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Perceived roles of information communication technologies (ICTs) for agricultural production among smallholder farmers in Oyo State

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Abstract
The use of ICT for agricultural information dissemination in the agrarian communities can help enhance agricultural production. This study examined the usage and effect of information and communication technology for agricultural production among smallholder farmers in Oyo State. Objectives of the study included to ascertain the types of ICTs used for agricultural production, assess respondents' knowledge on use of ICT for agricultural production and to examine the effect(s) of ICT on agricultural production among smallholder farmers in the study area. Multi stage sampling technique was used to select respondents from 5 rural LGAs of Oyo State to give 120 smallholder farmers. Interview schedule was used to elicit information from the respondents. Descriptive and inferential statistics such as Chi-Square and Pearson Product Moment Correlation were adopted to analyze data. Findings revealed that the mean age of respondents was 36.41±10.88 years and most cultivated crops in the study area were leafy vegetables (21.3%), cassava (18.8%) and maize (15.0%). Animals reared included poultry birds (28.8%), rabbit (5.0%), goat (2.5%) and cattle (2.5%). Mean years of farming experience was 10.1±5.95 years with average monthly income of ₦31,232.5±₦16,074.53. ICT tools utilized for agricultural information included mobile phones ($\bar{x}$=1.91), radio ($\bar{x}$=1.89) and television ($\bar{x}$=1.38). Respondents' knowledge on use of ICT for agricultural information was high (62.5%). Constraints encountered on use of ICT included inadequate infrastructural facilities ($\bar{x}$=1.51), insufficient income ($\bar{x}$=1.08) and poor electricity ($\bar{x}$=1.03). Effects of ICT on agricultural production included increased awareness on market ($\bar{x}$=1.90), personal skill development ($\bar{x}$=1.90) and increased knowledge on production ($\bar{x}$=1.90). Significant relationship exists between respondents' education (χ^2=11.139), knowledge (r=0.407) and effect of ICT on agricultural production. It was recommended that older farmers should be encouraged to improve on their educational background through improved extension services and there should be access to better infrastructural and financial facilities.

Keywords: *Information, Communication Technology, Facilities, Smallholder*

Introduction

Rural Development forms an important agenda of both the Government (at both Federal and State levels). However, the application of Information Communication Technologies (ICTs) in the Rural Development sector has been relatively slow. The main reasons for these are poor ICT infrastructure in rural areas, poor ICT awareness among agency officials working in rural areas and local language issues. Agriculture is an important sector with more than 70% of the Nigerian population living in rural areas and earns its livelihood by agriculture and allied means of income (Abhay and Singh, 2017). The sector faces major challenges of enhancing production in a situation of dwindling natural resources necessary for production. The growing demand for agricultural products, however, also offers opportunities for

producers to sustain and improve their livelihoods (Surabhiand, 2012). Information and Communication Technologies (ICTs) play an important role in addressing these challenges and uplifting the livelihoods of the rural farmers. ICTs offers an opportunity to introduce new activities, new services and applications into rural areas or to enhance existing services. ICTs can be interpreted broadly as "technologies that facilitate communication and the processing and transmission of information by electronic means." ICT promises a fundamental change in all aspects of our lives, including knowledge dissemination, social interaction, economic and business practices, political engagement, media, education, health, leisure and entertainment (Kumar, 2011). ICT also enhances the capacity of grassroot development and rural communication through the use of communication system managed by farmers and rural dwellers. Food and Agriculture Organization FAO (2012) is perfectly exploring new application for rural development including the use of ICTs in rural development through the use of information technology tools such as mobile phones, radio, television and the use of internet particularly in the field of agriculture innovation system which contributes to making communication development process more effective at the field level. The use of ICTs had helped the enhancement of agricultural and rural development through improved information and communication process more specifically involving the conceptualization, design, development, evaluation and application of imitative ways to use information and communication technology in the rural domain, with a primary focus on agricultural development.

One of the major reasons for setback to rural farmers is poor access to information necessary for agricultural production. Good internet access can make rural farmers especially small and medium scale enterprises (SMSs) less isolated and efficient ways of doing business with the use of ICTs. This can therefore help them solve other problems of agricultural production such as insufficient access to credit facilities, processing and marketing facilities. Access to information and modern technology is critical to improved rural welfare and agricultural production. ICTs can be used as effective means of disseminating information to communicate relevant information on market, technology, prices, successful experiences, credit facilities, government services and policies, weather, crop, livestock and natural resource production and food security (FAO, 2012). Some of the emerging ICT applications in small-scale agriculture in Africa included Market Information System (MIS), databases, public access facilities and mobile applications (Eniola, Siyanbola and Olaniyi 2008). Despite the various challenges faced by farmers, information communication technologies (ICTs) have reached even the rural sections of the farming communities. The agricultural sector is confronted with the major challenge of increasing production to feed a growing and increasingly prosperous population in a situation of decreasing availability of natural resources. Factors of particular concern are water shortages, declining soil fertility, effects of climate change and rapid decrease of fertile agricultural lands due to urbanization. However, the growing demand, including for higher quality products, also offers opportunities for improving the livelihoods of rural communities. Realizing these opportunities requires compliance with more stringent quality standards and regulations for the production and handling of agricultural produce. New approaches and technical innovations are required to cope with these challenges and to enhance the livelihoods of the rural population (John & Barclay, 2017). The role of ICT to enhance food security and

support rural livelihoods is increasingly recognized and was officially endorsed at the World Summit on the Information Society (WSIS) 2003-2005. These include the use of computers, internet, Geographical Information Systems (GIS), mobile phones, as well as traditional media such as radio or TV. Although it is a relatively new phenomenon, evidence of the contribution of ICT to agricultural development and poverty alleviation is becoming increasingly available. The vast majority of poor people lives in rural areas and derive their livelihood directly or indirectly from agriculture. Increasing the efficiency, productivity and sustainability of small-scale farms is an area where ICT can make a significant contribution. Farming involves risks and uncertainties, with farmers facing many threats from poor soils, drought, erosion and pests. ICTs can deliver useful information to farmers about agriculture like crop care and animal husbandry, fertilizer and feedstock inputs, pest control, seed sourcing and market prices (Kumar, 2011).

Moore and Feodoro, (2014) attested in a similar study that the use of ICT in disseminating agricultural information to rural farmers had significantly improved agricultural development in Nigeria and some other African countries through improved databases. Calvalho, Francisco & Relvas., (2014) in a similar study reiterated that low agricultural production had been attributed to lack of ICT proficiency by extension agents, insufficient ICT database system and high cost of technological infrastructure. The study therefore determined the perceived roles of ICT for disseminating agricultural information among smallholder farmers in Oyo State. The study objectives are to:

1. Examine Respondents' socio-economic characteristics
2. ascertain the types of ICTs used for agricultural production
3. Assess Respondents' knowledge on use of ICT for agricultural production
4. examine the effect(s) of ICT on agricultural production among smallholder farmers in the study area.

The following null hypotheses were tested:

$H_0$1: There is no significant relationship between respondents' socio-economic characteristics and the effects of ICT on agricultural production

$H_0$2: There is no significant relationship between respondents' knowledge on use of ICT and its effect on agricultural production

Methodology

Area of Study: The research was carried out in selected agrarian communities of Oyo State, Nigeria. Oyo State is bounded by Republic of Benin, Osun, Kwara and Ogun States and there are 33 local government areas (LGAs) in the State. According to 2006 National population census, the population of the State stood at 5,591,589.The weather conditions vary between the two distinct seasons in Nigeria; the rainy season (April - October) and the dry season (November - March). Oyo is located in the south west of Nigeria and it was among the 3 states carved out of the former Western State of Nigeria in 1976. Oyo State covers a total of 28, 249 square kilometres of land mass and it consists of old hard rocks and dome shaped hills. Oyo State is one of the food baskets in the federation. Agriculture is the major source of income for greater number of people in the State providing food and shelter, employment, industrial raw materials and remains an important source of internally generated revenue in the state. The climate of Oyo State is tropical with distinct wet and dry season with temperature ranging between 22-38^{0}C which favors the cultivation of food crops such as yam, cassava, millet, maize, fruits, vegetables and plantains), cash crops (such as cocoa, Tobacco and Timber) as well livestock like ruminant, poultry, fish and forest animals. The state has two vegetation zones which are

derived savannah and forest zones.

The population of the study consists of crop and livestock farmers in the selected local government areas of the State. Multi stage sampling procedure was used for the study.

Stage 1: Involves random selection of 30% of the 17 rural L.G.As in Oyo State to give 5 local government areas namely: Afijio, Atisbo, Ibarapa-North, Iwajowa and Surulere L.G.As.

Stage 2: Involves purposive selection of two communities from each of the selected L.G.As with high percentage of smallholder farmers which were Jobele and Iware from Afijio LGA, Irawo and Sabe from Atisbo LGA, Igangan and Tapa from Ibarapa North, Iganna and Iwere-Ile from Iwajowa, while Iresaadu and Gambari were selected from Surulere LGA.

Stage 3: Involves simple random sampling of 12 farmers from each of the selected communities.

Stage 4: Stratification of farmers into crop and livestock farmers from each of the selected communities to give a total of 120 farmers considered for the study.

Data Collection and analysis: Data were collected through the use of structured questionnaire and interview schedule. Data were analyzed using descriptive (frequencies and percentages) and inferential (chi-square and PPMC) statistics.

Measurement of Variables

Socio-economic characteristics

Age: Measured at interval (ordinal) level by asking respondents of their exact age in years

Sex: Measured at nominal level by giving options of their gender (male/female).

Educational qualification: Measured at ordinal level by listing the education qualification options for the respondents to choose from (e.g primary, secondary, tertiary, etc).

Household size: Measured at interval level by asking respondents to provide their exact household size in numbers

Type of agricultural Enterprise: Measured at nominal level by providing list of agricultural enterprises for respondents to choose those applicable to them.

Years of Experience and Income from agricultural production: Measured at interval level

Types of ICT used for agricultural production: Respondents were provided with lists of available ICTs used for agricultural production in the study area and other ones not included in the options were also mentioned and added.

Knowledge on use of ICTs for agricultural production: Seventeen knowledge statements on use of ICTs for agricultural production were asked and the respondents responded either correct or incorrect based on their knowledge level. Respondents that fell below the grand mean were regarded to have low knowledge while those that fell above the mean were regarded to have high knowledge on use of ICTs for agricultural production in the study area.

Effects of ICT on agricultural production: Respondents were provided with perceived effects of the use of ICT on agricultural production in the study area using the scale "to a great extent" (assigned 2), "to a lesser extent" (assigned 1) and "no effect at all" (assigned 0).

Results and Discussion

Table 1 revealed that respondents' mean age was 36.41±10.88 years indicating that the respondents were still in their productive years of agricultural production and being youthful enhances innovativeness which depicts better propensity towards the usage of ICT. Nwakure and Johagun (2009) reiterates that uniform distribution of age within a group ensures continuity in transition of innovation technology and exchange of knowledge. The distribution of respondents by sex reveals that

most (65.0%) of the respondents were male while 35.0% were female. This is an indication that males are more into agricultural production in the study area probably due to its strenuous nature. Perhaps males for being head of households are more in possession of productive assets (gadgets) than their female counterparts.

Majority (91.2%) of the respondents had one form of education or the other which will enhance their knowledge on the use of ICT for agricultural production. Obayelu and Ogunlade (2006) affirmed that high level of illiteracy could increase challenges associated with agricultural production. The mean household size of the respondents in the study area was 10.88 ±3.60 people which indicated that majority of the respondents may likely had the support of their family in farming which made their farming activities more productive.

Table 1: Distribution of Respondents by Socio-Economic Characteristics

Variables	Frequency	Percentage	Mean
Age			
20 - 34 years	60	50.0	
35 - 49 years	42	35.0	36.41±10.88
50 years and above	18	15.0	
Sex			
Male	78	65.0	
Female	42	35.0	
Educational Level			
No formal Education	11	9.2	
Primary Education	41	34.2	
Secondary Education	26	21.6	
Adult/ Literacy Education	42	35.0	
Household Size			
1 - 5 people	36	30.0	
6 - 10 people	60	50.0	10.88±3.60
Above 10 people	24	20.0	
Type of agricultural enterprise			
Crop Production	48	40.0	
Livestock production	34	28.8	
Integrated farming	27	22.5	
Agro – processing	11	8.8	
Years of experience			
1 - 10 years	84	70.0	
11 - 20 years	29	23.8	10.1±5.95
21 years and above	7	6.3	
Income per month			
₦10000 - ₦24000	40	42. 5	₦21,232.5±₦16,074.53
₦25000 - ₦39000	51	33.8	
₦40000 and above	29	23.8	

Source: Field Survey, 2018

Most (67.5%) of the respondents were non-members of farmers' group and the remaining 32.5% were members of farmers' group. Farmer groups are avenue for farmers to focus on common interest affecting their production and well-being. Farmers belonging to farmers

group may have an edge over their counterpart. Nwakure and Johagun (2009) affirmed that farmers' involvement in association membership help provide solution to most agricultural production challenges. The mean years of farming experience was 10.1±5.95. Some (40.0%) of the respondents were engaged in crop production, 28.8% were engaged in livestock production, 22.4% were engaged in integrated farming while the remaining 8.8% were engaged in agro-processing. The result indicated that more farmers in the study area were involved in crop than livestock production. The mean income of farmers was ₦21,232.5±₦16,074.53 per month indicating that most of the farmers were small scale farmers. Eniola, *et. al.,* (2008) also confirmed that most rural farmers that practice on small scale basis are arable crop farmers.

Types of ICTs Used for Agricultural Production

Findings in Table 2 reveals that the respondents mostly made use of mobile phones ($\bar{x}$=1.91), radio ($\bar{x}$=1.89) and Television ($\bar{x}$=1.38) as sources of information for their agricultural production. This implies that mobile communication technology tools were more accessible to farmers in the study area. Surabhiand Mamta, (2012) also attested that the use of radio and mobile phones had improved agricultural production globally due to their accessibility and simplicity to use by farmers of all ages.

Table 2: Distribution of Respondents' by Types of ICT Tools Used for Agricultural Production

ICT tools	To a great extent (%)	To a lesser extent (%)	Not at all (%)	Mean	Rank
Radio	88.8	11.3	0.0	1.89	2nd
Television	50.0	37.5	12.5	1.38	3rd
Internet	41.3	41.3	17.5	1.24	4th
Mobile Phones	92.5	6.3	1.3	1.91	1st
Newspaper	36.3	47.5	16.3	1.20	5th
Magazine	20.0	47.5	32.5	0.88	7th
Email	30.0	41.3	28.8	1.01	6th
Journals	12.5	36.3	51.3	0.61	8th

Source: Field Survey, 2018

Knowledge on the Use of ICT for Agricultural Information

Table 3a reveals that all the respondents (100%) were knowledgeable about agricultural programs on radio had helped to solve many agricultural problems like pests and weed management and that agricultural information from radio and bulletins had improved their personal marketing skills (100%). Majority were knowledgeable that ICT had helped them to improve communication with marketers and agro-processors (98.8%); that they made better connections with marketers and consumers through mobile phones (98.8%) and that the use of ICT can help in the production, marketing and processing of their agricultural produce/products (97.5%). ICT had helped the farmers achieve all year round agricultural production through irrigated farming (97.5%); provided better access to extension services (97.5%) and also increased income through better sales of produce/products (95.0%). ICT had also enabled the farmers have access to farm inputs like seed, herbicides and fertilizer (93.8%), provided better infrastructural facilities like electricity, good road, water, etc (88.8%) and access to agro-processing facilities (88.8%). In addition, the

categorization of respondents knowledge in Table 3b reveals that most (62.5%) of the respondents had high knowledge on the use of ICT for agricultural information which indicated that farmers' educational background influenced their knowledge and use of ICT for agricultural production in the study area. Food and Agriculture Organization of the United Nations (FAO), (2012) asserted this claim that the use of mobile ICT had brought about increased knowledge and skill of rural farmers leading to food security and agricultural development.

Table 3a Distribution of Respondents by Knowledge on the use of ICT for Agricultural Information

Knowledge statements on ICT	Correct (%)	Incorrect (%)	Mean
The use of ICT can help in the production, marketing and processing of my agricultural produce/products	97.5	2.5	0.98
ICT enables me have access to farm inputs like seed, herbicides and fertilizer	93.8	6.3	0.94
The use of ICT can help increase in income through better sales of agricultural produce/products	95.0	5.0	0.95
Regular use of ICT can lead to health hazards due to increased radiation	46.3	53.8	0.46
Use of ICT can provide better access to extension services	97.5	2.5	0.98
ICT help provide better health status through improved awareness	93.8	6.3	0.94
ICT causes climate change	52.5	47.5	0.53
ICT help increase agricultural production	95.0	5.0	0.95
Agricultural programs on radio had helped to solve many agricultural problems like pests, weed management, etc	100.0	0.0	1.00
Agricultural information from radio and bulletins had improved my personal marketing skills	100.0	0.0	1.00
ICT had helped to improve communication with marketers and agro-processors	98.8	1.3	0.90
ICT improved my communication with marketers and consumers through mobile phone	98.8	1.3	0.98
ICT had helped in achieving all year round agricultural production through irrigated farming	97.5	2.5	0.98
ICT has provided better infrastructural facilities like electricity, good road, water, etc	88.8	11.3	0.89
ICT had provided access to agro-processing facilities	88.8	11.3	0.89
ICT had helped to provide adequate security	66.3	33.8	0.66
ICT had increased the rate of theft	50.0	50.0	0.50

Source: Field Survey, 2018

Table 3b: Categorization of Respondents' knowledge of the use of ICT for Agricultural Information

Variable	Frequency	%	Mean	Standard Deviation
High knowledge level	75	62.5%	14.6	1.65
Low knowledge level	45	37.5%		

Source: Field Survey, 2018

Effect of ICT on Agricultural Production

According to Table 4a, majority of the respondents agreed that ICT to a greater extent increased awareness on market outlets ($\bar{x}$=1.90); personal skill developments e.g. improved individual marketing strategies ($\bar{x}$=1.90) and increased knowledge on general agricultural production ($\bar{x}$=1.90). ICT had also influenced farmers' access to extension services ($\bar{x}$=1.84); improved communication with marketers and agro-processors ($\bar{x}$=1.84); improvement in the production, marketing and processing of agricultural products ($\bar{x}$=1.81); increase in income through better sales of produce/products ($\bar{x}$=1.78); reduced migration to other neighboring communities ($\bar{x}$=1.76); improved health status ($\bar{x}$=1.75); access to farm inputs like seed, herbicides and fertilizer ($\bar{x}$=1.74); improved social status ($\bar{x}$=1.73); improved access to agro-processing facilities ($\bar{x}$=1.71); improved security of assets and produce ($\bar{x}$=1.61); better Infrastructural facilities like electricity, good road, and water ($\bar{x}$=1.60); access to governmental or NGO support ($\bar{x}$=1.44); increased rate of manipulation by younger farmers ($\bar{x}$=1.18) and exposure to health hazards due to increased radiation ($\bar{x}$=0.83). Furthermore, the categorization of the effect of ICT on agricultural production in Table 4b reveals that ICT had high productive effect (59.2%) on agricultural production in the study area. John and & Barclay (2017) also attested that the use of mobile ICT had helped increased agricultural production in the agrarian part of Nigeria.

Table 4a: Distribution of Respondents by Effect of ICT on Agricultural Production

Effect of ICT tools on production	To a great extent (%)	To a lesser extent (%)	Not at all (%)	Mean
Improvement in the production, marketing and processing of agricultural products	81.3	18.8	0.0	1.81
Access to farm inputs like seed, herbicides and fertilizer	75.0	23.8	1.3	1.74
Increase in income through better sales of produce/products	77.5	22.5	0.0	1.78
Exposure to health hazards due increased radiation	22.5	37.5	40.0	0.83
Better access to extension services	83.8	16.3	0.0	1.84
Improved health status	75.0	25.0	0.0	1.75
Increased awareness on market outlets	91.3	7.5	1.3	1.90
Increased knowledge on general agricultural production	91.3	7.5	1.3	1.90
Increased rate of agricultural manipulation by younger farmers due to increased knowledge of ICT	40.0	37.5	22.5	1.18
Personal skill developments e.g. improved individual marketing strategies	91.3	7.5	1.3	1.90
Improved communication with marketers and agro-processors	83.8	16.3	0.0	1.84
Improved social status of farmers	72.5	27.5	0.0	1.73
Reduced migration to other neighboring communities	80.0	16.3	3.8	1.76
Better infrastructural facilities like electricity, good road, and water	61.3	37.5	1.3	1.60
Improved access to agro-processing facilities	71.3	28.8	0.0	1.71
Access to governmental & NGO support	47.5	48.8	3.8	1.44
Improved security of assets and agricultural produce	62.5	36.3	1.3	1.61

Source: Field Survey, 2018

Table 4b: Categorization of the Effect of ICT on Agricultural Production

Variable	Frequency	%	Mean	Standard Deviation
High effect	71	59.2	28.3	4.95
Low effect	49	40.8		

Source: Field survey, 2018

Relationship between Respondents' Socio-Economic Characteristics and the Effect of Information Communication Technology (ICT) on Agricultural Production

The result of Chi-Square analysis in Table 5 reveals that a significant relationship exists between respondents' educational level (χ^2=11.139, p =0.049) and the effect of Information Communication Technology (ICT) on agricultural production. However, there was no significant relationship between respondents' sex (χ^2=0.046, p =0.830), marital status (χ^2=3.796, p =0. 150), religion (χ^2=5.468, p=0.065), type of agricultural enterprise (χ^2=1.004, p =0.800), scale of production (χ^2=3.736, p =0.154), major occupation (χ^2=9.354, p =0.405), membership of farmers' group (χ^2=0.018, p =0.894), name of group (χ^2=0.176, p =0.916), and the effect of Information Communication Technology (ICT) on agricultural production (Table 6). Mehta and Kalra (2013) also confirmed in a similar study that rural farmers' educational qualification and years of farming experience had significant influence on their agricultural production through the use of mobile ICTs.

Table 5: Chi square Analysis between Respondents' Selected Socio-Economic Characteristics and the Effect of Information Communication Technology (ICT) on Agricultural Production

Variable	χ^2 value	P-value	DF	Decision	Remark
Sex	0.046	0.830	1	Not significant	Accept
Educational level	11.139	0.049	5	Significant	Reject
Type of agricultural enterprise	1.004	0.800	3	Not significant	Accept
Scale of production	3.736	0.154	2	Not significant	Accept

Source: Field Survey, 2018

Table 6: Correlation between Respondents' Socio-Economic Characteristics and the Effect of Information Communication Technology (ICT) on Agricultural Production

Variable	r value	P value	Decision	Remark
Age	0.119	0.293	Not significant	Accept
Household size	-0.021	0.853	Not significant	Accept
Agricultural enterprise	-0.028	0.805	Not significant	Accept
Years of farming experience	-0.041	0.715	Not significant	Accept
Income	-0.031	0.785	Not significant	Accept

Source: Field Survey, 2018

Relationship between Respondents' Knowledge on the use of ICT and the Effect of Information Communication Technology (ICT) on Agricultural Production

The PPMC analysis in Table 7 reveals that there was significant relationship between respondents' knowledge on the use of ICT (r=0.407, p =0.000) and the effect of Information Communication Technology (ICT) on agricultural production. This implies

that respondents' knowledge on their various agricultural enterprises was influenced positively by the use of ICT to ensure improved agricultural production. John & Barclay (2017) in their study also confirmed that farmers' knowledge and skill on the use of ICT had positive influence on their agricultural production.

Table 7: Correlation between Respondents' Knowledge on the Use of ICT and the Effect of Information Communication Technology (ICT) on Agricultural Production

Variable	r value	P value	Decision	Remark
Knowledge	0.407	0.000	Significant	Reject

Source: Field Survey, 2018

Conclusion and Recommendations

It was concluded from the study that majority of the smallholder farmers were young males in their active age with one form of education or the other. They were mostly crop farmers with low income A good number of the farmers had access to family support (through large family size) with some years of experience in their agricultural production. The respondents received information on ICTs via radio, television and mobile phones. Respondents had high knowledge on use of ICTs in the study area despite some challenges encountered. Some of the challenges the farmers encountered included manipulation of older farmers by younger ones due to illiteracy and exposure to health hazards due to increased radiation. Respondents' level of education and knowledge on use of ICTs had a significant effect on their agricultural production. The study recommended that older farmers should be encouraged to improve on their educational level through improved extension services and better infrastructural and financial facilities be provided for farmers for improved production.

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