

Full Length Research Paper

Improving networking/information sharing through ICT and other aid methods for the enhancement of agricultural productivity and food security in Nigeria and other KAFACI member countries

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The role/contributions of Agricultural Extension (AE), Information and Communication Technology (ICT) and information sharing systems have been evaluated in Nigeria. The survey utilized one thousand (1,000) well-structured and manually self-filled questionnaires administered in ten selected States of Nigeria. This is in addition to specific online tools for interview such as email conversations, text messages and phone calls. The research proved that, enhancing information sharing between Agricultural Research Institutions, Agricultural Extension Organizations and farmers/other agro-entrepreneurs is an effective solution to such problems as low productivity/income, weak marketing linkages, poor information management, etc. The research also highlighted the methods to enhance and maintain networking/information sharing for the overall growth of the agriculture sector in Nigeria. These methods include implementation of Social Networking Service (SNS) in agriculture, creation of agribusiness mobile applications and bulk SMS systems, effective Cloud Computing/Storages usage in agriculture, modern methods of synergy between Agricultural Research Institutions and Extension organizations, etc. The survey also found out that, sharing of agribusiness information on radio, television, newspapers, fliers and DVDs as well as publication of research books and papers at open/free access journals is very effective and important to Agro-entrepreneurs, students, researches and extension organizations for the successful adoptions of research technology outcomes in the country.

Keywords: Agriculture, farming, extension, food security, ICT, Social Networking Service (SNS), Cloud Computing, KAFACI.

INTRODUCTION

Farmers and other stakeholders in agriculture are generally faced with myriads of challenges in gaining access to decent agricultural information for improved agronomic practices and increased production. This is generally due to inadequate number of extension agents, poor agricultural awareness, inappropriate channels of communications between agricultural research institutes, agricultural extension organizations, farmers and other agro-entrepreneurs. Therefore, improving Agricultural extension service delivery, enhancing networking/inform-

ation sharing through innovative ICT and other aid methods are essential to maximize production, reduce poverty and enhance food security not only in Nigeria, but in other KAFACI member countries with similar agricultural issues as Nigeria.

Information is a processed data that is capable of increasing the knowledge level of an individual in making the right decisions to enhance and improve life, it is a critical economic resource when utilized (Uthayasankar *et al.*, 2016). The presence, availability and the rapid adoption

of internet supported devices and activities have created a wide range of opportunities and expectations. Internet provide the opportunity to access and disseminate information in agriculture which include effective online webinars, better knowledge management, real-time information sharing, discussion forums, improved extension deliveries, etc. (FAO, 2017). Effective networking/information sharing through innovative Information and Communication Technologies (ICT) has the potential to transform agribusiness, innovation and economic growth not only in Nigeria but at Korea-Africa Food and Agriculture Cooperation Initiatives (KAFACI) member countries, and other African countries at large.

The World Bank and African Development Bank reports identified and explored the growing contribution of ICTs to agriculture, climate change adaptation, education, financial services, government services and health as the best practice in use of ICTs in the key sectors of African economy. In addition, the reports highlighted the role of ICT in enhancing African regional trade and integration as well as the need to build competitive ICT industries to promote innovation, job creation and export potential of African Companies (World Bank, 2012). Achieving Food Security is one of the greatest challenges to mankind today. Agricultural Extension Service is the most important public service with the widest range of responsibilities for rural development and food security worldwide. Therefore, availability of decent agricultural information sharing and networking system facilities cannot be over emphasized. Sharing of agricultural information creates awareness among farmers about latest technologies for adoption, which are needed for the overall development of agriculture and improvement of living standard of both small and medium scale farmers (Adeleke *et al.*, 2010).

In order to disseminate sustainable agricultural knowledge and technology effectively in African countries, ICT and other aid networking methods/systems must be enhanced (Wyche and Steinfield, 2015). Creation of programmes such as Social Networking Site (SNS) in Agriculture has the potential of improving Agricultural Extension service deliveries effectively, not only in Nigeria but at KAFACI member countries. The potential for SNS digital platforms to small farmer empowerment is very huge on receiving targeted messages such as updates on real time weather, markets information, harvesting techniques, etc. Having reliable SNS information on those, number of other factors could dramatically change the way farmers conducting their Agribusiness (Devesh and Mahesh, 2018). Through SNS, Nigeria's agriculture can be characterized by improving many weak linkages on extension services and will also help in attracting, engaging and retaining youth to Agriculture. Since, youth are more likely than old-ages to own ICT technologies/devices, such as Computers/smart-phones

and at the same time to disseminate information using these platforms.

The diffusion and adoption of any shared agricultural information to a large extent, depends on the channels through which the information is disseminated and the perception, knowledge and understanding of the farmers. In order for the human performance to be effective and efficient, a level of knowledge is needed on how, why and when certain things have to be done. Adequate awareness on any shared innovation or technology is a key to the success in the adoption and utilization of that technology for maximum yield output (Yimer, 2015). The overall goal of this research is to improve food production and food security in Nigeria by enhancing information sharing and networking in Agriculture. While the objectives include exploring current status of ICT/networking in Agriculture, identifying the constraints and opportunities of ICT/extension services in reaching out to small and medium scale farmers and suggest the possible ways forward.

METHODOLOGY

The methodology of this research includes face-to-face interview with agro-entrepreneurs, agricultural extension agents, researchers, Agricultural Development Programmes (ADPs), review of ICT books/papers related to agriculture, phone calls, emails conversations and text messages. A total of one thousand (1,000) copies of questionnaire on ICT Applications in Agriculture were also administered successfully at different towns and villages across the ten selected states in Nigeria (one hundred questionnaires per state). Figure 1 shows the ten selected questionnaire administered states. Although the research was conducted in Nigeria, the results, findings and recommendations are applicable in other KAFACI member countries with similar agricultural issues as Nigeria. Results obtained were analyzed using Microsoft Office 2016 and Descriptive Statistics/Multiple Response Sets in SPSS version 25.

RESULTS AND DISCUSSION

A total number of one thousand (1,000) copies of questionnaire on Information and Communication Technology (ICT) Applications in Agriculture were administered successfully at open agricultural market places in 10 selected states across Nigeria. Table 1 shows the respondent gender, number and percentage from each state participated. While the overall number of male and female respondents from all the selected states are 572 and 428 (that is 57.2% and 42.8% respectively), this indicated that, more men participated than women in this research.

The research also investigated the age categories of the respondents and classified them based on their age groups.

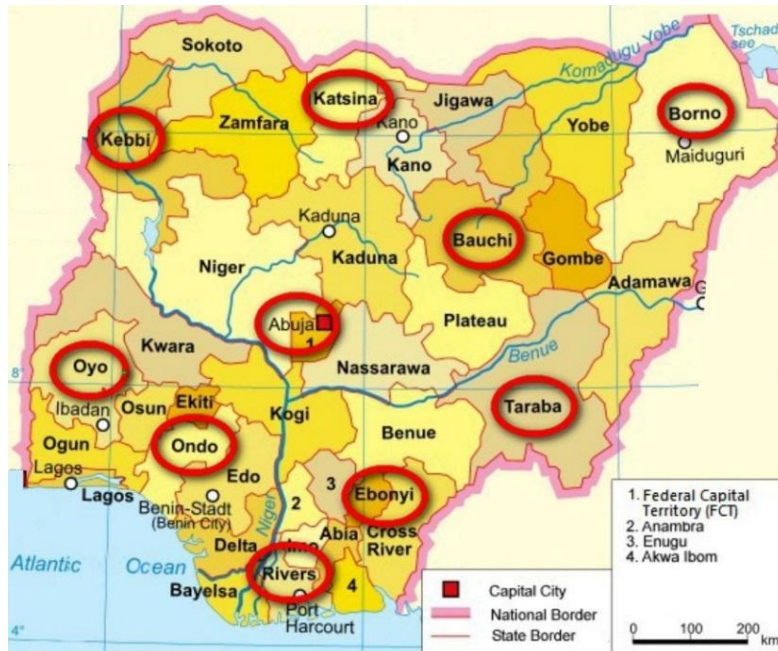


Figure 1. The study areas.

Table 1. States and Gender distribution of the 1,000 respondents of the research.

S/N	STATE	MALE		FEMALE	
		NUMBER	PERCENT	NUMBER	PERCENT
1.	Bauchi	69	6.9%	31	3.1%
2.	Borno	79	7.9%	21	2.1%
3.	Ebonyi	42	4.2%	58	5.8%
4.	FCT Abuja	49	4.9%	51	5.1%
5.	Katsina	77	7.7%	23	2.3%
6.	Kebbi	62	6.2%	38	3.8%
7.	Ondo	39	3.9%	61	6.1%
8.	Oyo	48	4.8%	52	5.2%
9.	Rivers	51	5.1%	49	4.9%
10.	Taraba	56	5.6%	44	4.4%
TOTAL		572	57.2%	428	42.8%

The five age groups (in years) are 18-25, 26-35, 36-45, 46-55 and above 56 years. Results showed that the male age group of 36-45 years old responded more than all the other categories with 17.7% (177 responses). This indicated that, the group has greater proportion in Nigeria's agribusiness activities. The least responses were obtained from female age group 18-25 years (28 responses) that is 2.8% of the total questionnaire administered, which indicated the group has the least participation in agribusiness in Nigeria. Figure 2 shows

result of the total number and percentage of respondents based on age group categories.

The instant agribusiness information sharing minimizes direct and indirect prices; particularly advertisement cost and at the same time improves business process (De-Silva *et al.*, 2008). Therefore, agro-entrepreneurs in Nigeria will have higher agricultural productivity, sell more products to potentials buyers, access relevant information and enhance effective management of sales by adopting the results of this research.

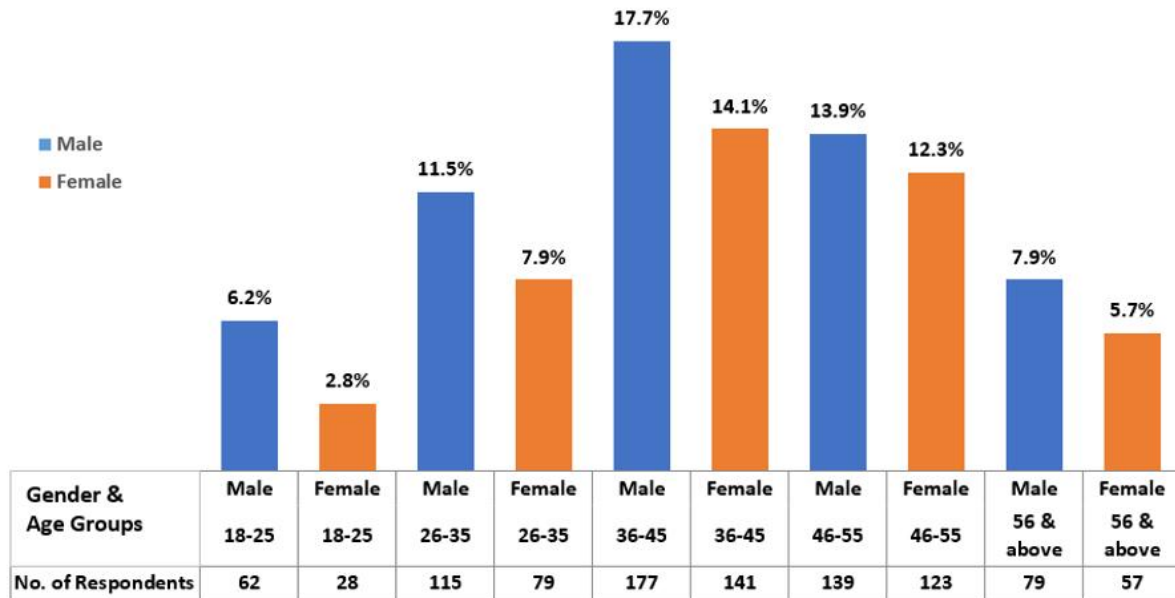


Figure 2. Respondents numbers and Age group categories.

IMPROVING AGRIBUSINESS PROGRAMMES BROADCAST ON RADIO AND TELEVISION CHANNELS

Communication innovation is playing very essential role in creating awareness about different agricultural technologies among farmers (Singh, 2015). Radio and television sets are still being considered as the most famous mass media that offer powerful channels for communicating agricultural information. The analyzed collected data revealed that 862 (86.2%) out of the one thousand respondents owned radio sets of different types/bands (AM, MW, SW and FM including non-internet FM radio on Mobile phones), while 138 (13.8%) respondents have no radio sets. Similarly, television sets utilization in the research areas was low compare to the radio receivers. The finding revealed that 583 (58.3%) out of the one thousand respondents owned television sets. Likewise, the ownership of DVD playing machine among the total of 1,000 respondents is 395 (39.5%) while 605 (60.5%) don't have DVD machines. This indicated that, agricultural information in illustrative Pictures, videos and audios format still can be shared on DVDs/CDs to agro-entrepreneurs and put into practice effectively. The graphical representations of radio, television and DVD machine ownerships results are shown in Figure 3.

The results in Figure 4 shows the percentages of the respondents receiving, listening and watching agricultural programme on their devices. However, among the 862 respondents who owned radio sets, 577 (66.9%) do receive agricultural information on their equipment and 285 (33.1%) respondents did not report for receiving any agribusiness programme/information on their devices.

The situations of broadcasting agricultural programmes on television channels are similar with that of radio stations in the selected states. 511 (87.7%) respondents among those who owned television sets use to receive and watch different agribusiness programmes on their television time to time. While 72 (12.3%) are not receiving any agribusiness programme on their television. These indicated that, both the ownership and receiving agricultural information on radio sets are more than that of television channels. This implied that, due to good reception of radio signals, affordability and portability many people listen to radio in the selected research areas.

The duration of broadcasting agriculture and related programmes on radio were also assessed by categorizing the airing time as less than or equal to 2hours/week, 2-4hours/week and equal to or more than 4hours/week. Furthermore, the research revealed that 495 (85.8%) out of 577 respondents that do receive Agricultural information on their radio sets reported that, the broadcasting time is not more than two hours per week, while 74 (12.8%) out of 577 respondent reported receiving agriculture programmes of two to four hours per week, and only 8 (1.4%) of 577 respondent indicated receiving more than 4 hours agricultural programmes on radio (figure 5). Furthermore, 402 (78.7%) out of the respondents who watch agricultural programmes on their TV reported that, the broadcasting time is not more than 2hours per week. Also 109 (21.3%) of them reported that broadcasting time of such agricultural programmes on TV is 2-4 hours per week, and none of the respondents reported for more than four hours per week. Figure 5 shows the duration for broadcasting agricultural programmes

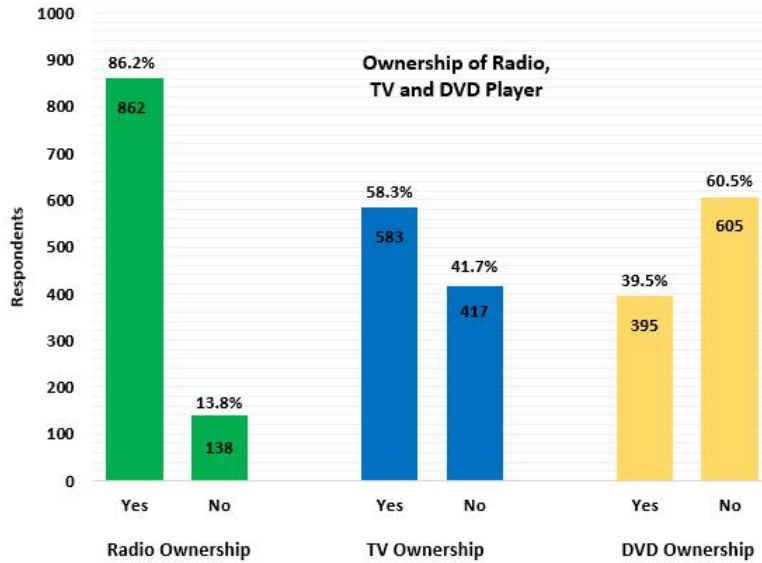


Figure 3. Ownership of Radio Receivers, Television and DVD Players among the respondents.

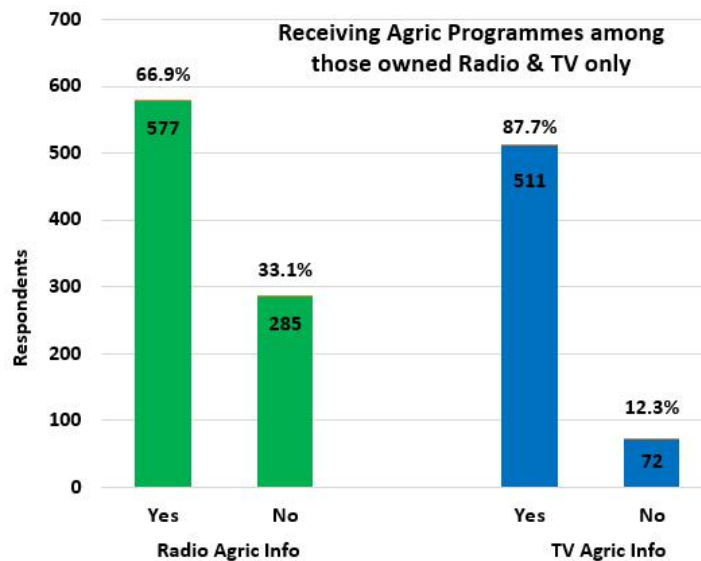


Figure 4. Receiving Agribusiness Programmes on Radio and TV channels.

on radio and television channels, in which the larger and higher proportions of respondents from both of the two categories reported that, the airing time of such programmes is not more than two hours per week. The results from the Figures 4 and 5 indicated that, both radio and television channels have the ability to disseminate information efficiently to a larger and wider audience nationwide. In countries where literacy level is very low especially in rural areas the choice of mass media for information dissemination is very important

(Kughur *et al.*, 2016). In this regard, radio and television play a major role in transfer of modern agricultural technology/innovations to educate and build the capacity of farmers within a short time. Radio receivers are more affordable and portable and TV is more demonstrative in practical aspect of farming to farmers; since it is an audio-visual means of disseminating information (Yahaya *et al.*, 2018). Therefore, in order to improve the entire agribusiness practice in Nigeria there is need to enhance radio and television service using the advices given under

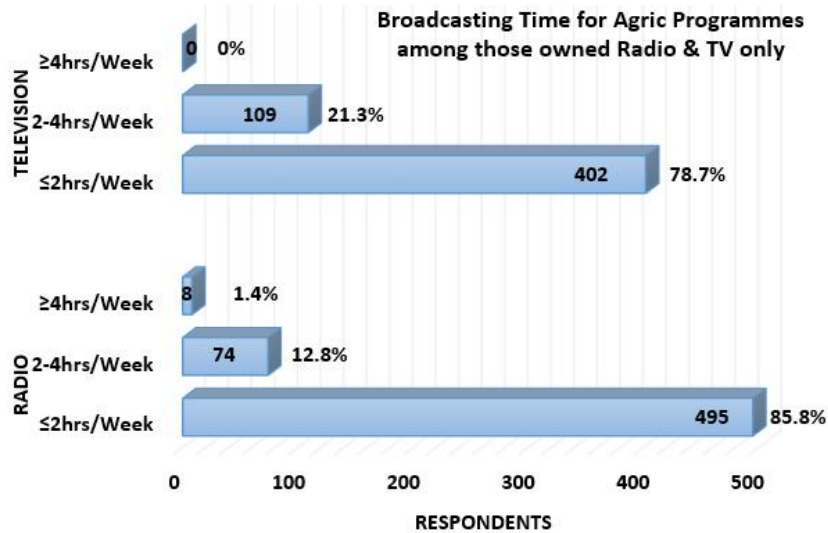


Figure 5. Durations of broadcasting Agribusiness Programmes on Radio and TV channels.

recommendation section of this research.

IMPLEMENTATION OF SOCIAL NETWORKING SERVICE (SNS) IN AGRICULTURE PROGRAMME

The Social Networking System, Site or Service (SNS), all refers to an online platform used to build social networks or social relations among people with similar personal/career interests, activities, backgrounds or real-life connections. SNS vary in format and the number of features incorporated into a range of Information and Communication Technology (ICT) tools operating on desktop Computers, laptop, tablet and smart mobile phones (Danah and Nicole, 2017).

Based on the investigation conducted under this research in Nigeria, there are many farmers' cooperatives, local agricultural machines/tool fabricators, agro-Input dealers, etc. but their information cannot be found online such as business type/name, location, prices, contact details, etc. majority of them totally depend on traditional methods of conducting their agribusinesses. Likewise, the research did not found any organization either Government or Non-Governmental Organizations (NGOs) running SNS in agriculture programme in the country. Therefore, there is urgent need for wider sensitization on SNS and creation of centralized Agricultural SNS systems by the Government Ministries, Departments and Agencies (MDAs) at all levels, NGOs and other agricultural stakeholders in Nigeria. Farmers' cooperative groups, local agro-factories/agro-inputs companies, etc. are required to register for free with the centralized SNS bodies in order for them to benefit from the innovation of

networking and relevant decent information sharing based on group activities in Agriculture (Naruka *et al.*, 2017). The most popular digital media platforms in Nigeria includes WhatsApp, Facebook, Twitter, Instagram, etc. all of these can be used for SNS in Agriculture programmes effectively both the web based and their Mobile Phone APPs (Salman *et al.*, 2016). Figure 6 shows a representation of SNS interconnected multi-stakeholders' value-chain groups linked-up with the organizers of the programmes, for example NGO stakeholders in Agriculture, State Ministries of Agriculture (SMA) or Federal Ministry of Agriculture and Rural Development (FMARD) Abuja, Nigeria.

The result in figure 7 shows the level of mobile phone and personal computer (PC) ownerships among the respondents. The finding revealed that 889 (88.9%) of the respondents owned different types of mobile phones while 111 (11.1%) have no mobile phones at all. On the other hand, the ownership of Personal Computer among the all respondents is just 136 (13.6%) while 864 (86.4%) do not have Personal Computers.

Figure 8 shows the results of internet and social media usage among the 889 respondents who owned mobile phones. The result showed that, a total of 368 (41.4%) respondents have basic mobile phones used for making calls and Short Messages Service (SMS) only, thus they don't have access to internet and do not use social media. While total of 521 (58.6%) of the 889 respondents who owned mobile phones have access to internet facilities. 108 (12.1%) among them reported of not engaging themselves for using any social media despite having the internet access facilities on their phone, while

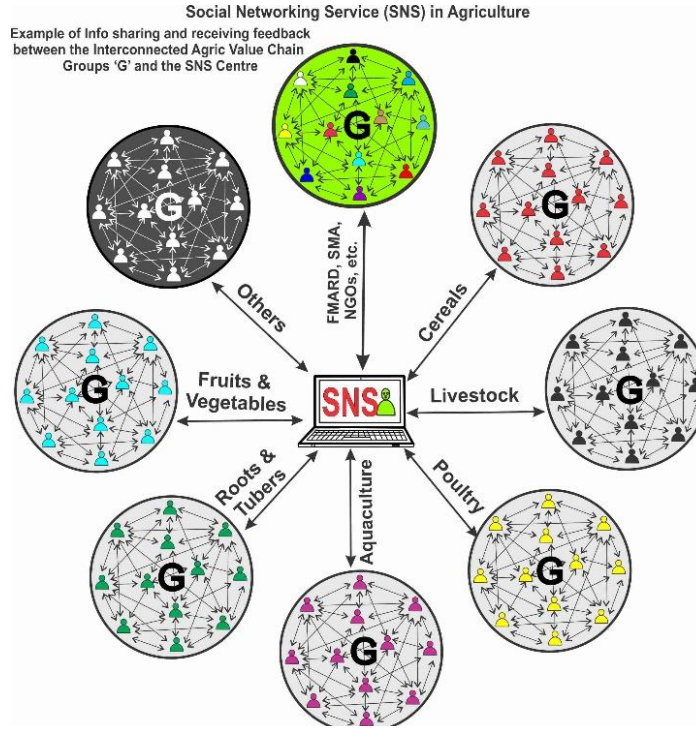


Figure 6. Example of Social Networking Service (SNS) in Agriculture Groups (G).

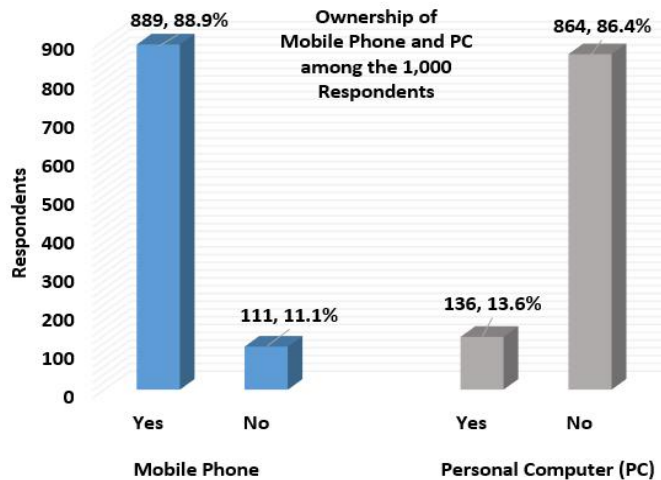


Figure 7. Ownership of Mobile Phones and Personal Computers among the respondents.

413 (46.5%) are using different types of social media generally for news, chatting, sending and receiving messages.

Figure 9 shows that, among 889 respondents who owned mobile phones, only 114 (12.8%) had ever received agricultural information on their phones. The range of information they received includes invitations to farmer's

trainings, capacity buildings, empowerments, Growth Enhancement Support Scheme (GESS), etc. While 775 (87.2%) indicated that, they never received any agricultural information on mobile phone. Figure 9 shows the numbers and percentages of respondents receiving/not receiving any agricultural information on their mobile phones.

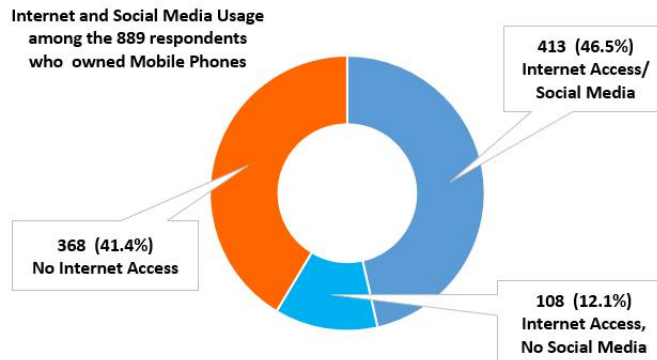


Figure 8. Internet and Social Media usage among the 889 respondents.

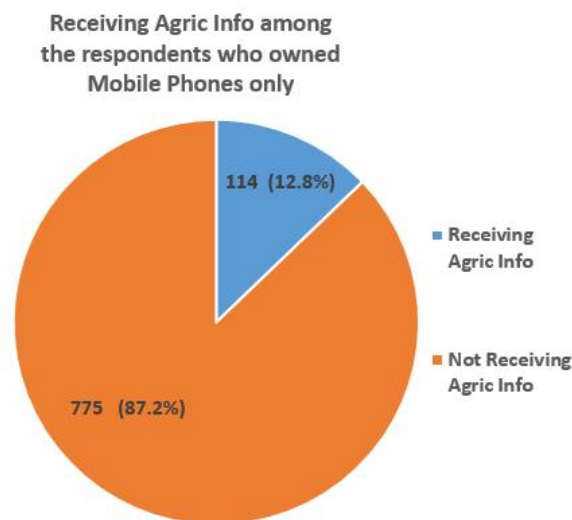


Figure 9. Receiving Agribusiness Information on Mobile Phone.

The results for respondents' mobile phones ownership, internet access and social media usage is very encouraging, since mobile phone is one of the basic tools for ICT in agriculture. Therefore, creating network of people who have some knowledge of ICT, who can connect with SNS and disseminate information to other members of their groups instantly is crucial to improving agribusiness entirely (Devesh and Mahesh, 2018). The SNS programme is to run side-by-side on digital social media platforms, utilize the opportunities and take advantage of popular digital Social Media Websites and their Mobile Phone Applications to converts ordinary chatting/messages from less important levels to vital Agricultural information sharing system in Nigeria. Hence, the SNS programme is to connect together farmers, consumers, Agro-dealers, Agro-Companies (including Agricultural machines manufactures), Government/NGOs and all the other reachable stakeholders in Agriculture for ease of knowledge/experience sharing and for conducting agribusiness with each other directly. The

main goals for SNS is to maximize agricultural productivity, transform rural incomes, improve living standard of farmers and achieve maximum food security in Nigeria and other African developing countries.

DEVELOPING OF AGRIBUSINESS MOBILE APPS AND BULK SHORT MESSAGE SERVICE (SMS) SYSTEMS

Information is a tool for self-reliance and empowerment. In addition, as agricultural production is becoming ever more dependent on ICT, it is very important to explore the potential of ICT in agriculture for the improvement of total production system (Singh *et.al*, 2015). The Bulk SMS is the integral system of communication for sending large number of text message to multiple recipients' mobile phone numbers at the same time (Munyua and Adera, 2009).

The Apps to be developed should be easy/freely to use with Multi-Nigerian major languages interface (i.e. English,

Hausa, Yoruba and Igbo). Apps should be efficient, user-friendly with search facilities and be able to provide all the relevant information such as real-time weather, market price, location, etc. Push notification feature is very important (i.e. the pop-up message that usually came up without waiting for the user to login the Apps), as it will allow users to get information at their fingertips in case of emergencies such as early warnings on disease outbreaks, flooding, etc. Likewise, in the case of bulk SMS system there should be permanent and dedicated mobile phone numbers from Agricultural MDAs and NGOs circulated to entire public for receiving feedbacks from Agro-entrepreneurs nationwide.

Therefore, by considering the number of people owned mobile phones in the research area (see figure 7), consequently creating these mobile Apps and bulk SMS Systems will offer optimum Agricultural services (especially extension deliveries) also will improve Agricultural networking, boost/enhance the entire Agribusiness in Nigeria. Figure 10 shows an example of the structure of Information flow and Reporting System between Agricultural Organizations and farmers/agro-entrepreneurs in the country.

EFFECTIVE CLOUD-COMPUTING AND CLOUD STORAGES USAGE IN AGRICULTURE

The research revealed that, very few Agricultural MDAs, NGOs and Agro-entrepreneurs are committed to using cloud computing and cloud storage technologies in Nigeria. The term “cloud” is generally used to describe data centers available to many users over the Internet. Cloud Computing technology uses the internet and central remote servers to maintain data and applications fast and effective with simplified troubleshooting and less maintenance (Kun and Donga, 2012). Cloud computing in Agriculture will allow MDAs, NGOs and Agro-entrepreneurs to use applications without installations, also access/share their personal files on any computer or mobile phone having internet connectivity. The technology allows efficiently computing by centralizing the data storage, processing and automatic synchronizations to update the files over the web servers effectively within short time (Arokia and Shanmugapriya, 2012). Figure 11 shows an example of cloud computing system structure.

Cloud Computing offers and deliver services on the following three basic models viz; Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Furthermore, the technology of Cloud Computing is based on three different deployment models viz; Private, Public and Hybrid (i.e. the combination of private and public models). Among the fears and challenges of the technology includes the need for internet connection in order to access the data banks in the cloud, maintenance/supervision by third party

company and less physical control by administrators and subscribers (Kamala, 2012). While the benefits and role of Cloud Computing technology in Agriculture are many and very helpful in reducing technical issues by centralizing data; which is always available for access to all users at any time from everywhere in the world (by just providing correct security log-in details). The Agricultural data that can be centralized includes information on soil, weather, researches, crops, farmer’s information, agricultural marketing, fertilizers, pesticide, etc. Furthermore, the technology is applicable for the improvement of agricultural growth, product, food safety, economic condition and the entire GDP of the nation through circulation of decent information (Sushil *et al.*, 2016).

The other advantages of Cloud computing include elimination of the capital expenses for buying hardware, software, setting up/running on-site data centers/servers, disaster recovery, business continuity, easier/less expensive, automatic files updates, web-base/software integration, eliminating the provision of electricity power at all the time for operation, cooling and employment of ICT experts for managing the infrastructure, etc. (Lakshmi and Padma, 2014). Therefore, both MDAs and NGOs (including those that are dealing with Big-data), corporate agro-entrepreneurs, agricultural policy makers, expert and researchers in Nigeria are encouraged to create their own free remote access cloud storages for sharing documents and serving as secure/safer back-up storages for their important information. Statistics shows that, the number of cloud computing service applications have been rising extremely from 11,953 in the year 2010 to 117,135 in 2018 worldwide (figure 12).

Cloud Storage usage is not free of charge, but there are many providers who offer free space for those who require the minimum personal usage from their services (e.g. Google offers initial space of 15 Gigabytes ‘GB’ of Cloud-Drive storage to every subscriber free of charge). Subscribers may need to pay and extend their storage size in order to upload more data whenever they exhausted their initial opening free storage space allocated to them. They may also need to subscribe and pay for the Business or Organizational Cloud Storage Services of their own choice based on their plan (Pradnya and Deepak, 2014). Table 2 shows the twelve cloud computing service providers among others that offers storage space free of charge, free storage size, maximum storage size that you can buy and starting price of their minimum plan per month (in U.S. Dollars). Based on the research conducted, these 12 selected cloud storages can be operated and provide support/Compatibility on Windows Operating System (OS), Mac OS, Linux OS, Web Browsers, Android phones, iPhone, iPad and blackberry. Likewise, they are all regulatory compliance commonly using Service Level Agreement (SLA), Secure Socket Layer (SSL) and Advanced

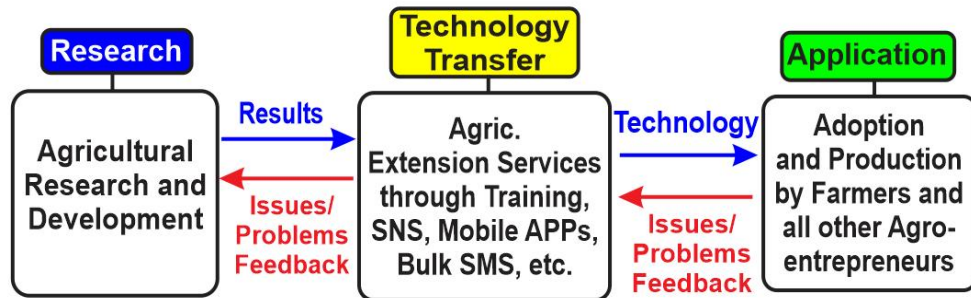


Figure 10. Example and structure of Information flow/Reporting System between Agricultural Organizations and farmers/agro-entrepreneurs.

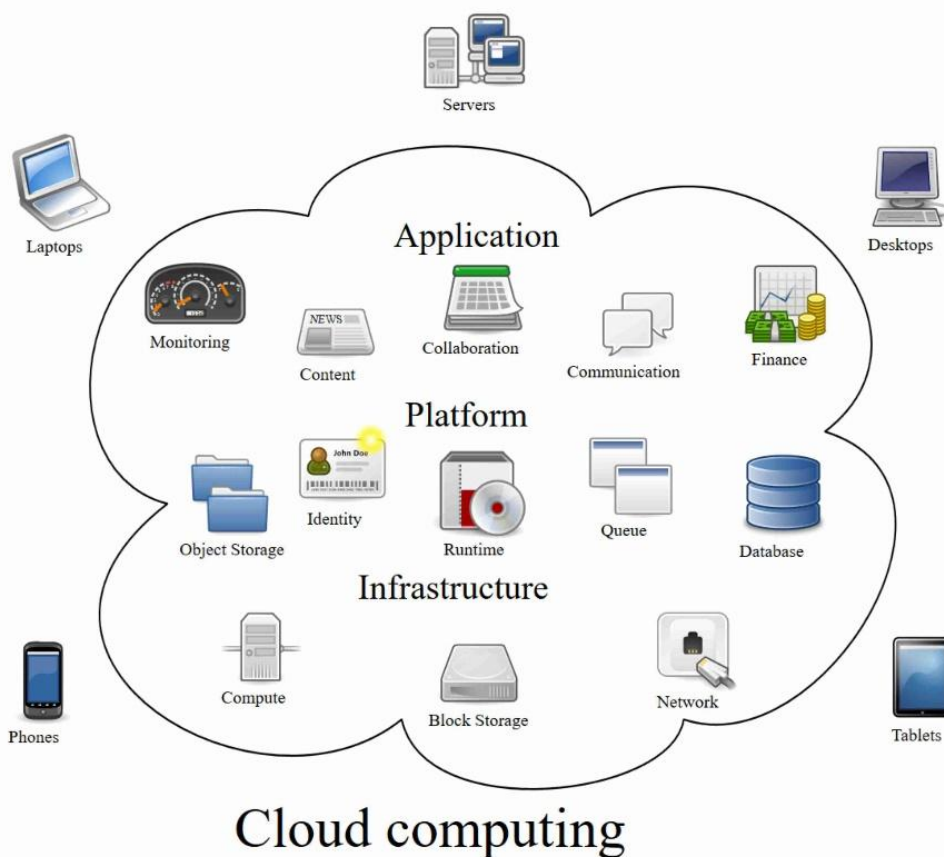


Figure 11. An example of cloud computing system structure, source: (Sushil et al., 2016).

Encryption Standard (AES)-256 securities. Therefore, due to the benefits of Cloud Computing/Storage, there's urgent need for all the Agricultural MDAs, NGOs and Agro-entrepreneurs in Nigeria to adopt this technology.

ADVANCED FARMERS' COOPERATIVE SESTABLISHMENT

Farmers and other agro-entrepreneurs' cooperatives or groups are independent associations of men and women

united together voluntarily to meet their common goals and aspirations through collective action in Agriculture (IFAD, 2018). Collective action is the core resource of agricultural cooperatives/groups by creating social relationship, that will enable members to achieve their objectives which may not otherwise be able to achieve individually. Agro-entrepreneurs should be encouraged to form cooperatives which would serve as a platform for sharing agricultural and other entropy among themselves. Forming agro-entrepreneurs' cooperatives has a lot of

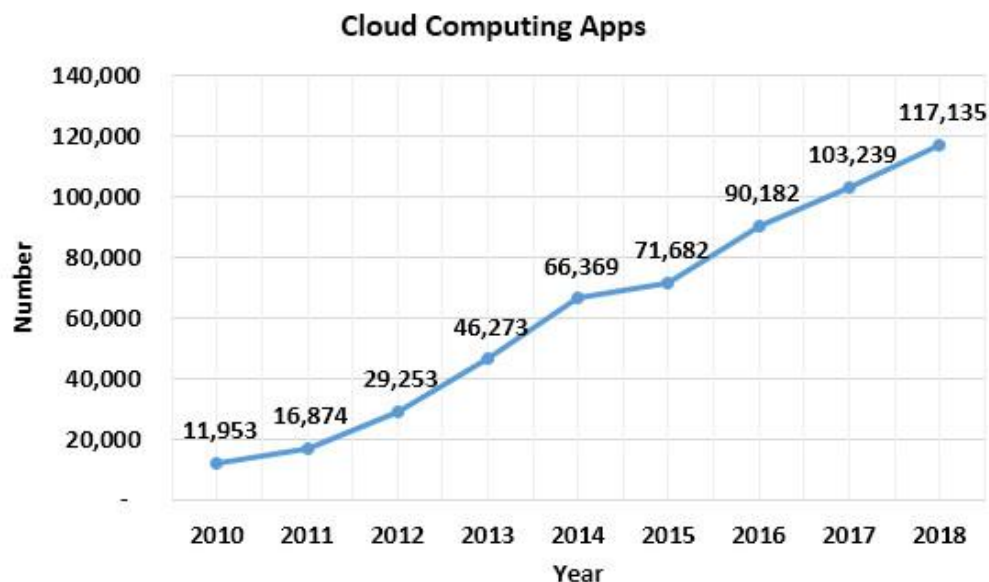


Figure 12. Number of cloud computing Apps 2010-2018, source: statista.com.

Table 2. Some of the Cloud Storages offering free space and other facilities(October, 2019).

SN	Cloud Name	Storage	Free Size	Storage	Maximum Storage Size	Starting Price (if ran out of space or needs to upgrade)
1.	Google Drive	15GB			Unlimited	\$2/Month/100GB
2.	Media Fire	10GB			2TB	\$3.75/Month/1TB
3.	Box Drive	10GB			Unlimited	\$11.5/Month/100GB
4.	MiMedia	10GB			2TB	\$8/Month/500GB
5.	Yandex Disk	10GB			2TB	\$1.6/Month/100GB
6.	IceDrive	10GB			5TB	\$2/Month/150GB
7.	OneDrive	5GB			Unlimited	\$2/Month/100GB
8.	iCloud Drive	5GB			2TB	\$1/Month/50GB
9.	Amazon Drive	5GB			2TB	\$20/Year/100GB
10.	iDrive	5GB			5TB	\$52/Year/5TB
11.	Dropbox	2GB			3TB	\$10/Month/2TB
12.	Jumpshare	2GB			2TB	\$8.25/Month/1TB

benefits in such a way that, the decent information received by even a single member can easily be shared with the rest members of the group for the overall well-being. The result in Figure 13 shows a greater proportion of 978 (97.8%) out of the 1,000 respondents reported of disseminating agricultural information to others, this indicated the mutual agricultural information sharing among the agro-entrepreneurs. However, 2.2% of the respondent indicated of not disseminating information to others.

Farmer to farmer extension and other Agribusiness technology obtained and disseminated to fellow members

of the association is very reliable, also does not cost anything. Encouraging the establishment of agro-entrepreneurs' cooperatives, groups or associations will help not only in information dissemination but in many ways such as serving as self-help group, easy access to loan, reduction for costs of acquiring inputs, discounts for advertisements, paving trade links for competing at international markets, etc. (Nwankwo, 2012). Furthermore, involving every member of agro-entrepreneurial cooperative in decision making processes will empower the group both economically and socially. Collective decision creates additional employment oppor-

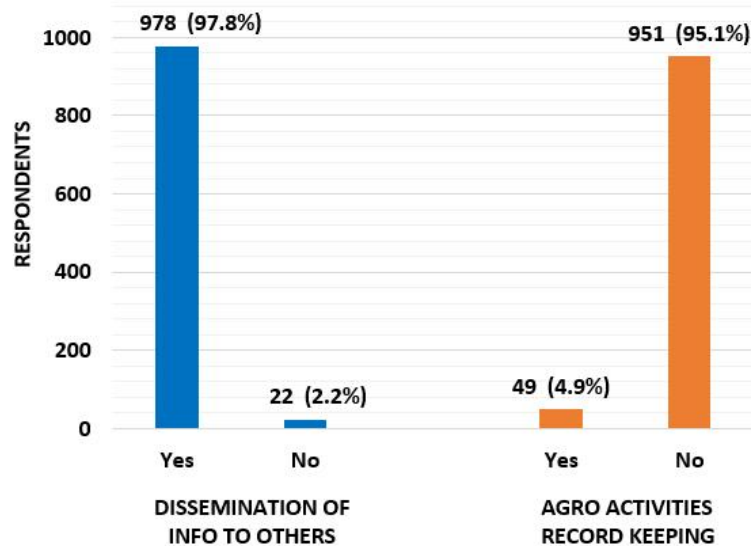


Figure 13. dissemination of agro information to other fellows and agribusiness record keeping.

opportunities by improving processing, production, marketing, service quality, etc. Collective decision making also reduce the risk in agribusiness and enable the cooperative members to become more resilient to environmental and economic shocks (Nwankwo, 2012). While on the other hand, keeping accurate record of agribusiness activities is very important, in fact it is the first step of becoming a successful manager through measuring your efficiency, strength, weakness and progress (Enoch *et al.*, 2010). But unfortunately result on figure 13 above shows that only 49 (4.9%) of 1,000 respondents indicated of keeping record of their agribusiness activities, while a larger proportion of 951 (95.1%) did not pointed of keeping record for their agribusiness activities. Accurate record keeping has a lot of benefits such as helping agro-entrepreneurs plan and complete realistic forecasting for the coming year, identifying the methods, plan, inputs, etc. that works better for their agribusiness. Record keeping also enables Agro-entrepreneurs make better prediction of inputs and produce price changes from the previous expenditures and sales record kept. Accurate record keeping of income and expenditure evidences are often needed and by government agencies, lenders and insurance companies before giving out loans and other interventions to agro-entrepreneurs (Simpa and Emmanuel, 2015). Therefore, agro-entrepreneurs should be encouraged to form cooperative groups for better access to agricultural information and keep accurate/well-maintained records of their agribusiness activities for future plan and references. They should also be encouraged to add their personal or cooperative full information on their products for traceability and food security purposes.

Agribusiness information with clearer pictures can be published on newspapers, leaflets, brochures and fliers. These can also be shared to farmers through cooperatives for improving agricultural productivity (Abdullah and Samah, 2013). Likewise, simple ICT interventions such as provision of an accessible rural pay phone, cybercafé, mobile phone charging points, the use of e-wallet to facilitate payment and redemption of agricultural inputs can play significant roles in enhancing the ability of rural poor families in contribution to national agricultural productions (Buyukbay and Gunduz, 2013). Furthermore, improvement of education at rural areas in order for the farmers to acquire basic skills of using ICT facilities in agriculture is critical to this effort. Moreover, empowerment and capacity building trainings for eradication of poverty among the smallscale farmers will explore them to afford mobile/internet devices and make full usage of modern ICT equipment (Duncombe, 2007).

NEEDS FOR INFRASTRUCTURAL DEVELOPMENT AND IMPROVING EDUCATIONAL SECTOR

The vast extent of agricultural productivity and food security cannot be achieved without effective networking and decent information sharing among all the agricultural stakeholders in the country (Anoop *et al.*, 2017). Illiteracy among farmers and lack of infrastructural developments such as electricity, mobile phone network coverage, etc. especially at rural areas, are the major constraints hampering the innovations and adoption of the latest agricultural technologies such as running of Smart farms, generating/accessing real-time online disaster occurrence map, operating modern agricultural mechanization machines/tools, real-time weather/market

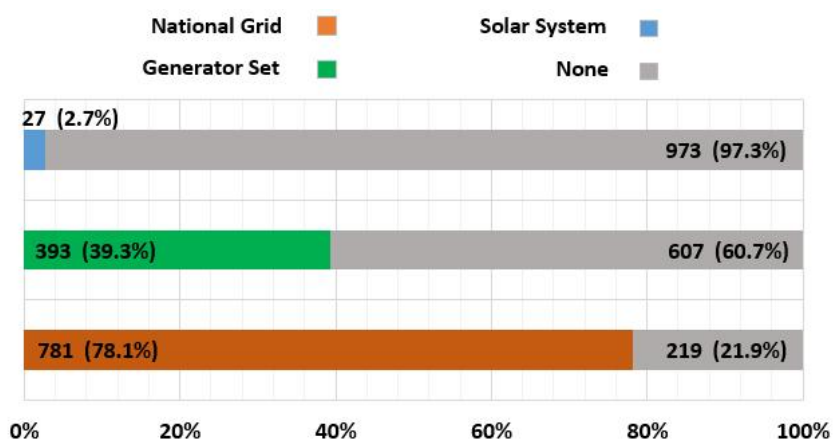


Figure 14. The three most common power sources in Nigeria and their usage among the 1,000 respondents of the research areas.

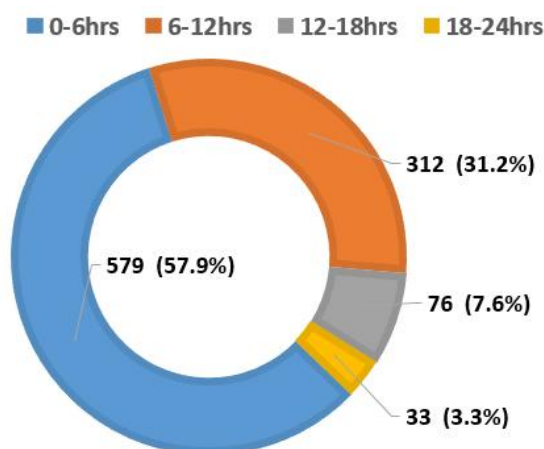


Figure 15. Daily power usage among the respondents.

Information in Nigeria (Tolulope *et al.*, 2015). Figure 14 shows the three most common power sources in Nigeria in which 781 (78.1%) out of 1,000 respondents indicated of having access and connected to National electricity grid. While 39.3% and 2.7% reported additionally of using power source of Petrol/Diesel generators and solar system respectively in order to meet up their daily power demands. These last two percentages are from both the 21.9% of the total respondents that are not yet connected to the national grid in the research areas and also among those that are already connected to the grid, but they are using other power sources as supplements/backup due to frequent power outage in the country.

The result presented in figure 15 shows the power usage from all the available sources (i.e. National grid and personal supplement/backup sources) among the 1,000 respondents. The smallest proportion of 33 (3.3%) reported using power of 18-24 hours per day while 76

(7.6%) indicated using power of 12-18 hours per day, 312 respondents (31.2%) were using power of 6-12 hours per day and the largest proportion of 579 (57.9%) accounted of using power of not more than 6 hours per day. The result indicated that, there is pressing need for infrastructural development in Nigeria especially electricity. Low current and electricity outages are the issues causing agro-entrepreneurs to lose a lot of agricultural information broadcast through different channels and hinders the optimum usage of ICT for agricultural productivity in the country.

The result in Figure 16 shows the numbers and percentages of the respondents' educational qualifications from the selected areas of research, in which the holders of Secondary School Certificates participated more with 40.9%. While the holders of Primary School Certificate constituted 32.4%, tertiary certificates (National Diploma, National Certificate of

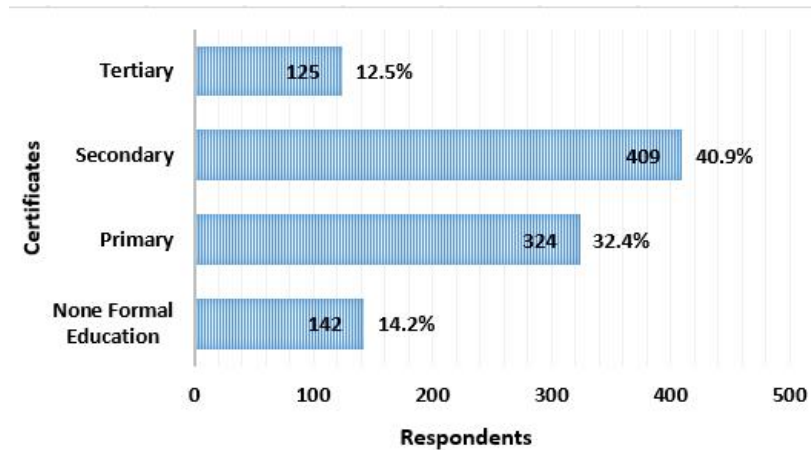


Figure 16. Respondents' educational qualifications.

Education, Higher National Diploma and University degrees) comprised only 12.5% while 14.2% are non-formal education respondents. This result indicated that, agribusiness has been left in the hands of less educated and illiterates in the communities. Therefore, Ministries of Education at National, State and Local Government levels in Nigeria have very important roles to play for eradicating illiteracy among farmers. Even though child education is compulsory in the country also FMARD/FAO is conducting Farmer Field School (FFS) programme. But, there's urgent need for nomadic and adult education systems to be revived and more intensified in order for the agro-entrepreneurs to fully utilize the opportunities of using ICT/networking in Agriculture.

CONCLUSION AND RECOMMENDATIONS

Enhancing Networking/Information Sharing through ICT and other aid methods has a great potential on Agricultural Productivity and Food Security in the country. The study proved the feasibility of SNS in Agriculture, for connecting together the farmers, consumers, agricultural machines fabricators/manufacturers, agricultural organizations, etc. for direct information/knowledge sharing, market negotiations, etc. Therefore, it is highly recommended to implement that the SNS in agriculture programme, as it is going to yield good and encouraging results in Nigeria and other KAFACI Member Countries with similar agricultural Issues as Nigeria. Likewise, farmers should be encouraged to form effective cooperative groups that will serve as platform for sharing agribusiness information by means of newspapers, fliers, DVDs etc. which will in turn increases their yields, sales and profits. While in order to improve the entire agribusiness practice in Nigeria by means of radio and television channels, it is recommended to do the following:

- i. Expanding of Radio/TV Networks coverage and establishments of booster stations for powerful transmission of signals across all the regions in the country
- ii. More public and private Radio/TV stations are needed in the country
- iii. Needs for broadcasting programmes in local languages within each region or state
- iv. Absence of electricity that hampers the use of television especially by the rural farmers need to be addressed urgently in the country
- v. Needs for more Agricultural programmes and more broadcasting time on both Radio and TV channels
- vi. Programmes should be interactive in order to be more attractive to Agro-entrepreneurs and the future farmers
- vii. Agricultural programmes needs to be presented at a convenient time to farmers in order for them to benefit from it (especially between 4:00pm to 10:00pm in Nigeria)
- viii. Needs for special discounts to farmers for advertisements of their agricultural goods on both radio and TV channels
- ix. Needs for broadcasting Agricultural programmes over the internet

The other methods to be enhanced for the overall development of Agriculture include creation of agribusiness mobile APPs and Bulk SMS Systems for effective dissemination of information to farmers and other agro-entrepreneurs in Nigeria and KAFACI member countries. Furthermore, the synergy and collaborations between Agricultural Research Institutions and Extension Organizations can be improved effectively by adopting the technology of cloud computing systems/storages, whereby the published journal papers, books, conferences, etc. can easily be shared widely among the organizations in Nigeria. Moreover, displaying of research results in non-complicated ways, publication of research

books and papers at open/free access journals is significant to farmers, researchers and extension organizations for the successful adoptions of the latest research technology outcomes in the country. Similarly, in order for ICT to be applied effectively in Agriculture especially at rural areas, extensive training for farmers and establishment of ICT/electricity infrastructures are highly/urgently required in Nigeria.

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