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Arable Crop Farmers' Utilization of ICT Devices in Accessing Climate Change Information for Agricultural Production in Osun State, Nigeria

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ABSTRACT

This study assessed arable crop farmers' utilization of Information Communication Technology (ICT) devices in accessing climate change information for agricultural production in Osun State, Nigeria. Specifically, it identified ICT devices used, assessed farmers' perceptions, determined the extent of ICT utilization and identified benefits and challenges associated with the usage of ICT for climate change information for food security. A multistage sampling technique was used to select 180 respondents from three LGAs across two agricultural zones (Ife-Ijesha and Iwo). Data were analyzed using frequency distribution, mean, percentage, and Chi-square. Results showed that mobile phones (66.7%), radio (58.3%), and television (41.7%) were the most frequently used ICT tools. Also, 36% of respondents had a high level of ICT utilization. Major constraints were high costs of ICT facilities (mean =2.76), rural poverty (mean =2.60), and erratic power supply (mean =2.42). Education (χ^2=154.3, P=0.041) and type of occupation (χ^2=30.2, P=0.006) influenced ICT use. The study concludes that moderate ICT utilization exists among farmers and recommends training programmes to enhance farmers' ICT proficiency and climate change information access for increased food security in the nation.

1.0 Introduction

One of the most complicated and urgent global environmental issues facing modern society is climate change (Nordhaus, 2019; Pörtner et al., 2022). Changes in biodiversity loss, weather patterns, sea level rise, and other environmental effects can all be caused by the change in the climate. Climate change is posing significant challenges to global agricultural systems, impacting environmental sustainability, food security, and livelihoods. Both human activities and the environment are impacted by climate change.

In Osun State, Nigeria, where agriculture is the primary industry and means of livelihood for the people, the effects of climate change are evident. Because they depend heavily on weather patterns and environmental conditions, farmers who grow crops are especially vulnerable to the detrimental consequences of climate change and fluctuation. Information and communication technology, as defined by Essien, Abredu, and Zotoo (2022), is the use of computer systems and telecommunications in the handling and provision of information services. Information and communication technology (ICTs) have promising opportunities to increase agricultural systems' resilience to climate change by providing farmers with timely and relevant information. Using ICT tools such as mobile phones, radio broadcasts, and internet platforms to access weather forecasts, agronomic advice, market information, and climate adaptation strategies helps farmers make better decisions and mitigate the negative impacts of climate variability and change on their livelihoods.

Farmers need access to a trustworthy source of information that covers their particular needs and challenges, such as information on soil conditions, weather patterns, pest and disease outbreaks and the newest agricultural technologies, given the increasing complexity of modern agriculture especially in the production of arable crops (Adara, Duntoye, Uyamasi, Asiyanbi, and Oyeyemi, 2025). Without access to accurate weather forecasts, agronomic advice and climate adaptation strategies, farmers are less equipped to make informed decisions about

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climate. Furthermore, the effectiveness of the several channels now in use for information distribution, such as the community networks, extension services, community-based organizations and radio broadcasts in providing arable crop farmers with information about climate change, is also unknown. Local communities must be involved in the planning and decision-making stages of universal access initiatives for ICT implementation to be successful (Moses and Paul, 2023). The problem is made worse by a lack of comprehensive understanding of the impact, utility, and accessibility of information and communication technology (ICT) tools in supplying climate change information to arable crop farmers. Although ICT tools have the potential to increase the amount of information that arable farmers receive about climate change, obstacles like high costs, technical complexity, and cultural barriers may restrict their acceptance and utilisation rates in Osun State's rural areas. Furthermore, it is still unclear how well ICT-based information delivery systems can reach vulnerable and marginalised farmer groups, which raises concerns regarding their fairness and inclusivity.

1.1 Purpose of Study

The essence of this study is to fill the knowledge gap by exploring the utilization of ICTs in disseminating climate change information to arable farmers and identifying strategies to strengthen their resilience in the face of a changing climate. Thus, the main objectives of the study are to:

i. identify different ICT devices utilized by arable crop farmers for accessing climate change information;
ii. determine the perception of arable farmers towards the use of ICTs for accessing climate change information;
iii. examine the extent of utilization of ICTs by arable farmers for obtaining climate change information; and
iv. identify the benefits and challenges of ICTs use for accessing climate change information in the study area.

1.2 Hypothesis

H_0: There is no significant relationship between the socio-economic characteristics of the arable crop farmers and the extent of utilization of ICTs for obtaining climate change information.

2.0 Methodology

The study was conducted in Osun State. The state's geographical coordinates place it approximately between latitudes 7.45°N and 8.20°N and longitudes 4.50°E and 5.20°E. This positioning situates Osun State within the humid tropical zone which experiences a typical pattern of wet and dry seasons that significantly influences agricultural practices in the region.

A multistage sampling technique was employed to select the respondents for this study.
At the first stage, two agricultural zones out of the three zones were selected based on the preponderance of arable crop cultivation in the zones. These were: the Iwo and the Ife-Ijesa zones, respectively. A proportionate selection of Local Government Areas (LGAs) within each agricultural zone was undertaken. At the first stage, a proportionate sampling technique was used to select two LGAs from the Ife Ijseha zone and one LGA from the Iwo zone. This process ensured that the study covered a broad spectrum of agricultural practices and climatic conditions within each zone. The LGAs selected were Ife North and Atakumosa West from the Ife Ijesha zone, and Ayedaade from the Iwo zone. At the second stage, a simple random sampling technique was used to select six communities from the Ife-Ijesa and Iwo zones. Within each of these LGAs, 60 respondents were selected, 10 respondents from each of the communities, amounting to a total of 180 respondents for the entire study. This selection was carried out through a combination of stratified and random sampling techniques. Data were analyzed using frequency distribution, mean, percentage, and Chi-square.
The dependent variable for the study was the utilization of ICTs. This was operationalized using the extent of usage of 10 ICTs in accessing climate change information for agricultural production by arable crop farmers. The respondents were asked to indicate how each of the ICT tools was used to obtain 14 pieces of climate change information. Each climate change information was scored 1 point for yes and 0 for no. All the responses were summed together to form the utilization score. The minimum score was 0 while the maximum score was 140. Mean plus and minus standard deviation was used to categorise the score as (high, moderate, and low).

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Arable crop farmers were given ten different ICT devices, among them were rated on a four-point scale: used, most preferred, preferred, and least preferred, ranging from 4 to 1. Equal intervals were used to categorise the score as (high, moderate, and low). Also, perceptions towards ICT usage were measured by asking the respondents to react to 10 perceptional statements on a five-point scale from Strongly Agree, Agree, Undecided, Disagree, or Strongly Disagree. These range from 5-1, and the grand mean score was used to categorise the perceptional statements as favourable and unfavourable. The benefit derived from using ICT was measured by asking respondents to select from ten benefits listed on the table and each was scored a point, which was measured using frequency and percentage. In the same vein, challenges derived from using ICT were measured by asking respondents to select from ten challenges listed on the table, and each was scored a point and was measured using frequency and percentage.

3.0 Results and Discussions

3.1 Different ICT Devices Utilized by Arable Crop Farmers for Accessing Climate Change Information

Results in Table 1 show that mobile phone (mean = 2.99) and radio (mean = 2.95) were the most preferred ICT devices among the respondents. In addition, television (mean = 2.44), and internet (agricultural website) (mean = 2.37), social media (mean =2.18), non-e-sources (mean =2.13), and tablet (mean=2.18) were the preferred ICT devices utilised by arable crop farmers for accessing climate change information in the study area. This suggests that among farmers, cell phones and radios are the most widely used and preferred ICT devices for obtaining information about climate change, whereas email and newspapers/magazines are the least chosen. Farmers now have better access to critical information that might impact their marketing choices and increase their negotiating power due to the broad availability of mobile networks, especially in distant places (Ajani et al., 2022). According to Adeniyi and Yekinni (2023) and Ekong and Adebayo (2021), radio is a good means to spread information about the marketing of agricultural goods and services because they are inexpensive, widely available and can reach a large audience. They also frequently broadcast agricultural news in local languages. However, limited digital literacy in rural areas, high data costs and inadequate infrastructure limit internet usage (Ojo et al., 2023).

TABLE 1: ICT Devices Utilized for Accessing Climate Change Information

Sources of information	Used (%)	Most preferred (%)	Preferred (%)	Least preferred (%)	Mean
Mobile phone	120 (66.7)	60 ()	18 (10.0)	0(0.0)	2.99
Radio	105 (58.3)	18 (10.0)	14 (7.8)	43 (23.9)	2.95
Television	75 (41.7)	53 (29.4)	52 (28.9)	0 (0.0)	2.44
Internet (agricultural website)	70 (38.9)	15 (8.3)	0 (0.0)	1 (0.6)	2.37
Social media (WhatsApp, Facebook, Instagram, Twitter, etc.)	53 (29.4)	32 (17.8)	30 (16.7)	40 (22.2)	2.18
Non-e-sources (Extension agents, Fellow farmers and friends, etc.)	52 (28.9)	66 (36.7)	51 (28.3)	61 (33.9)	2.13
Tablet	44 (24.4)	52 (28.9)	18 (10.0)	57 (31.7)	2.04
Computer/Laptop	40 (22.2)	70 (38.9)	57 (31.7)	1 (0.6)	1.97
Newspaper/Magazine	5 (2.8)	52 (28.9)	14 (7.8)	44 (24.4)	1.77
Email	5 (2.8)	10 (5.6)	5 (2.8)	19 (10.6)	1.49

Source: Field Survey, 2024.

3.2 Level of Different ICT Devices Utilized by Arable Crop Farmers for Accessing Climate Change Information

Results in Figure 1 show that a substantial portion (36%) of arable crop farmers had a high level of utilization of ICT devices for accessing climate

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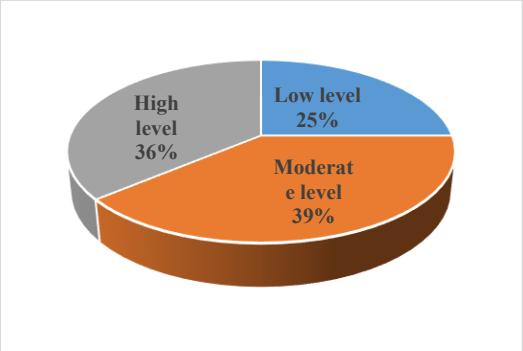
change information. While about (39%) of the respondents experience a moderate level of utilization. In the same vein, about (25.0%) of the respondents fall into the low level of ICT utilization. Overall, the results indicate that although most farmers of arable crops are actively using ICT d devices to gather information about climate change, a sizeable percentage are still not as involved. This suggests that arable crop farmers depend on technology to differing degrees, with many actively using ICT tools to control the effects of climate change on their farming methods. The varying degrees of ICT use emphasize how crucial it is to expand access to and training for these technologies so that all farmers may use them to successfully address climate-related issues. As a result, arable farmers need access to high-quality information in order to make well-informed decisions regarding the production and sale of their crop (Ajani et al., 2021; Kikulwe et al., 2020; Vanlauwe et al., 2023).

Figure 1: Extent of utilization of ICTs for accessing climate change information



Source: Field survey, 2024

3.3 The Perception of Arable Farmers Towards the Use of ICTs for Accessing Climate Change Information

Results in Table 2 present the findings related to arable crop farmers' perception concerning ICT utilisation. The results indicate that farmers were undecided on the following statement: can provide feedback to the source regarding the relevance of information (mean=3.37), have been receiving a particular package of agricultural information at the right time (mean=2.94), and always use ICT tools to obtain information about climate change (mean=2.91) among others. This suggests that farmers are somewhat neutral regarding the effectiveness of ICT tools in aiding better decision-making. In addition, farmers were also neutral to the following negative statement that accessing climate change information using ICT tools is too challenging (mean=42.90), and ICT tools have not assisted me in making better farming decisions despite receiving climate change information from them (mean=2.80). This demonstrates a moderate level of agreement that accessing information can be challenging and that some farmers do not use these tools.

The results suggest that although ICT tools are perceived favourably for raising awareness and offering feedback, there is also a significant degree of scepticism about their efficacy and dependability in comparison to more conventional sources. This supported the findings of Abdus and Muhammad (2020), who found that farmers felt that using ICT as a source of information in agriculture was crucial to achieving the highest possible crop yield. Through a variety of technical and skilled training programs, farmers can be encouraged and trained to use the various ICT devices.

Table 2: Perception Towards the Use of ICTs for Accessing Climate Change Information

Statement	Mean	SD
I can provide feedback to the source regarding the relevance of information.	3.37	1.325
I have been receiving a Particular package of agricultural information at the right time.	2.94	1.132
I always use ICT tools (e.g., mobile phone, social media) to obtain information about climate change	2.91	1.117
ICT tools are effective in spreading awareness about climate change issues among farmers in my community.	2.90	0.862
I regularly receive updates or alerts about climate change and weather conditions through ICT tools.	2.73	0.939
ICT tools have helped me reduce losses caused by climate change-related events.	2.04	1.145
I am satisfied with the climate change information available to me through ICT tools.	1.97	1.157
ICT tools have helped me make better farming decisions based on climate change information received from them.	1.96	0.453
Accessing climate change information using ICT tools is too challenging.	2.90	0.898
ICT tools have not assisted me in making better farming decisions despite receiving climate change information from them.	2.80	0.988

Source: Field survey, 2024

3.4 Levels of Perception of Arable Farmers

Results in Figure 2 show that 67 percent of the respondents had a low perception of the usage of ICTs for climate change information. About 21 percent had a moderate level of perception on the usage of ICTs for climate change information,

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while just 12 percent of the respondents had a high perception on the usage of ICT tools to access climate change information. This finding supported the claim made by Izuogu, Kadurumba, Azuamairo, Njoku, and Olaolu (2022) that respondents acknowledged that rural farmers' usage of digital technology is not sustainable.

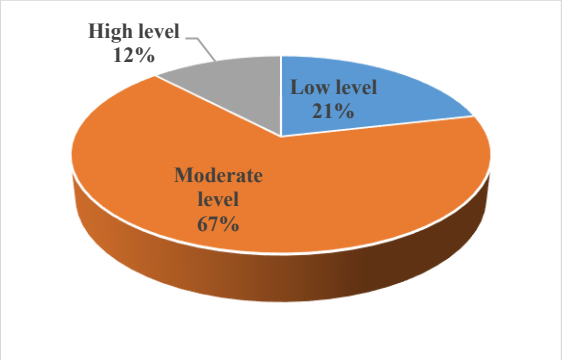

Figure 2: Level of perception of arable farmers towards the use of ICTs for accessing climate change information
Source: Field survey, 2024

3.5 Extent of Utilization of ICTs by Arable Farmers for Obtaining Various Climate Change Information

Results in Table 3 show that mobile phones (45.4%) are relatively used by respondents for accessing various types of climate and agricultural information with a particularly high level of usage for receiving weather forecasts, pest and disease warnings and information on disaster alerts. Despite their moderate overall utilization, there is a notable drop in the usage for information on bush burning which may suggest a lower relevance or accessibility of mobile phones for this particular type of information.

Radio (30.6%) implies that respondents do not make use of it as much as they use mobile, even though it has been in existence for a long time and there is no need for network search on a mobile phone. With all these, the medium remains relevant due to its wide reach and real-time broadcasting capabilities which are crucial for the timely dissemination of information. Television (30.4%) suggests that it is also a powerful medium for obtaining climate change information, especially for disaster alerts and weather forecasts. The relatively high level of utilization reflects its role in providing comprehensive and often visually engaging content.

Non-electronic sources, such as extension agents and fellow farmers have a mean usage percentage of 30.1 percent. This high level of use highlights how crucial direct one-on-one communication tools are for passing useful, situation-specific information regarding agriculture and climate change to the arable crop farmers. This suggests that computers, tablets and social media platforms have lower-level mean usage percentages; mobile phones, radios, and televisions are the most often used devices. This distribution balances the practicality and real-time accessibility of various ICT tools, reflecting the many ways respondents prioritise and access various forms of information. Low knowledge, lack of risk management insurance, lack of technical expertise and the inappropriateness of these technologies have all been blamed for this (Bolfe et al., 2020).

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Table 3: Extent of Utilization of ICTs for Obtaining Various Climate Change Information

ICTs	Information on weather forecasts	Information on pest and disease warnings	Information on best farming practices	Information on market prices	Information on disaster alerts	Information on Using Disease-Resistant Crops	Information on the time of pesticide application	Information on harvesting periods	Information on the decision on when to plant	Information on deforestation	Information on soil erosion	Information on the time of fertilizer application	Information on mulching	Information on bush burning	**Total %**
	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	
Mobile phone	99 (55)	108(60)	90(50)	81(45)	72(40)	95(53)	94(52)	85(47)	90(50)	68(38)	81(45)	99(55)	90(50)	7 (4)	45.4
Computer/Laptop	27 (15)	18(10)	22(12)	32(18)	14 (8)	16 (9)	20(11)	18(10)	23(13)	14 (8)	18 (10)	22(12)	13(7)	9 (5)	9.8
Newspaper/Magazine	18 (10)	14 (8)	27(15)	36(20)	9 (5)	22(12)	24(13)	32(18)	22(12)	36 (20)	27(15)	18(10)	36(20)	13 (7)	12.0
Tablet	9 (5)	7 (4)	11 (6)	13(7)	5 (3)	7 (4)	9 (5.0)	11 (6)	9 (5)	7 (4)	9 (5)	9 (5)	11 (6)	5 (3)	4.8
Radio	54 (30)	63(35)	45(25)	54(30)	99(55)	58(32)	52(29)	52(29)	50(28)	54 (30)	45 (25)	54(30)	45(25)	50(28)	30.6
Television	60 (33)	65 (36)	55 (31)	50(28)	70(39)	55(31)	60(33)	50(28)	55(31)	45(25)	50 (28)	55(31)	50(28)	45 (25)	30.4
Email	15 (0.8)	65 (36)	22 (12)	13 (7)	22(12)	16 (0)	20(11)	18(10)	23(13)	14 (8)	18 (10)	22(12)	13 (7)	11 (6)	11.5
Internet-(agricultural website)	40 (22)	38 (21)	18 (10)	36(20)	18(10)	22(12)	24(13)	32(18)	22(12)	36 (20)	27 (15)	18(10)	36(20)	30 (17)	16.4
Social media (WhatsApp, Facebook, Instagram, Twitter, etc.)	45 (25)	50 (28)	9 (5)	11 (6)	9 (5)	7 (4)	9 (5)	11 (6)	9 (5)	7 (4)	9 (5)	9 (5)	11 (6)	40 (22)	10.0
Non-e-sources (Extension-agents, Fellow farmers and friends, etc.)	60 (33)	60 (33)	54 (30)	45(25)	54(30)	58(32).	52(29)	52(29)	50(28)	54 (30)	45 (25)	54(30)	45(25)	55 (31)	30.1

Source: Field Survey, 2024

3.6 Levels of Extent of Utilization of ICTs

Results in Figure 3 show that 58 percent of the respondents have moderate usage of ICT tools, 35.0 percent fall into the low level of utilization of ICT tools and 7 percent have high utilization of ICT tools. This suggests that these instruments are employed moderately frequently and play a more important part in gathering data on climate change. Although they are not widely used, tools in this category including radio and television are used frequently. Adeniya and Adebayo (2024) propose that television and radio are typical means for crop growers to obtain information from many sources. But even in rural areas, mobile phone networks are widely available which has made it simpler for farmers to obtain important information.

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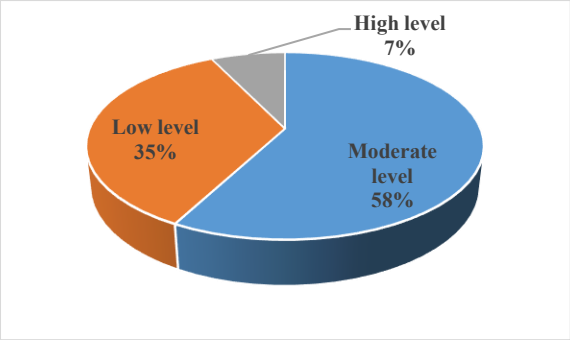

Figure 3: Extent of Utilizing ICTs for Accessing Climate Change Information
Source: Field survey, 2024

3.7 Benefits of ICTs Use for Accessing Climate Change Information

Results in Table 4 show the distribution of perceived benefits from using ICTs for accessing climate change information, categorized by whether respondents find each benefit applicable. The table reveals that 100 percent acknowledge that ICTs use improves crop productivity and yield, prevents farm hazards and provides access to climate change information relevant to their farming activities. This demonstrates a unanimous recognition of these benefits, highlighting their essential roles in farming practices. For other benefits, 76.1 percent reported that ICTs usage reduces farming costs and increases efficiency. This shows that a sizable majority of people think ICTs are a useful instrument for operational efficiency and cost control. ICTs are generally seen by respondents as being very helpful in several farming-related areas, such as increasing crop yield per hectare, reducing climate-related crop losses, and gaining access to pertinent climate change information, as the table shows. Everyone agrees that ICTs have fundamental benefits, and the data demonstrates strong positive impacts in areas like communication, expert advice, efficiency, and cost reduction.

Table 4: Benefits of ICTs Use for Accessing Climate Change Information

Benefits	Freq.	Percentage (%)
Improve crop yield	180	100.0
Prevention of farm hazard	180	100.0
Proper farm planning	128	71.1
Enhance the good farm decision-making process	106	58.9
Enhance weed & pest management	111	61.7
Prevent farm drudgery	165	91.7
Provides me with up-to-date market information, which helps in selling my crops	110	61.1
Reduced farming costs and increased efficiency	137	76.1
Provides real-time weather updates that are crucial for my farming operations.	109	60.6
Access to climate change information relevant to my farming activities	180	100.0

Source: Field Survey, 2024.

3.8 Challenges Faced in ICTs Use for Accessing Climate Change Information

Results in Table 5 show that the high cost of ICT devices is universally recognized as a challenge, with all 100.0 percent affirming this. Similarly, erratic power supply is reported by 97.8 percent as a significant challenge, highlighting the pervasive nature of this problem. Limited technical know-how is cited by 98.9 percent, underscoring the widespread lack of technical skills among users. Rural poverty is also a major challenge, affecting 99.4 percent which reflects its substantial impact on ICTs accessibility and use. Poor internet connectivity is reported by 82.2 percent, while inadequate access to information affects 91.7 percent of the respondents. These issues reveal significant barriers to the effective use of ICTs for climate change information.

The complicated obstacles that prevent efficient ICT usage in this situation are highlighted by these difficulties taken together. One obstacle to digitalisation in sub-Saharan Africa is the low level of digital literacy and Government policies.

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According to Ojo et al. (2024), Kim et al. (2020) and Paul et al. (2020). The second biggest obstacle to the usage of ICTs for arable crop marketing is inadequate network coverage. This suggests that insufficient internet infrastructure in rural locations significantly restricts farmers' access to internet-based services, phone calls and message sending. According to Akintunde et al. (2021), farmers' confidence, market access, financial results and capacity to use these instruments for marketing can all be greatly enhanced by ICT training.

TABLE 5: Distribution of the Respondents by Challenges Faced in ICT Use for Accessing Climate Change Information

Challenges encountered	Frequency	Percentage (%)
High cost of ICT facilities	180	100.0
Limited technical know-how	178	98.9
Erratic power supply	176	97.8
Inadequate access to information	165	91.7
Poor network	148	82.2
Illiteracy in language	37	20.6
Inadequate infrastructure	73	40.6
Our culture and tradition are not in support of the usage of ICTs	87	48.3
There is no training on the use of ICT facilities for climate change information.	76	42.2
Communication policy of the government	69	38.3

Source: Field Survey, 2024.

3.7 Hypothesis

Results of Chi-Square Analysis showing Relationship between Selected Respondents' Personal and Socio-Economic Characteristics and Usage of ICTs for Accessing Climate Change Information

Results in Table 6 show the association with selected personal and socio-economic characteristics of respondents and usage of ICTs for accessing climate change information. It was revealed that the level of education (χ^2 =154.342, C=0.679, P= 0.041), major occupation (χ^2=30.211, C=0.379, P=0.006), and arable crop cultivated (χ^2=133.685, C=0.049, P=0.049) had a significant positive association, as the p-value is less than the 0.05 threshold. That indicates that increased use of ICTs for climate change information is correlated with higher educational attainment and a variety of important occupations. Additionally, the kind of arable crop grown affects how ICTs are used to obtain information on climate change. This affirmed the assertion of Adeniyi and Adebayo (2024) that the degree to which arable crop farmers use ICT for marketing information is highly influenced by their educational background.

Table 6: Chi-Square analysis showing usage of ICTs for accessing climate Change information

Variables	χ^2 value	C	P-value	Decision
Sex	23.439	0.339	0.608	Not significant
Level of education	154.342*	0.679	0.041	Significant
Major occupation	30.211**	0.379	0.006	Significant
Arable crop cultivated	133.685*	0.653	0.049	Significant

Source: Field survey, 2024

4.0 Conclusion and Recommendations

In conclusion, the study revealed that education emerged as a significant factor influencing ICT usage, highlighting the critical role of educational attainment in enhancing farmers' ability to effectively use technology for accessing climate change information. The respondents cited increased crop yield and productivity, reduced crops failure and easier access to climate change information pertinent to their agronomical practices as the main advantages of using ICTs to obtain climate change information. The respondents cited the high cost of ICT gadgets and unstable power supplies as the main barriers to using ICTs to acquire information on climate change. Thus, this study suggests that since arable crop farmers' inadequate technical expertise poses a significant obstacle to their use

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of ICT tools to access information on climate change, it is necessary to create and execute targeted training and retraining programmes that enhance farmers' technical expertise and ICT tool competency. Training must be useful and customised to meet the unique requirements of farmers. These training initiatives could be made possible through collaborations with NGOs, educational institutions, and agricultural extension organisations.

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