | 59.18% | 61.0% |

Table 5.2 shows that bad network from service providers is perceived as the most pressing challenge faced by both field workers (83.72%) and office workers (71.43%). And issues with technical-know-how are the least challenge for field workers while unavailability of ICT accessories is the least pressing for office workers.

5.1.4 The way forward.

Based on observations from the qualitative responses of participants (Appendix 4.1 Table 2) the use of ICTs provided for agricultural extension service delivery by the ESADP structures is not yet perceived as supportive. Twenty (20) responses from the field workers and 21 from office-based staff reveal that agricultural extension personnel are still struggling with issues such as affordability of data, gadgets, software and other devices because they have not been provided with these items in their workplace to enable them carry out their duties. Other concerns raised include shortage of staff, lack of location-specific information, lack of capacity (that is, the required skills-set to use and maintain these devices), and lack of infrastructure. On the other hand, staff members who embrace the use of the internet, Google, smartphones

and socio-networking sites such as WhatsApp, Facebook, Telegram, Twitter, LinkedIn and Instagram indicate that the use of ICTs for agricultural extension service delivery is slowly but rapidly transforming/influencing agricultural extension delivery because of the numerous benefits that they enjoy from using these devices. Therefore, the way forward is to encourage the government and the ESADP to provide better infrastructure and policies that will help support the use of ICTs for agricultural extension service delivery.

5.2 Recommendations

In support of existing literatures, this study affirms that the use of ICTs is spreading, consequently changing the approach to agricultural extension service delivery while creating a gap between those who have skills to use these technological resources and those who don't.

Therefore, based on the findings obtained from this study, the following recommendations are suggested to enable the government, Edo State Agricultural Development Program (ESADP) and agricultural extension personnel to address the challenges encountered while using their ICT devices.

- Adequate measures must put in place to ensure in-service training of agricultural extension workers. Induction courses which focus on the effective use of ICTs for agricultural extension service delivery can also be introduced to recruits.
- Computer-related courses are taught in-house to facilitate effective use of ICTs within the work environment.
- Basic computer skills should be one of the prerequisites to be enlisted as an agricultural extension worker.
- Reducing internet service costs will encourage more use of ICTs for agricultural extension service delivery.

5.2.1 Recommendation for extension programming.

Government should recruit more agricultural extension personnel and design more policies to develop and implement software licensing and usage. (These policies should be aimed at curbing the misuse/abuse of ICTs and encouraging its use for a more productive, efficient and effective service delivery). Government should also engage the services of technical/support staff who will help to handle the maintenance and technical issues as the need arises. Such staff will also assist the agricultural extension workers with technological resources/guidance

whenever they encounter difficulties. The government in collaboration with the Edo State Agricultural Development Program (ESADP) should conduct regular monitoring and evaluation (impact assessment) to ascertain the areas that are making progress or facing more difficulties and to strategize on the way forward. Government must do more to ensure provision and usage of modern-day technological devices for agricultural extension service delivery and to improve power supply (electricity).

5.2.2 Recommendations for further research

The use of ICTs for agricultural extension service delivery was examined in this study at a time when the Edo State Agricultural Development Program (ESADP) was gradually moving towards embracing the digital era. After a steady use of the technological devices, further evaluation and monitoring could look at the type or sources of information that are accessed and valued and the technical challenges and on-going training. These will provide a clearer picture as to the benefits and challenges and need for evolving sources and resources.

The findings of this study are location specific and a web-based survey questionnaire was used to continue during the global pandemic (Covid-19) and the restrictions on human contact. The design would have benefited from the opportunity to probe using focus group discussion. Hence, some responses provided by the participants did not adequately supply sufficient information to complement the breadth of the relationship between agricultural extension service delivery and the use of ICTs by agricultural extension personnel. While it was assumed that agricultural extension workers were already exposed to the use of ICTs, the study could have benefited from an intervention associated with action research that would explore ICT as a shift in the way service providers can improve. Further probing might also raise context specific insight into the use of different ICT devices for agricultural extension service delivery in order to thoroughly understand their individual benefits/challenges. No Focus Groups Discussions (FGDs) or interview schedule was used in this study therefore; further research can use FGDs and panel data to get an in-depth qualitative understanding on how the use of ICTs is transforming agricultural extension service delivery.

Further tests could be conducted in other areas to validate how the use of ICTs is transforming agricultural extension service delivery and to investigate the most suitable ICT sources used by extension workers, and the desire to use ICTs. Also, generating statistical relationships that

represent the entire state to support the decision making of policy makers and precipitate innovation in applications and access to relevant information.

5.4 Conclusion

According to the findings of this study, the evolution of agricultural advisory services from traditional methods to more sophisticated digital systems gave rise to an increase in the use of ICTs for extension service delivery. The results show that these devices were embraced by extension workers because they provide easy access to timely and up-to-date information, reduced the time and cost of travelling and other logistics, connected all stakeholders in the agricultural value chain and encouraged a feedback mechanism. This increase in the use of ICTs is also challenged by an erratic power supply, delayed response from service providers, inaccessibility to recharge vouchers and lack of location-specific information, among others. This study observed from participants' responses that the transformation of agricultural extension service delivery is still not obvious because the only viable and reliable platform for sending and receiving information available to them at the moment is their WhatsApp group. Therefore, a negative relationship exists between using ICTs and transforming agricultural extension service delivery at the ESADP. This is consistent with the work of Chukwunyere, (2019) who further encouraged agricultural institutions to establish their own websites and link up with others for sharing of information and tailor-made in-service trainings on the use of ICTs for agricultural extension agents.

Technologists, scientists and technicians have continued searching for lasting solutions to these challenges and researchers are also providing significant findings that will help improve their work. In the future, extension workers hope that this kind of research will lead to relevant policy formulation that will help mitigate these challenges discussed and improve on the benefits of using ICTs for agricultural extension service delivery. But if these challenges are not managed effectively, it will be difficult for agricultural extension workers to support precision agriculture and inclusion of rural farmers into the formal economy. Therefore, more research, monitoring, evaluation, and resourcing that includes training of extension workers is needed in order to maintain and sustain the benefits derived from the use of ICTs.

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Appendix 3.1 Cover letter of invitation to participants

INVITATION TO PARTICIPATE IN RESEARCH

Dear agricultural extension officer,

My name is Courage Efeomo Uahomo, a postgraduate student from the department of Agricultural Extension and Rural Resource Management, University of Kwazulu-Natal, South Africa, with phone number +27737415925 and email address as 219098473@stu.ukzn.ac.za.

You are being invited to consider participating in a study that involves the use of information and communication technologies (ICTs) in agricultural extension service delivery. The aim and purpose of this research is to investigate the use of ICTs by the Field and Office extension staff in the Agricultural Development Program (ADP) office providing extension services to farmers in Edo state.

The study will enrol 100 participants in total, 50 from the office staff while the other 50 will be selected from among the field-level agricultural extension workers at the Agricultural Development Program (ADP), Benin-City. This involves filling out a questionnaire that will be provided to you. The duration of your participation if you choose to enrol and remain in the study is expected to be 6 minutes.

The study will provide no direct benefits to you but aims to produce knowledge pertaining to establishing what ICT resources are available in the ADP (What ICTs are in use?), describing the role that ICT resources play in service delivery (What role/s is/are played by ICTs?) and to conceptualize the benefits/challenges of ICT use in similar contexts for service delivery (What are the benefits/challenges of using ICTs on agricultural extension service delivery and the way forward?). Hence, participation is voluntary and participants can withdraw at any point and in the event of refusal/withdrawal of participation there will be no penalty, loss of treatment or other benefit to which you are normally entitled.

Having understood the concept explained above, filling out the questionnaire will be considered as consent given. Thanks for your cooperation.

If you are a field level agricultural extension worker, please click on this link:
<https://www.surveymonkey.com/r/8CDPFTD>

If you are an office based agricultural worker, please click on this link:

<https://www.surveymonkey.com/r/C8KRYQX>

Appendix 3.2 Ethics approval letter



21 August 2021

Miss Courage Efeomo Uahomo (219098473)
School Of Agri Earth & Env Sc
Pietermaritzburg Campus

Dear Miss Uahomo,

Protocol reference number: HSSREC/00003053/2021

Project title: ICTs; Transforming agricultural extension service delivery? (A case study of the Edo state Agricultural Development Program, ADP)

Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received 05 July 2021 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 21 August 2022.

To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,



Professor Dipane Hlalele (Chair)

/dd

Humanities and Social Sciences Research Ethics Committee

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Telephone: +27 (0)31 260 8350/4557/3587 Email: hssrec@ukzn.ac.za Website: <http://research.ukzn.ac.za/Research-Ethics>

Founding Campuses:  Edgewood  Howard College  Medical School  Pietermaritzburg  Westville



INSPIRING GREATNESS

Appendix 3.3 Summary of Pretest Questionnaire

Work environment

1. What is your area of specialization?
 - (1) Administration (a) yes (b) no
 - (2) Research laboratory (a) yes (b) no
 - (3) Technical/IT department (a) yes (b) no
 - (4) Pensions and account department (a) yes (b) no
 - (5) Consult/advice and train farmers (a) yes (b) no
 - (6) Research field (a) yes (b) no
2. As an agricultural extension officer; what is/are your source(s) of information?
 1. Mobile phone (a) yes (b) no
 2. Web portals (a) yes (b) no
 3. Newsletters, journals and memos (a) yes (b) no
 4. Radio and television (a) yes (b) no
 5. Emails (a) yes (b) no
 6. Books (a) yes (b) no
 7. Magazines (a) yes (b) no
 8. Research papers (a) yes (b) no
 9. Departmental documents on agricultural processes and technology (a) yes (b) no
 10. Words of mouth from family, friends and colleagues (a) yes (b) no
3. Were you trained before, during or after using such ICT tools? (a) Yes (b) no
4. Do you have access to the internet at home? (a) yes (b) no (c) sometimes
5. Do you have access to internet in the office? (a) yes (b) no (c) sometimes
6. Do you have access to internet on the field? (a) yes (b) no (c) sometimes
7. How do you collect, process, analyze, archive and use agricultural information available?
 1. Manually (a) yes (b) no
 2. Automatically (a) yes (b) no
8. Does the use of ICTs replace the use of traditional extension methods? (a) yes (b) no
9. Does the use of ICTs complement the use of traditional extension methods? (a) yes (b) no

Appendix 3.4 Office Questionnaire

1. Age

25 - 35

36 - 46

47 - 57

58 - 68

2. Gender

Male

Female

3. Relationship status

Married

Single

Divorced

Widowed

4. Educational qualification:

Bachelor of Agriculture

- Masters of Agriculture
- PhD
- Other (please specify)

5. LGA of origin

- Owan East
- Owan West
- Akoko-Edo
- Irrua
- Igueben
- Oredo
- Ikpoba - Okha
- Esan South East
- Etsako Central
- Esan West
- Esan Central
- Ovia North East
- Uhunwonde

- Orhiomwon
- Egor
- Esan North East
- Etsako East
- Etsako West
- Ovia South West

6. Position/level in the agricultural extension department

- Junior staff
- Senior staff

7. Grade level?

8. What is your area of specialization?

- Administration
- Research laboratory

- Technical/IT department
- Pensions and account department
- Other (please specify)

9. Are you aware of the use of information and communication technology devices/tools for agricultural extension service delivery?

- Yes
- No

10. What kind of gadgets/devices do you have?

- Mobile phone
- Desktop computer
- Laptop
- Tablet
- Other (please specify)

11. Where did you use the devices mentioned above?

- At the office
- At home

Both

12. For what purpose did you use the above-listed devices?

For work

For personal use

Both

Other (please specify)

13. When you are working in the office, through which voice means do you communicate more often?

Phone calls

Face-to-face

Voice notes/voice messages

All of the above

Other (please specify)

14. While working in the office, what text message platforms do you use the most?

SMS

Email

WhatsApp

Telegram

Other (please specify)

15. What video call platforms do you use more often?

Zoom

WhatsApp

Teams

Google Meet

Skype

Telegram

Other (please specify)

16. Is there a physical platform (like a cooperative or Annual General Meeting) that connects farmers, extension workers, traders, middlemen and consumers?

Yes

No

17. If yes to question 16 above, then what are their names?

18. And how often do they meet?

19. Is there currently an app or platform online at the Edo state ADP that connects extension workers, farmers, middlemen, traders and consumers?

Yes

No

20. If yes to question 19 above, what is this app/platform called?

21. Why do you use the above-mentioned information platforms?

Ease of use

It is faster and super convenient

Timely

Accuracy of information

To generate feedback

Reaches a larger audience

Reduces time spent on road transportation and other logistics

It provides the latest up to date information

- Increases connectivity with stakeholders
- Facilitates local market chains
- All of the above
- Other (please specify)

22. Which other professional platform do you get official information from?

- Journals
- Emails
- Conferences
- Seminars
- Workshops
- Attending online trainings
- Webinars
- Books and study materials
- Agricultural websites
- Cooperatives
- Colleagues
- Radio/TV broadcast

Newspaper

Other (please specify)

23. What kind of devices do you use in the office?

Training devices

Information gathering devices

Research devices

Other (please specify)

24. How do you collect, process, analyse, archive and use information at the office?

By sending hard copies of documents for signature

By using drop box

Microsoft office

One drive

Other (please specify)

25. What kind of information is available to you at the office?

Information about staff details, finance, office administration and other general clerical duties

Science and technology information including weather reports, pest and disease outbreak, innovations, identification of plants and animals, sounds, planting rotation, experts opinion/consultancy, networking for sales/purchase and market prices

Indigenous knowledge including the beliefs/practices of the rural farmers and their feedback

Other (please specify)

None of the above

26. Who provides the information you use at the office?

Government

Research institute

Agricultural Development Program

The farmers

You (the extension worker)

Other (please specify)

None of the above

27. Who provides the devices you use in the office?

Government

Personal

Agricultural Development Program

Other (please specify)

28. Do you have access to the internet at home?

Yes

No

29. If yes to question 28 above, then how do you access the internet?

Family Wi-Fi

Personal data bundle

Other (please specify)

30. Do you have access to internet in the office?

Yes

No

31. If yes to question 30 above, then how do you access the internet?

Official LAN

Office Wi-Fi

Sharing data bundles with colleagues

Personal data bundle

32. While working in the office, describe your level of accessibility to agricultural extension information through the use of your device.

Highly accessible

Accessible

Not accessible

33. Do you encounter any of the following issues when using your device?

Bad network from the service providers

Delayed response

Power failure

Issues with technical-know-how

Unavailability of ICT accessories

Inaccessibility to recharge vouchers

High charges on internet services

Non-availability of location-specific information

All of the above

Other (please specify)

34. Were you able to resolve the issues listed above by yourself?

Yes

No

35. Did you request an expert to help you out with the issues encountered while using your device?

Yes

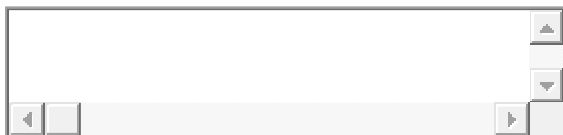
No

36. Has access to Google, e-books and open-source journals available online affected the way you obtain information?

Yes

No

37. Please explain your answer in question 36 above



38. Has your use of the internet replaced your use of hard copy documents?

Yes

No

I still use both side by side

39. Explain your answer in question 38 above.



40. On a scale of 1-5, indicate your level of agreement or disagreement to the following statements: government needs to do more to ensure the provision and usage of modern-day technological devices for agricultural extension service delivery.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

41. Adequate measures should be put in place to ensure in-service training of extension workers.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

42. Computer-related courses should be taught in schools in order to prepare students for the work environment as an extension personnel?

- Strongly agree
- Agree
- Neither agree nor disagree

Disagree

Strongly disagree

43. That basic computer skills should be one of the pre-requisites to be enlisted as an extension worker

Strongly agree

Agree

Neither agree nor disagree

Disagree

Strongly disagree

44. With all the answers you have provided above; do you agree that the use of ICTs is influencing (transforming) agricultural extension service delivery?

Yes

No

45. Give reason(s) for your answer above

Appendix 3.5 Field Questionnaire

1. Age

25 - 35

36 - 46

47 - 57

58 - 68

2. Gender

Male

Female

3. Relationship status

Married

Single

Divorced

Widowed

4. Educational qualification:

Bachelor of Agriculture

- Masters of Agriculture
- PhD
- Other (please specify)

5. LGA of origin

- Owan East
- Owan West
- Akoko-Edo
- Irrua
- Igueben
- Oredo
- Ikpoba - Okha
- Esan South East
- Etsako Central
- Esan West
- Esan Central
- Ovia North East
- Uhunwonde

- Orhiomwon
- Egor
- Esan North East
- Etsako East
- Etsako West
- Ovia South West

6. Position/level in the agricultural extension department

- Junior staff
- Senior staff

7. Grade level?

8. What is your area of specialization?

- Consult/advice and train farmers
- Research field
- Other (please specify)

9. Are you aware of the use of information and communication technology devices/tools for agricultural extension service delivery?

Yes

No

10. What kind of gadgets/devices do you have?

Mobile phone

Desktop computer

Laptop

Tablet

Other (please specify)

11. For what purpose did you use the above listed devices?

For work

For personal use

Both

12. What kind of devices do you use on the field?

- Training devices
- Information gathering devices
- Research devices

13. Which other professional platform do you get information about weather forecast, pest and disease infestation, market prices and other factors from?

- Journals
- Emails
- Conferences
- Seminars
- Workshops
- Attending online training
- Webinars
- Books
- Study materials
- Agricultural websites
- Cooperatives
- Colleagues

Radio/TV broadcast

Newspaper

14. While working in the field, through which means of voice communication do you communicate more often?

Phone calls

Face - to - face

WhatsApp voice note

Gong

Flutes

Town criers

15. While working in the field, what text message platforms do you use?

Twitter

Instagram

SMS

Email

WhatsApp

Telegram

Messenger

16. What video call platforms do you use more often?

Zoom

WhatsApp

Teams

Google meet

Skype

17. What kind of information is available to you on the field?

Information about farmers, the challenges they face on their farms and their demand for more improved farm practices/systems

Science and technology information including weather reports, pest and disease outbreaks, innovations, identification of plants and animals, sounds, planting rotation, expert's opinion/consultancy, networking for sales/purchase and market prices

Indigenous knowledge including the beliefs/practices of the rural farmers and their feedback

18. Is there currently an app or platform online at the Edo state ADP that provides the above information/connects extension workers, farmers, middlemen, traders and consumers?

Yes

No

19. If yes to question 18 above, what is this app/platform called?

20. Is there a physical platform (like a cooperative or Annual General Meeting) that provides information/connects farmers, extension workers, traders, middlemen and consumers?

Yes

No

21. If yes to question 20 above, then what are their names?

22. And how often do they meet?

23. Where do you prefer to get agricultural extension-related information for your fieldwork?

Online

Offline

Other (please specify)

24. Give reason for your answer in question 23 above.

25. How do you collect information from the field?

By taking notes in your jotter

Using a tablet

Using your phone to take pictures

Making recordings

Using remote sensors

26. How do you share information on the field?

From your personal experiences

From your notes

From what you learnt at school

From your tablet

From your phone

27. Why do you use the above mentioned information devices?

- Ease of use
- It is faster and super convenient
- Timely
- Accuracy of information
- To generate feedback
- Reaches a larger audience
- Reduces time spent on road transportation and other logistics
- It provides the latest up to date information
- Increases connectivity with stakeholders
- Facilitates local market chains
- Other (please specify)

28. Do you have access to internet at home?

- Yes
- No

29. If yes to question 28 above, then how do you access the internet?

- Family Wi-Fi
- Personal data bundle

30. Do you have access to internet on the field?

Yes

No

31. If yes to question 30 above, then how do you access the internet?

Official LAN

Office Wi-Fi router

Sharing data bundles with colleagues

Personal data bundle

32. Who provides the devices you use on the field?

Government

Personal

Agricultural Development Program (ADP)

33. While working in the field, describe your level of accessibility to agricultural extension information through the use of your device.

Highly accessible

Accessible

Not accessible

34. Who provides the information you use on the field?

Government

- The research institute
- Agricultural Development Program (ADP)
- The farmers
- From personal research

35. Do you encounter any of the following when using your ICT device?

- Bad network from the service providers
- Delayed response
- Power failure
- Issues with technical-know-how
- Unavailability of ICT accessories
- Inaccessibility to recharge vouchers
- High charges on internet services
- Non-availability of location-specific information

36. Which other issue(s) do you face while using your devices on the field?

- Access to loan
- Lack of equipment
- Insufficient manpower
- Inadequate government policies to support software licensing

37. Has your access to Google, e-books and open-source journals available online affected the way you obtain information?

Yes

No

38. Has your use of the internet affected your use of gongs, flutes, extension-to-farmer visits, town criers and other traditional methods of extension?

Yes

No

39. On a scale of 1 - 5, indicate your level of agreement or disagreement to the following statements: Government needs to do more to ensure the provision and usage of modern-day technological devices for agricultural extension service delivery.

Strongly agree

Agree

Neither agree nor disagree

Disagree

Strongly disagree

40. Adequate measures should be put in place to ensure in-service training of extension workers

Strongly agree

Agree

Neither agree nor disagree

Disagree

Strongly disagree

41. Computer-related courses should be taught in schools to prepare students for the work environment as an extension personnel

Strongly agree

Agree

Neither agree nor disagree

Disagree

Strongly disagree

42. That basic computer skills should be one of the prerequisites to be enlisted as an extension worker.

Strongly agree

Agree

Neither agree nor disagree

Disagree

Strongly disagree

43. Government should recruit more extension personnel to achieve the 1:100 extension-farmer ratio.

Strongly agree

Agree

- Neither agree nor disagree
- Disagree
- Strongly disagree

44. Reduction in internet service cost will encourage more use of technology for extension service delivery.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

45. More should be done to improve power supply

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

46. More policies should be put in place to ensure software licensing and usage

- Strongly agree
- Agree

Neither agree nor disagree

Disagree

Strongly disagree

47. With all the answer you have provided above; do you agree that the use of ICTs is influencing (transforming) agricultural extension service delivery?

Yes

No

48. Give reason(s) for your answer above

Appendix 3.6 Example of Data coding using excel

| Respondent number | Q1. Age 25-35 | 36-46 | 47-57 | 58-68 | Q2. Gender Male | Female | Q3. Marital status Married | Single | Divorced | Separated | Q4. Educational qualification | Masters | B.Agric |
|-------------------|---------------|-------|-------|-------|-----------------|--------|----------------------------|--------|----------|-----------|-------------------------------|---------|---------|
| 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 2 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 3 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 4 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 5 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 6 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 7 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 8 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 9 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 10 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 11 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 12 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 13 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 14 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 15 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 16 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 17 | 1 | 1 | 0 | Nr | 1 | 1 | 1 | 0 | 0 | 1 | 0- | Nr | 1 |
| 18 | 0 | 1 | 0 | `1 | 1 | 1 | 1 | Nr | 1 | 1 | 0 | 1 | 0 |
| 19 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| 20 | 1 | 0 | `1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | `1 |

Appendix 3.7 Gatekeeper's letter



Edo State Agricultural Development Programme

HEAD OFFICE:
Ogba Road,
Oka Village,
P.M.B 1698,
Benin City,
Edo State, Nigeria.

Your Ref: _____

Our Ref: _____

Date: 2nd March, 2021

The Research Ethics Committee,
Department of Agricultural Extension and Rural Resource Management,
College of Agriculture, Earth and Engineering Sciences,
University of Kwazulu-Natal,
Pietermaritzburg Campus,
RSA.

Approval for Permission to Conduct Research

Above subject matter refers please.

2. Your request for consent to access the full names and email address of frontline (field level) Agricultural Extension workers of Edo Agricultural Development Programme for the purpose of your MSc research project has been granted.
3. Consequently, you are to liaise with the Director of Agric Extension Services, Mr Princewill Igbinedion (Mobile: 08054499997; Email: princewillvellowater@yahoo.com) for further necessary action.
4. Please note that this approval is granted only for research purpose as detailed in your request letter.
5. Please accept the assurances of my warmest regards

Aikhuomobhogbe P.U.
Programme Manager

Appendix 4.1 Field Data Summary (2021)

Appendix 4.1. Table 1. Summary of Field and Office Worker Responses from Questionnaires.

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---------------------|-------------------|-----------------|-----------------------------|------------------|------------------------------|
| Age | Ag1 (25-35) | 46,67% | 21 | 36.0% | 18 |
| | Ag2 (36-46) | 22,22% | 10 | 26.0% | 13 |
| | Ag3 (47-57) | 24,44% | 11 | 26.0% | 13 |
| | Ag4 (58-68) | 6,67% | 3 | 12.0% | 6 |
| | Answered | | 45 | | 50 |
| | Skipped | | 0 | | 0 |
| Gender | Gm (Male) | 55,56% | 25 | 54.0% | 27 |
| | Gf (Female) | 44,44% | 20 | 46.0% | 23 |
| | Answered | | 45 | | 50 |
| | Skipped | | 0 | | 0 |
| Relationship Status | Rm (married) | 44.44% | 20 | 34.00% | 17 |
| | Rs (single) | 37.78% | 17 | 36.00% | 18 |
| | Rd (divorced) | 6.67% | 3 | 24.00% | 12 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---------------------------|-------------------|-----------------|-----------------------------|------------------|------------------------------|
| | Rw (widowed) | 11.11% | 5 | 8.00% | 4 |
| | Answered | | 45 | | 50 |
| | Skipped | | 0 | | 0 |
| Educational qualification | Eb (Bachelor) | 35.56% | 16 | 30.00% | 15 |
| | Em (Masters) | 35.56% | 16 | 42.00% | 21 |
| | EPhD (PhD) | 22.22% | 10 | 18.00% | 9 |
| | Eo (Others) | 8.89% | 4 | 10.00% | 5 |
| | Answered | | 45 | | 50 |
| | Skipped | | 0 | | 0 |
| LGA of Origin | LGo (Owan East) | 20.0% | 9 | 12.24% | 6 |
| | LGow (Owan West) | 8.89% | 4 | 2.04% | 1 |
| | LGa (Akoko-Edo) | 2.22% | 1 | 6.12% | 3 |
| | LGi (Irrua) | 6.67% | 3 | 8.16% | 4 |
| | Lgig (Igueben) | 4.44% | 2 | 2.04% | 1 |
| | LGor (Oredo) | 0.0% | 0 | 0.00% | 0 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|-----------------|-------------------------|-----------------|-----------------------------|------------------|------------------------------|
| | LGik (Ikpoba – Okha) | 4.44% | 2 | 6.12% | 3 |
| | LGes (Esan South East) | 2.22% | 1 | 6.12% | 3 |
| | LGec (Etsako Central) | 8.89% | 4 | 2.04% | 1 |
| | LGew (Esan West) | 11.11% | 5 | 10.20% | 5 |
| | LGes (Esan Central) | 4.44% | 2 | 8.16% | 4 |
| | Lgov (Ovia North East) | 4.44% | 2 | 4.08% | 2 |
| | LGuh (Uhunwonde) | 4.44% | 2 | 4.08% | 2 |
| | LGorh (Orhiomwon) | 6.67% | 3 | 2.04% | 1 |
| | LGeg (Egor) | 0.0% | 0 | 6.12% | 3 |
| | LGene (Esan North East) | 4.44% | 2 | 8.16% | 4 |
| | LGet (Etsako East) | 4.44% | 2 | 4.08% | 2 |
| | LGetw (Etsako West) | 4.44% | 2 | 2.04% | 1 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|--|---------------------------------------|-----------------|-----------------------------|------------------|------------------------------|
| | Lgosw (Ovia South West) | 0.0% | 0 | 6.12% | 3 |
| | Answered | | 45 | | 49 |
| | Skipped | | 0 | | 1 |
| Position/level in the agricultural extension department. | Pj (Junior staff) | 60.47% | 26 | 58.33% | 28 |
| | Ps (Senior staff) | 39.53% | 17 | 41.67% | 20 |
| | Answered | | 43 | | 48 |
| | Skipped | | 2 | | 2 |
| What is your area of specialization? | Ac (Consult/advice and train farmers) | 43.18% | 19 | - | - |
| | Ar (Research field) | 54.55% | 24 | - | - |
| | Ao (Other) (please specify) | 4.55% | 2 | - | - |
| | Aad (Administration) | - | - | 30.61% | 15 |
| | Arl (Research laboratory) | - | - | 26.53% | 13 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|--------------------------------------|-----------------|-----------------------------|------------------|------------------------------|
| | At (Technical/IT department) | - | - | 32.65% | 16 |
| | Ap (Pensions and account department) | - | - | 16.33% | 8 |
| | Answered | | 44 | | 49 |
| | Skipped | | 1 | | 1 |
| Are you aware of the use of information and communication technology devices/tools for agricultural extension service delivery? | Auy (Yes) | 97.73% | 43 | 93.88% | 46 |
| | Aun (No) | 2.27% | 1 | 6.12% | 3 |
| | Answered | | 44 | | 49 |
| | Skipped | | 1 | | 1 |
| What kind of gadgets/devices do you have? | Dmp (Mobile phone) | 90.91% | 40 | 88.00% | 44 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|--|------------------------------|-----------------|-----------------------------|------------------|------------------------------|
| | Ddc (Desktop computer) | 20.45% | 9 | 32.00% | 16 |
| | Dlp (Laptop) | 52.27% | 23 | 64.00% | 32 |
| | Dtb (Tablet) | 34.09% | 15 | 32.00% | 16 |
| | Dot (Other) (please specify) | 0.0% | 0 | 0.00% | 0 |
| | Answered | | 44 | | 50 |
| | Skipped | | 1 | | 0 |
| For what purpose did you use the above listed devices? | Pw (For work) | 75.0% | 33 | 32.00% | 16 |
| | Pp (For personal use) | 56.82% | 25 | 36.00% | 18 |
| | Pb (Both) | 36.36% | 16 | 74.00% | 37 |
| | Answered | | 44 | | 50 |
| | Skipped | | 1 | | 0 |
| What kind of devices do you use on the field? | Kt (Training devices) | 48.84% | 21 | - | - |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|--|------------------------------------|-----------------|-----------------------------|------------------|------------------------------|
| | Ki (Information gathering devices) | 41.86% | 18 | - | - |
| | Kr (Research devices) | 30.23% | 13 | - | - |
| | Answered | | 43 | - | - |
| | Skipped | | 2 | - | - |
| Which other professional platform do you get information about weather forecast, pest and disease infestation, market prices and other factors from? | Pjo (Journals) | 56.82% | 25 | 48.00% | 24 |
| | Pem (Emails) | 59.09% | 26 | 44.00% | 22 |
| | Pco (Conferences) | 36.36% | 16 | 52.00% | 26 |
| | Pse (Seminars) | 38.64% | 17 | 36.00% | 18 |
| | Pwo (Workshops) | 45.45% | 20 | 42.00% | 21 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|---------------------------------|-----------------|-----------------------------|------------------|------------------------------|
| | Pao (Attending online training) | 27.27% | 12 | 44.00% | 22 |
| | Pwe (Webinars) | 36.36% | 16 | 40.00% | 20 |
| | Pbo (Books) | 52.27% | 23 | 52.00% | 26 |
| | Psm (Study materials) | 36.36% | 16 | 34.00% | 17 |
| | Paw (Agricultural websites) | 43.18% | 19 | 48.00% | 24 |
| | Pcp (Cooperatives) | 34.09% | 15 | 32.00% | 16 |
| | Pcl (Colleagues) | 25.0% | 11 | 58.00% | 29 |
| | Pra (Radio/TV broadcast) | 45.45% | 20 | 46.00% | 23 |
| | Pne (Newspaper) | 45.45% | 20 | 0.00% | 0 |
| | Answered | | 44 | | 50 |
| | Skipped | | 1 | | 0 |
| While working in the field, through which means of voice communication do | Cp (Phone calls) | 65.12% | 28 | 58.00% | 29 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|--------------------------|-----------------|-----------------------------|------------------|------------------------------|
| you communicate more often? | | | | | |
| | Cf (Face - to – face) | 65.12% | 28 | 56.00% | 28 |
| | Cw (WhatsApp voice note) | 48.84% | 21 | 44.00% | 22 |
| | Cg (Gong) | 4.65% | 2 | - | - |
| | Cf (Flutes) | 9.3% | 4 | - | - |
| | Ct (Town criers) | 2.33% | 1 | - | - |
| | Ca (All of the above) | - | - | 62% | 31 |
| | Answered | | 43 | | 50 |
| | Skipped | | 2 | | 0 |
| While working in the field, what text message platforms do you use? | Ttw (Twitter) | 4.65% | 2 | - | - |
| | Tin (Instagram) | 18.6% | 8 | - | - |
| | Tsm (SMS) | 65.12% | 28 | 70.00% | 35 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|--|-------------------|-----------------|-----------------------------|------------------|------------------------------|
| | Tem (Email) | 60.47% | 26 | 72.00% | 36 |
| | Twh (WhatsApp) | 88.37% | 38 | 72.00% | 36 |
| | Tte (Telegram) | 30.23% | 13 | 52.00% | 26 |
| | Tme (Messenger) | 27.91% | 12 | - | - |
| | Answered | | 43 | | 50 |
| | Skipped | | 2 | | 0 |
| What video call platforms do you use more often? | Vz (Zoom) | 48.84% | 21 | 60.00% | 30 |
| | Vw (WhatsApp) | 69.77% | 30 | 60.00% | 30 |
| | Vt (Teams) | 32.56% | 14 | 46.00% | 23 |
| | Vg (Google meet) | 44.19% | 19 | 62.00% | 31 |
| | Vs (Skype) | 23.26% | 10 | 50.00% | 25 |
| | Vte (Telegram) | - | - | 40.00% | 20 |
| | Answered | | 43 | | 50 |
| | Skipped | | 2 | | 0 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|--|---|-----------------|-----------------------------|------------------|------------------------------|
| What kind of information is available to you on the field? | Ii (Information about farmers, the challenges they face on their farms and their demand for more improved farm practices/systems) | 74.42% | 32 | - | - |
| | Is (Science and technology information including weather reports, pest and disease outbreaks, innovations, identification of plants and animals, sounds, planting rotation, experts opinion/consultancy, networking for sales/purchase and market prices) | 67.44% | 29 | 62.50% | 30 |
| | Iin (Indigenous knowledge including | 39.53% | 17 | 64.58% | 31 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|---|-----------------|-----------------------------|------------------|------------------------------|
| | the beliefs/practices of the -rural farmers and their feedback) | | | | |
| | Isd (Information about staff details, finance, office administration and other general clerical duties) | - | - | 60.42% | 29 |
| | In (None of the above) | | | 4.17% | 2 |
| | Answered | 43 | | | 48 |
| | Skipped | 2 | | | 2 |
| Is there currently an app or platform online at the Edo state ADP that provides the above information/connects extension workers, farmers, middlemen, | Ay (Yes) | 62.79% | 27 | 63.27% | 31 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|--|-------------------|-----------------|-----------------------------|------------------|------------------------------|
| traders and consumers? | | | | | |
| | An (No) | 39.53% | 17 | 36.73% | 18 |
| | Answered | | 43 | | 49 |
| | Skipped | | 2 | | 1 |
| Is there a physical platform (like a cooperative or Annual General Meeting) that provides information/connects farmers, extension workers, traders, middlemen and consumers? | Cy (Yes) | 80.95% | 34 | 75.51% | 37 |
| | Cn (No) | 21.43% | 9 | 26.53% | 13 |
| | Answered | | 42 | | 49 |
| | Skipped | | 3 | | 1 |
| Where do you prefer to get agricultural extension-related | Aio (Online) | 100.0% | 43 | | |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|--|---|-----------------|-----------------------------|------------------|------------------------------|
| information for your fieldwork? | | | | | |
| | Aof (Offline) | 16.28% | 7 | - | - |
| | Aot (Other (please specify)) | 4.65% | 2 | - | - |
| | Answered | | 43 | - | - |
| | Skipped | | 2 | - | - |
| How do you collect information from the field? | Ctn (By taking notes in your jotter) | 83.33% | 35 | - | - |
| | Ctb (Using a tablet) | 35.71% | 15 | - | - |
| | Cup (Using your phone to take pictures) | 71.43% | 30 | - | - |
| | Cmr (Making recordings) | 64.29% | 27 | - | - |
| | Crs (Using remote sensors) | 2.38% | 1 | - | - |
| | Answered | | 42 | - | - |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|--|---|-----------------|-----------------------------|------------------|------------------------------|
| | Skipped | | 3 | - | - |
| How do you share information on the field? | Spe (From your personal experiences) | 79.07% | 34 | - | - |
| | Sfn (From your notes) | 58.14% | 25 | - | - |
| | Sfs (From what you learnt at school) | 60.47% | 26 | - | - |
| | Sft (From your tablet) | 30.23% | 13 | - | - |
| | Sfp (From your phone) | 62.79% | 27 | - | - |
| | Answered | | 43 | - | - |
| | Skipped | | 2 | - | - |
| How do you collect, process, analyze, archive and use information at the office? | Psc (By sending hard copies of documents for signature) | - | - | 84.00% | 42 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|--|-----------------|-----------------------------|------------------|------------------------------|
| | Pud (By using drop box) | - | - | 44.00% | 22 |
| | Pmo (Microsoft office) | - | - | 46.00% | 23 |
| | Pod (One drive) | - | - | 42.00% | 21 |
| | Pot (Other (please specify)) | - | - | 0.00% | 0 |
| | Answered | - | - | | 50 |
| | Skipped | - | - | | 0 |
| Why do you use the above mentioned information devices? | We (Ease of use) | 76.19% | 32 | 81.25% | 39 |
| | Wf (It is faster and super convenient) | 69.05% | 29 | 60.42% | 29 |
| | (Timely) | 47.62% | 20 | 52.08% | 25 |
| | Wa (Accuracy of information) | 61.9% | 26 | 62.50% | 30 |
| | Wg (To generate feedback) | 47.62% | 20 | 35.42% | 17 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|--|-----------------|-----------------------------|------------------|------------------------------|
| | Wr (Reaches a larger audience) | 45.24% | 19 | 45.83% | 22 |
| | Wt (Reduces time spent on road transportation and other logistics) | 61.9% | 26 | 62.50% | 30 |
| | Wp (It provides the latest up to date information) | 52.38% | 22 | 64.58% | 31 |
| | Wi (Increases connectivity with stakeholders) | 45.24% | 19 | 56.25% | 27 |
| | Wf (Facilitates local market chains) | 33.33% | 14 | 33.33% | 16 |
| | Answered | | 42 | | 48 |
| | Skipped | | 3 | | 2 |
| Do you have access to internet at home? | Acy (Yes) | 100.0% | 42 | 89.80% | 44 |
| | Acn (No) | 0.0% | 0 | 10.20% | 5 |
| | Answered | | 42 | | 49 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|--|--|-----------------|-----------------------------|------------------|------------------------------|
| | Skipped | | 3 | | 1 |
| Do you have access to internet on the field? | Afy (Yes) | 83.33% | 35 | 81.63% | 40 |
| | Afn (No) | 16.67% | 7 | 18.37% | 9 |
| | Answered | | 42 | | 49 |
| | Skipped | | 3 | | 1 |
| Who provides the devices you use on the field? | Pfg (Government) | 26.19% | 11 | 57.14% | 28 |
| | Pfp (Personal) | 88.1% | 37 | 57.14% | 28 |
| | Pfa (Agricultural Development Program (ADP)) | 59.52% | 25 | 87.76% | 43 |
| | Answered | | 42 | | 49 |
| | Skipped | | 3 | | 1 |
| While working in the field, describe your level of accessibility to agricultural | Lh (Highly accessible) | 23.81% | 10 | 39.58% | 1 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|--|--|-----------------|-----------------------------|------------------|------------------------------|
| extension information through the use of your device | | | | | |
| | La (Accessible) | 64.29% | 27 | 39.58% | 19 |
| | Ln (Not accessible) | 14.29% | 6 | 20.83% | 10 |
| | Answered | | 42 | | 48 |
| | Skipped | | 3 | | 2 |
| Who provides the information you use on the field? | Pig (Government) | 23.81% | 10 | - | - |
| | Pir (The research institute) | 30.95% | 13 | - | |
| | Pia (Agricultural Development Program (ADP)) | 50.0% | 21 | - | - |
| | Pif (The farmers) | 54.76% | 23 | - | - |
| | Pip (From personal research) | 66.67% | 28 | - | - |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|---|-----------------|-----------------------------|------------------|------------------------------|
| | Answered | | 42 | - | - |
| | Skipped | | 3 | - | - |
| Do you encounter any of the following when using your ICT device? | Cbn (Bad network from the service providers) | 83.72% | 36 | 71.43% | 35 |
| | Cdr (Delayed response) | 51.16% | 22 | 46.94% | 23 |
| | Cpf (Power failure) | 60.47% | 26 | 48.98% | 24 |
| | Cit (Issues with technical-know-how) | 39.53% | 17 | 53.06% | 26 |
| | Cua (Unavailability of ICT accessories) | 51.16% | 22 | 36.73% | 18 |
| | Cir (Inaccessibility to recharge vouchers) | 62.79% | 27 | 59.18% | 29 |
| | Chc (High charges on internet services) | 65.12% | 28 | 51.02% | 25 |
| | Can (Non-availability of location-specific information) | 62.79% | 27 | 59.18% | 29 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|---|-----------------|-----------------------------|------------------|------------------------------|
| | Answered | | 43 | | 49 |
| | Skipped | | 2 | | 1 |
| Which other issue(s) do you face while using your devices on the field? | Il (Access to loan) | 35.71% | 15 | - | - |
| | Ie (Lack of equipment) | 69.05% | 29 | - | - |
| | Im (Insufficient manpower) | 76.19% | 32 | - | - |
| | Ip (Inadequate government policies to support software licensing) | 61.9% | 26 | - | - |
| | Answered | | 42 | - | - |
| | Skipped | | 3 | - | - |
| Were you able to resolve the issues listed above by yourself? | Ry (Yes) | - | - | 63.27% | 31 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|-------------------|-----------------|-----------------------------|------------------|------------------------------|
| | Rn (No) | | - | 36.73% | 18 |
| | Answered | - | - | | 49 |
| | Skipped | - | - | | 1 |
| Did you request an expert to help you out with the issues encountered while using your device? | - | - | - | 41.67% | 20 |
| | | - | - | 58.33% | 28 |
| | Answered | - | - | | 48 |
| | Skipped | - | - | | 2 |
| Has your access to Google, e-books and open-source journals available online affected the way you obtain information? | Oiy (Yes) | 78.57% | 33 | 62.50% | 30 |
| | Oin (No) | 21.43% | 9 | 37.50% | 18 |
| | Answered | | 42 | | 48 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|--|-------------------------------------|-----------------|-----------------------------|------------------|------------------------------|
| | Skipped | | 3 | | 2 |
| Has your use of the internet affected your use of gongs, flutes, extension-to-farmer visits, town criers and other traditional methods of extension? | <u>Uy</u> (Yes) | 68.29% | 28 | - | - |
| | Un (No) | 31.71% | 13 | - | - |
| | Answered | | 41 | - | - |
| | Skipped | | 4 | - | - |
| Has your use of the internet replaced your use of hard copy documents? | Rhy (Yes) | - | - | 18.75% | 9 |
| | Rhn (No) | - | - | 41.67% | 20 |
| | Rhb (I still use both side by side) | - | - | 41.67% | 20 |
| | Answered | - | - | | 48 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|----------------------------------|-----------------|-----------------------------|------------------|------------------------------|
| | Skipped | - | - | | 2 |
| On a scale of 1 - 5, indicate your level of agreement or disagreement to the following statements: Government needs to do more to ensure the provision and usage of modern-day | Psa (Strongly agree) | 65.85% | 27 | 83.33% | 40 |
| | Pa (Agree) | 31.71% | 13 | 16.67% | 8 |
| | Pnd (Neither agree nor disagree) | 0.0% | 0 | 0.00% | 0 |
| | Pd (Disagree) | 0.0% | 0 | 0.00% | 0 |
| | Psd (Strongly disagree) | 2.44% | 1 | 0.00% | 0 |
| | Answered | | 41 | | 48 |
| | Skipped | | 4 | | 2 |
| Adequate measures should be put in place to ensure in-service | Tsa (Strongly agree) | 47.62% | 20 | 62.50% | 30 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|----------------------------------|-----------------|-----------------------------|------------------|------------------------------|
| training of extension workers | | | | | |
| | Ta (Agree) | 50.0% | 21 | 25.00% | 12 |
| | Tnd (Neither agree nor disagree) | 0.0% | 0 | 8.33% | 4 |
| | Td (Disagree) | 2.38% | 1 | 2.08% | 1 |
| | Tsd (Strongly disagree) | 0.0% | 0 | 2.08% | 1 |
| | Answered | | 42 | | 48 |
| | Skipped | | 3 | | 2 |
| Computer-related courses should be taught in schools to prepare students for the work environment as an extension personnel | Csa (Strongly agree) | 52.38% | 22 | 65.31% | 32 |
| | Ca (Agree) | 40.48% | 17 | 20.41% | 10 |
| | Cnd (Neither agree nor disagree) | 7.14% | 3 | 10.20% | 5 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|--|----------------------------------|-----------------|-----------------------------|------------------|------------------------------|
| | Cd (Disagree) | 0.0% | 0 | 2.04% | 1 |
| | Csd (Strongly disagree) | 0.0% | 0 | 2.04% | 1 |
| | Answered | | 42 | | 49 |
| | Skipped | | 3 | | 1 |
| That basic computer skills should be one of the prerequisites to be enlisted as an extension worker. | Esa (Strongly agree) | 48.78% | 20 | 59.18% | 29 |
| | Ea (Agree) | 48.78% | 20 | 24.49% | 12 |
| | End (Neither agree nor disagree) | 2.44% | 1 | 10.20% | 5 |
| | Ed (Disagree) | 0.0% | 0 | 6.12% | 3 |
| | Esd (Strongly disagree) | 0.0% | 0 | 0.00% | 0 |
| | Answered | | 41 | | 49 |
| | Skipped | | 4 | | 1 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number | |
|--|----------------------------------|-----------------|-----------------------------|------------------|------------------------------|---|
| Government should recruit more extension personnel to achieve the 1:100 extension-farmer ratio. | Rsa (Strongly agree) | 64.29% | 27 | - | - | |
| | Ra (Agree) | 35.71% | 15 | - | - | |
| | Rnd (Neither agree nor disagree) | 0.0% | 0 | - | - | |
| | Rd (Disagree) | 0.0% | 0 | - | - | |
| | Rsd (Strongly disagree) | 0.0% | 0 | - | - | |
| | Answered | | | 42 | - | - |
| | Skipped | | | 3 | - | - |
| Reduction in internet service cost will encourage more use of technology for extension service - delivery. | Ssa (Strongly agree) | 54.76% | 23 | - | - | |
| | Sa (Agree) | 42.86% | 18 | - | - | |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|----------------------------------|-----------------|-----------------------------|------------------|------------------------------|
| | Snd (Neither agree nor disagree) | 0.0% | 0 | - | - |
| | Sd (Disagree) | 2.38% | 1 | - | - |
| | Ssd (Strongly disagree) | 0.0% | 0 | - | - |
| | Answered | | 42 | - | - |
| | Skipped | | 3 | - | - |
| More should be done to improve power supply | Msa (Strongly agree) | 64.29% | 27 | - | - |
| | Ma (Agree) | 35.71% | 15 | - | - |
| | Mnd (Neither agree nor disagree) | 0.0% | 0 | - | - |
| | Md (Disagree) | 0.0% | 0 | - | - |
| | Msd (Strongly disagree) | 0.0% | 0 | - | - |
| | Answered | | 42 | - | - |
| | Skipped | | 3 | - | - |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|---|----------------------------------|-----------------|-----------------------------|------------------|------------------------------|
| More policies should be put in place to ensure software licensing and usage | Lsa (Strongly agree) | 61.9% | 26 | - | - |
| | La (Agree) | 35.71% | 15 | - | - |
| | Lnd (Neither agree nor disagree) | 0.0% | 0 | - | - |
| | Ld (Disagree) | 0.0% | 0 | - | - |
| | Lsd (Strongly disagree) | 2.38% | 1 | - | - |
| | Answered | | 42 | - | - |
| | Skipped | | 3 | - | - |
| With all the answer you have provided above; do you agree that the use of ICTs is influencing (transforming) agricultural extension service delivery? | Iy (Yes) | 76.19% | 32 | 79.59% | 39 |
| | In (No) | 23.81% | 10 | 20.41% | 10 |

| Characteristics | Code for variable | Field Workers % | Field Workers Actual number | Office Workers % | Office Workers Actual number |
|-----------------|-------------------|-----------------|-----------------------------|------------------|------------------------------|
| | Answered | | 42 | | 49 |
| | Skipped | | 3 | | 1 |

Appendix 4.1 Table 2. Exmple Qualitative answers to survey questionnaire

| | | | | | | | | |
|-------------------------------|------------------|--|---|--|----------------------------------|---|---|--|
| Q4. Educational qualification | Q7. Grade level | Q7. What is your area of specialization? | Q19. If yes to question 18 above, what is the app or platform called? | Q21. If yes to question 20 above, then what are their names? | Q22. And how often do they meet? | Q23. Where do you prefer to get agricultural extension related information for your field work? | Q24. Give reason(s) for your answer in question 23 above. | Q48. Give reason(s) for your answer above. |
| (Others, please specify) | (Please specify) | (Others, please specify) | | | | (Others, please specify) | | |

| | | | | | | | | |
|---------------------------------|---|-------------------------------|--------------|---------------------------|------------------|-------------------|---|---|
| Ordinary National Diploma (OND) | 7 | Peace and conflict resolution | Agrovest | Farmers' cooperative | Weekly | From colleagues | Online using my phone is much easier | It has helped to change the minds of youths |
| Higher National Diploma (HND) | 5 | Peace and conflict resolution | Agrovest | Farmers association | Monthly | From cooperatives | With the use of computers is convenient | No, the ADP use less ICTs |
| Higher National Diploma (HND) | 4 | | Edo Agrovest | Farmers union | Once in 6 months | | From my phone is faster | To make information available |
| Higher National Diploma (HND) | 6 | | Agrovest | Herders association | Once in 3 months | | ICTs gives faster access to information | It provides ease to extension workers |
| | 5 | | Edo Agrovest | Cocoa farmers association | Yearly | | It is easier | We are still struggling to use ICTs |

*This table is an example of the qualitative response of respondents. It shows the themes/patterns in which the answers from the participants follow.

Appendix 4.2 Correlations.

Appendix 4.2.1 Correlation Matrix for Age of Respondents and Devices Owned.

| | | Correlations | | | | |
|---------|---------------------|--------------|---------|---------|---------|---------|
| | | Age | Phones | Desktop | Laptop | Tablet |
| Age | Pearson Correlation | 1 | -.634** | -.604** | -.851** | -.704** |
| | Sig. (2-tailed) | | <.001 | <.001 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 |
| Phones | Pearson Correlation | -.634** | 1 | .216* | .424** | .252* |
| | Sig. (2-tailed) | <.001 | | .035 | <.001 | .014 |
| | N | 95 | 95 | 95 | 95 | 95 |
| Desktop | Pearson Correlation | -.604** | .216* | 1 | .510** | .859** |
| | Sig. (2-tailed) | <.001 | .035 | | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 |
| Laptop | Pearson Correlation | -.851** | .424** | .510** | 1 | .594** |
| | Sig. (2-tailed) | <.001 | <.001 | <.001 | | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 |
| Tablet | Pearson Correlation | -.704** | .252* | .859** | .594** | 1 |
| | Sig. (2-tailed) | <.001 | .014 | <.001 | <.001 | |
| | N | 95 | 95 | 95 | 95 | 95 |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Null hypothesis (H_0): Age of respondents and devices/gadgets owned are not related in the population; the proportions of age of respondents are the same for different values of devices/gadgets owned.

Alternative hypothesis (H_a): Age of respondents and devices/gadgets owned are related in the population; the proportions of age of respondents are not the same for different values of devices/gadgets owned.

| | | | | | | | | | | | | | | | | |
|-----------|---------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|-------|
| | Sig. (2-tailed) | .054 | <.001 | <.001 | <.001 | | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 |
| Workshops | Pearson Correlation | .226* | .844** | .862** | .979** | .877** | 1 | .857** | .896** | .844** | .837** | .958** | .958** | .958** | .799** | .979* |
| | Sig. (2-tailed) | .027 | <.001 | <.001 | <.001 | <.001 | | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 |
| Online | Pearson Correlation | .194 | .723** | .739** | .839** | .977** | .857** | 1 | .956** | .723** | .977** | .821** | .821** | .821** | .932** | .875* |
| | Sig. (2-tailed) | .060 | <.001 | <.001 | <.001 | <.001 | <.001 | | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 |
| Webinars | Pearson Correlation | .203* | .757** | .773** | .877** | .978** | .896** | .956** | 1 | .757** | .934** | .859** | .859** | .859** | .891** | .916* |
| | Sig. (2-tailed) | .049 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 |
| Books | Pearson Correlation | .268** | 1.000* | .979** | .863** | .740** | .844** | .723** | .757** | 1 | .707** | .881** | .881** | .881** | .674** | .826* |
| | Sig. (2-tailed) | .009 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 |
| Materials | Pearson Correlation | .189 | .707** | .722** | .820** | .955** | .837** | .977** | .934** | .707** | 1 | .802** | .802** | .802** | .954** | .855* |
| | Sig. (2-tailed) | .066 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 |
| Websites | Pearson Correlation | .236* | .881** | .900** | .979** | .840** | .958** | .821** | .859** | .881** | .802** | 1 | 1.000** | 1.000* | .765** | .938* |

| | | | | | | | | | | | | | | | | |
|--------------|---------------------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|--------|--------|-------|
| | Sig. (2-tailed) | .021 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 |
| Cooperatives | Pearson Correlation | .236* | .881** | .900** | .979** | .840** | .958** | .821** | .859** | .881** | .802** | 1.000** | 1 | 1.000* | .765** | .938* |
| | Sig. (2-tailed) | .021 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 |
| Colleagues | Pearson Correlation | .236* | .881** | .900** | .979** | .840** | .958** | .821** | .859** | .881** | .802** | 1.000** | 1.000** | 1 | .765** | .938* |
| | Sig. (2-tailed) | .021 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 |
| Radio | Pearson Correlation | .181 | .674** | .689** | .782** | .911** | .799** | .932** | .891** | .674** | .954** | .765** | .765** | .765** | 1 | .816* |
| | Sig. (2-tailed) | .080 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 |
| Newspaper | Pearson Correlation | .221* | .826** | .844** | .958** | .896** | .979** | .875** | .916** | .826** | .855** | .938** | .938** | .938** | .816** | 1 |
| | Sig. (2-tailed) | .031 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Null hypothesis (H_0): Awareness of ICT devices/tools for extension service delivery and platforms where extension workers get information are not related in the population; the proportions of awareness of ICT devices/tools for extension service delivery are the same for different values of platforms where extension workers get information.

Alternative hypothesis (H_a): Awareness of ICT devices/tools for extension service delivery and platforms where extension workers get information are related in the population; the proportions of awareness of ICT devices/tools for extension service delivery are not the same for different values of platforms where extension workers get information.

Appendix 4.2.3 Correlation Matrix for app/online platform available at the ADP and the level of accessibility to agricultural extension information.

| | | Correlations | | | |
|------|---------------------|---------------------|--------|--------|--------|
| | | Apps | Lh | La | Ln |
| Apps | Pearson Correlation | 1 | .289** | .774** | .359** |
| | Sig. (2-tailed) | | .005 | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 |
| Lh | Pearson Correlation | .289** | 1 | .373** | .804** |
| | Sig. (2-tailed) | .005 | | <.001 | <.001 |
| | N | 95 | 95 | 95 | 95 |
| La | Pearson Correlation | .774** | .373** | 1 | .464** |
| | Sig. (2-tailed) | <.001 | <.001 | | <.001 |
| | N | 95 | 95 | 95 | 95 |
| Ln | Pearson Correlation | .359** | .804** | .464** | 1 |
| | Sig. (2-tailed) | <.001 | <.001 | <.001 | |
| | N | 95 | 95 | 95 | 95 |

** . Correlation is significant at the 0.01 level (2-tailed).

Null hypothesis (H_0): Apps/online platforms available at the ADP and the level of accessibility to agricultural extension information are not related in the population; the proportions of Apps/online platforms available at the ADP are the same for different values of level of accessibility to agricultural extension information.

Alternative hypothesis (H_a): Apps/online platforms available at the ADP and the level of accessibility to agricultural extension information are related in the population; the proportions of Apps/online platforms available at the ADP are not the same for different values of level of accessibility to agricultural extension information.