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Climate-Smart Agriculture Information Needs of Arable Crop Farmers in Osun State: Implications for Food Security

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ABSTRACT

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This study assessed the Climate-smart agriculture information needs of arable crop farmers in Osun State: implications for food security. Specifically, it identified the various sources of Climate-smart agriculture (CSA) information for food security; determined farmers' information needs and adaptation strategies to ensure food security; assessed the perceived benefits of CSA information for food security and identified the barriers to CSA information use for food security among the arable crop farmers in Osun State, Nigeria. A multistage sampling procedure was used to select 180 farmers from six LGAs across three agricultural zones. Data were analyzed using descriptive and inferential statistics. Results showed that farmers' associations ($\bar{x}$ =2.49) were the primary CSA information source, followed by social media ($\bar{x}$ =2.17) and religious organizations ($\bar{x}$ =2.16). Most farmers (61.1%) had a moderate need for CSA information. Also, 85 percent of respondents reported perceiving significant benefits from climate change information. The main barriers to accessing CSA information were the high costs of farmland and irrigation facilities. Socio-economic factors such as sex ($\chi2$=7.119) and ethnicity ($\chi2$=19.155) significantly influenced adaptation strategies to ensure food security. Targeted extension programmes and localized outreach initiatives to improve CSA information access and enhance farmers' adaptation to climate change for food security.

1.0 Introduction

Africa is the continent most susceptible to the effects of climate change in all climate scenarios with temperatures above 1.5°C (Ikpe, Ukoh, and Ikpe, 2023). Africa is at risk for systemic harm to its economies, agriculture, water, food systems, and means of subsistence, even though it has the lowest emissions and the least contribution to global warming (Africa Development Bank (AfDP), 2023). Climate-smart agriculture [CSA] emerged as a result of the need to work with farmers to adopt innovative agricultural practices that will enable them to cope with the negative effects of climate change on food production, food security, and the environment. These effects have drawn attention from all over the world (Waaswa, Nkurumwa, Kibe, and Kipkemoi, 2021).

Climate change is currently having an impact on Nigeria's agricultural output, causing natural disasters such as floods, droughts, storms, and forest fires (Ojo, Kolawole, Owolabi, Baniyi, Ayeni, Adeniyi, and Ogundipe, 2024). Ensuring food security in the face of climate change and rising dietary needs is the aim of climate-smart agriculture. Accordingly, CSA is a method of farming that helps meet the aims of sustainable development (Mutengwa *et al.,* 2023; Ojo *et al.,* 2024).

The adoption of CSA practices is low overall, particularly in Africa, including Nigeria, despite the many advantages they offer (Makate, 2019). Since all aspects of agriculture, including the production of arable crops, are becoming more and more knowledge-intensive, farmers need to have access to accurate information tailored to their farm regions and operational conditions in order to boost their production efficiency. As a result, technological techniques are replacing local expertise, undermining traditional service delivery patterns. In 2022, Onyeneka *et al.,* unfortunately, as the natural resources needed for production decline, Nigeria's arable crop production faces significant obstacles to increasing output. This makes it harder for them to invest in better farming methods and technologies. The dearth of effective agricultural extension services in many rural regions, as highlighted by Ogunleye (2018), prevents young farmers from learning about best practices, climate-smart farming techniques, and new technologies.

The precise information needs of these farmers concerning climate change impacts and adaptive practices are poorly understood, despite the crucial necessity of climate change adaptation techniques. Osun State farmers are aware of climate change and how it affects farming methods, but many do not have access to timely and pertinent information that may support their adaptation efforts. According to Agboola *et al.* (2024), for example, indigenous knowledge systems influence how farmers respond to climate variability, but they are frequently poorly understood and insufficiently incorporated into contemporary farming methods.

Furthermore, Ojo *et al.* (2023) highlight the necessity of better communication channels for the efficient dissemination of climate-related information. Nevertheless, thorough studies that concentrate on the kinds of climate change information that farmers of arable crops need and the obstacles they encounter in obtaining it are still lacking.

1.1 Purpose of Study

This study seeks to fill this gap by investigating the specific climate change information needs of arable crop farmers in Osun State. Thus, the main objectives are to:

i. identify various sources of information on climate change among the respondents;
ii. determine the information needs and adaptation strategies of the respondents on climate change;
iii. assess the respondent’s perceived benefits of climate change information; and
iv. identify the barriers to using climate change information among the respondents

1.2 Hypothesis

Ho: There is no significant relationship between farmers’ socio-economic characteristics and their information needs on climate change.

2.0 Methodology

The study was carried out in Osun State. Geographically, the state is situated roughly between latitudes 7° 6' 0.0180" N and longitude 4° 50' 30.0984" E (Alabi et al., 2020). A tropical environment with a wet season from April to October and a dry season from November to March characterises the state, which has a size of about 9,251 square kilometres (National Population Commission (NPC), 2006). To choose study participants, a multistage sampling technique was used. Based on local climate-related agricultural practices, two of the state's three ADP zones were chosen. Three LGAs from the Osogbo zone, two from the Ife/Ijesa zone, and one from the Iwo zone were chosen at random for the first stage. The LGAs chosen were Iwo LGA from the Iwo zone; Ife East and Atakunmosa East LGAs from the Ife/Ijesa zone; and Irepodun, Olorunda, and Ifelodun LGAs from the Osogbo zone.

At the second stage, a simple random technique was used to select three communities from each LGA, giving a total of 18 communities. At the third stage, simple random sampling was used to select 10 arable crop farmers from each community. In total, 180 respondents provided a comprehensive dataset for evaluating the climate change information needs of arable crop farmers in the region. Primary data collected were analysed using frequency, percentage, mean, standard deviation and Chi-square analysis.

The dependent variable for the study was the climate change information needs of arable crop farmers regarding climate change. To measure this, four key indicators were utilized. Each indicator contained statements reflecting utilization effectiveness, rated on a 3-point Scale: 'Rarely', 'Occasionally', and 'Always', scored as 1, 2, and 3, respectively. The Interval derived from the respondents was calculated to determine the information needs score, which was then categorized into high, low, and moderate. On various sources of information on climate change, 10 statements on climate change were listed and were ranked on a 4-point Likert-like scale of used, most preferred, preferred, and least preferred, ranging from 4 to 1. The grand mean score for the statements was 2.15. Any statement that the mean score was less than 2.15 was regarded as the least preferred source of information on climate change, while those with the mean score above

2.15 were regarded as the most preferred sources of information on climate change.

Perceived benefits of information on CSA 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. This ranges from 5-1, and a grand mean score was used to categorise the perceptional statements as favourable and unfavourable. The barriers to using climate change information were measured by asking respondents to select from fifteen benefits listed on the table, and each was scored a point, which was measured using frequency and percentage.

3.0 Results and Discussions

3.1 Various sources of information on climate change

Information presented in Table 1 shows the various sources of climate change information accessed by arable crop farmers as ranked by the respondents and based on the grand mean of 2.15. The result shows that the majority of the farmers indicated that farmers' associations (mean=2.49), social media (mean=2.17), religious organizations (mean=2.16), and mobile phones (mean=2.15) were the primary sources of climate change information. Other sources, such as television (mean=2.11), universities (mean=2.11), books (mean=2.11), fellow farmers and friends (mean=2.10), radio (mean=2.10), and agricultural shows and workshops (mean=2.08) were also used but to a lesser extent. This agrees with the reports of Bahn, Yehya, and Zurayk (2021) and Waaswa et al. (2021), who submitted that farmers' associations and social media play critical roles in disseminating climate-smart agriculture information, enabling farmers to learn about adaptive strategies that improve crop yields and mitigate climate risks. This implies that arable crop farmers in Osun State rely more on informal, community-based, and low-cost information sources than on formal extension channels. The preference for farmers' associations suggests that trust, shared experience, and collective learning are key drivers of information uptake. Similarly, the use of religious organizations indicates that faith-based institutions serve as unconventional but effective platforms for climate communication, especially in rural settings where church or mosque attendance is regular. However, the relatively low mean scores (all below 2.15) for formal sources such as universities and agricultural workshops indicate that these channels are underutilized, pointing to a weak linkage between research-generated climate-smart agriculture (CSA) innovations and their end-users. For food security, this gap implies that many arable crop farmers may lack access to validated, timely information on drought-resistant varieties, optimal planting windows, and water-saving techniques. This result is in line with Makate (2019), who stated that access to reliable climate information is a prerequisite for successful adoption of climate-smart agricultural practices, and without it, farmers remain vulnerable to production shocks that threaten food security.

Table 1: sources of information on climate change (n=180)

Variables	Least Preferred		Preferred		Most Preferred		Used		MEAN	RANK
	Freq	%	Freq	%	Freq	%	Freq	%		
Farmers association	6	3.3	54	30.0	70	38.9	144	80.0	2.49	1st
Social media	2	1.1	146	81.1	32	17.8	180	100.0	2.17	2nd
Religious organizations	0	0.0	72	40.0	14	7.8	86	47.8	2.16	3rd
Mobile phone	4	2.2	142	78.9	30	16.7	176	97.8	2.15	4th
Television	2	1.1	140	77.8	20	11.1	160	88.9	2.11	5th
Universities	2	1.1	58	32.2	10	5.6	68	37.8	2.11	6th
Books	8	4.4	120	66.7	24	13.3	152	84.4	2.11	7th
Fellow farmers and friends	0	0.0	142	78.9	16	8.9	158	87.8	2.10	8th
Radio	8	4.4	130	72.2	24	13.3	162	90.0	2.10	9th
Agricultural shows and workshops	4	2.2	122	67.8	16	8.9	142	78.9	2.08	10th

Source: Field survey, 2024; Benchmark = 2.15

3.2 Information needs on climate change

Evidence from Table 2 shows that arable crop farmers required information on multiple climate change parameters because no single information need can fully address the complex and interconnected challenges posed by climate variability on arable crop production. The result shows that majority of the respondents indicated that their most critical information needs were deforestation (mean=2.19), utilization of weather information (mean=1.96), change in timing of farm operations (mean=1.83), irrigation (mean=1.82), crop diversification (mean=1.78), altering of growing seasons (mean=1.78), usage of weed tolerant and crop varieties (mean=1.77), planting of trees (mean=1.77), bush burning (mean=1.75), increase in erosion (mean=1.72), overgrazing (mean=1.71), and soil management (mean=1.71) among others. This agrees with the reports of Eta et al. (2023) and Obabire et al. (2021), who submitted that crop farmers use several important adaptation strategies and climate-smart agricultural practices, including crop rotation, crop diversification, planting improved pest and disease-resistant varieties, mixed farming, intercropping, fallowing, and drought-resistant varieties, all of which require targeted information dissemination. This implies that arable crop farmers perceived that climate change had created pressing information needs across multiple domains, with deforestation ranking highest due to its direct and observable impact on local climate patterns, soil degradation, and farm productivity. Besides, the high demand for information on utilization of weather information (mean=1.96) and change in timing of farm operations (mean=1.83) indicates that farmers are acutely aware of shifting rainfall patterns and are seeking actionable knowledge to realign their farming calendars accordingly. This was because arable crop farmers in the study area depend almost entirely on rain-fed agriculture, making them highly vulnerable to rainfall variability, delayed onset of rains, and unexpected dry spells; without timely and accurate information on weather patterns and adaptive practices, planting decisions become guesswork, leading to crop failure, reduced yields, and heightened food insecurity. This result is in line with Ogallo et al. (2020) and Ojo et al. (2023), who stated that farmers' awareness of climate change varies considerably, and communication strategies must be tailored to meet diverse information needs—ranging from basic awareness for those with lower knowledge levels to detailed technical guidance for those with higher demands. The results also show that lower-ranked information needs such as drying up of rivers and lakes (mean=1.30), poor yield of crops (mean=1.40), reduction in soil nutrients (mean=1.42), harsh weather conditions (mean=1.55), and implementation of conservative agriculture (mean=1.56) had means below the benchmark of 1.69, indicating that farmers either already possess some knowledge about these parameters or perceive them as less immediate compared to the top-ranked needs. This is due to the fact that farmers prioritize information that directly translates into actionable farm management decisions—such as when to plant, what varieties to use, how to control bush burning, and how to manage deforestation—over more distal or less controllable environmental changes. The results are also due to the fact that farmers' immediate concerns are shaped by observable and recurrent climate stressors, with deforestation and bush burning being visible daily practices, whereas long-term issues like soil nutrient reduction and drying of water bodies may be perceived as less urgent despite their cumulative significance.

Table 2: Information needs on climate change

Variables	Always		Occasionally		Rarely		Tick		MEAN	Rank
	Freq	%	Freq.	%	Freq	%	Freq.	%		
Deforestation	42	23.3	126	70.0	8	4.4	176	97.8	2.19	1st
Utilization of weather information	8	4.4	146	81.1	14	7.8	168	93.3	1.96	2nd
Change in the timing of farm operation	10	5.6	118	65.6	38	21.1	162	90.0	1.83	3rd
Irrigation	2	1.1	130	72.2	32	17.8	162	90.0	1.82	4th
Crop diversification	2	1.1	122	67.8	38	21.1	162	90.0	1.78	5th
Altering of growing seasons	2	1.1	126	70.0	38	21.1	166	92.2	1.78	6th
Usage of weed-tolerant and crop varieties	8	4.4	106	58.9	44	24.4	158	87.8	1.77	7th
Bush burning	2	1.1	122	67.8	44	24.4	164	91.1	1.75	8th
Increase erosion	16	8.9	84	46.7	62	34.4	162	90.0	1.72	9th
Overgrazing	10	5.6	100	55.6	60	33.3	170	94.9	1.71	10th
Soil management	2	1.1	112	62.2	50	27.8	162	90.0	1.71	11th
High mortality of livestock	14	7.8	86	47.8	68	37.7	168	93.3	1.68	12th
CO_2 emissions from vehicles	10	5.6	94	52.2	66	36.7	170	94.4	1.67	13th
Uses of excess chemicals	12	6.7	88	48.7	66	36.7	166	92.2	1.67	14th
Increase in pets	8	4.4	84	46.7	76	42.2	168	93.3	1.60	15th
Increase in production costs and market volatility	12	6.7	76	42.2	78	43.3	166	92.2	1.60	16th
Increased weed competition	10	5.6	80	44.4	82	45.6	172	95.6	1.58	17th
Implementation of conservative agriculture	0	0.0	90	50.0	72	40.0	160	88.9	1.56	18th
Harsh weather conditions	8	4.4	76	42.2	82	45.6	166	92.2	1.55	19th
Reduction in soil nutrients	18	10.0	34	18.9	116	64.4	166	92.2	1.42	20th
Planting of trees	8	4.4	106	58.9	44	24.4	158	87.8	1.77	21st
Poor yield of crops	12	6.7	44	24.4	114	63.3	170	94.4	1.40	22nd
Drying up of the rivers and Lakes	4	2.2	42	23.3	118	65.6	164	91.1	1.30	23rd

Source: Field survey, 2024

3.3 Level of information needs on climate change among arable crop farmers

Results in Figure 1 showed that more than half (61.1%) of the respondents had a moderate level of information needs on climate change, while 23.9 percent of the respondents had a low level of information needs on climate change, and 15 percent had a high level of information on climate change. This suggests that the respondents' awareness and knowledge levels varied widely. It suggests that in order to successfully implement climate-smart agriculture in the study area, farmers of arable crops need extensive training in these methods. Knowing their information needs could aid in creating the appropriate training that the respondents need to successfully lessen the impact of climate change on their output. This result is consistent with that of Ogallo et al. (2020), who discovered that farmers' awareness of climate change varies. In order to meet these diverse needs, climate change communication tactics should be modified to make material both understandable to those with lower awareness levels and adequately thorough for those with higher information demands.

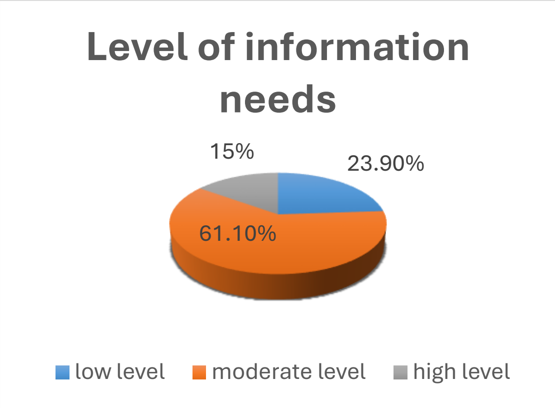

Figure 1: Levels of information needs on climate change

Source: Field survey, 2024

3.4 Perceived benefit of climate information

Results in Table 3 showed the respondents' perceived benefits of climate change information in relation to their farming practices, decision-making, and overall agricultural management. The results indicate that respondents strongly agreed that climate change information was useful in planning their planting schedules (mean=4.68). In the same vein, they agreed that the access to climate change information (mean= 4.08), the knowledge of climate change was highly valued in decision-making, particularly in crop selection, (mean= 4.26), climate change information increased their awareness of risks associated with extreme weather events, reflected (mean= 4.17), understanding climate change helps them adopt more sustainable farming techniques (mean =4.21) and managing irrigation and water resources (mean= 4.24), respectively. Most of the respondents still found climate change data relevant, despite a small portion perceiving it as less important. This suggests that farmers recognize the importance of climate information in enhancing agricultural productivity.

Interestingly, the statements with negative connotations (e.g., climate change information being detrimental or undermining better financial planning) received lower levels of agreement, like climate change information is irrelevant to managing irrigation (mean = 4.33), climate information undermines financial planning (mean =4.10), and it worsens soil management practices (mean =4.46), respectively. These suggest that farmers' views on the value of climate information influence their agricultural practices and adaptation plans. They recognise how production systems are changing and how crucial it is to adjust to climate change to ensure food security. The results are in tandem with Hasan and Kumar's (2019) observation that farmers who see themselves as more vulnerable to climate change also implement more adaptation strategies.

Variables	SD		D		I		A		SA		MEAN
	Freq	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
Access to climate change information has improved my farming practices (P)	0	0.0	0	0.0	2	1.1	162	90.0	16	8.9	4.08
Knowledge of climate change helps me make better decisions in crop selection (P)	2	1.1	4	2.2	0	0.0	114	63.3	60	33.3	4.26

Climate change information has increased my awareness of the risks related to extreme weather (P)	0	0.0	0	0.0	4	2.2	142	78.9	34	18.9	4.17
I find climate change information useful for planning my planting schedules (P)	0	0.0	6	3.3	2	1.1	120	66.7	54	31.1	4.68
Understanding climate change helps me to adopt more sustainable farming techniques (P)	4	2.2	2	1.1	0	0.0	120	66.7	54	30.0	4.21
Climate change data is irrelevant for managing irrigation and water resources efficiently (N)	2	1.1	4	2.2	4	2.2	108	60.0	62	34.4	4.24
The information about climate change has been detrimental in reducing crop loss during droughts (N)	90	50.0	78	43.3	0	0.0	6	3.3	6	3.3	4.33
Access to climate change information undermines better financial planning and risk management (N)	44	24.4	126	70.0	0	0.0	4	2.2	6	3.3	4.10
Climate change information is	94	52.2	76	42.2	2	1.1	4	2.2	4	2.2	4.40

unimportant for deciding on the use of fertilizers and pesticides (N)											
My knowledge of climate change impacts has worsened my soil management practices (N)	100	55.6	74	41.1	0	0.0	0	0.0	6	3.3	4.46

Source: Field survey, 2024

3.5 Level of perception

Results in Figure 2 show that 85 percent of the respondents had a high perceived benefit of climate change information, while just 15 percent of the respondents had a moderate perceived benefit of climate information. This implies that respondents perceived the information on climate change high might be due to its benefit to their farming activities.

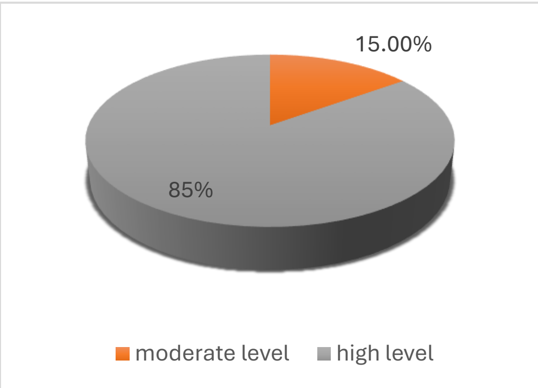

Figure 2: Level of perceived benefit of climate change

Source: Field survey, 2024

3.6 Barriers to using climate change information

Results in Table 4 reveals the barriers to using climate change information as identified by arable crop farmers. The result shows that the majority of the farmers indicated that high cost of farm land (96.7%), limited land availability (95.6%), high cost of irrigation facilities (95.6%), inherited land ownership (93.3%), non-availability of credit (93.3%), erratic power (92.2%), inadequate coping knowledge (92.2%), high cost of improved seeds (92.2%), lack of weather forecast technologies (86.7%), and government irresponsiveness (85.6%) were the most pressing barriers. This agrees with Ige et al. (2021) **and** Ifeanyi-Obi & Corbon (2023) that lack of funding, poor extension services, limited climate information access, and erratic power supply are main obstacles to climate information utilization. This implies that arable crop farmers face interconnected economic, infrastructural, institutional, and informational barriers that constrain action on climate information. The high cost of farmland and irrigation points to severe capital constraints, meaning that even when climate information is available, farmers cannot implement adaptive practices—a direct threat to food security as rain-fed agriculture remains vulnerable to drought and crop failure. Besides, erratic power and lack of weather forecast technologies undermine digital information tools, leaving farmers without timely planting advisories and increasing the risk of yield losses that deepen household food insecurity. This is due to the fact that climate-smart agriculture requires upfront investment in drought-tolerant seeds, irrigation, and storage, which smallholder farmers with limited savings and poor credit access cannot afford, perpetuating low productivity and chronic food insecurity. Furthermore, inadequate coping knowledge and government irresponsiveness reveal weak extension delivery and policy support, which Ogunleye (2018) **and** Ojo et al. (2023) noted perpetuate vulnerability to climate change. The results are also due to the fact that insecure land ownership discourages long-term adaptation investments, while lack of storage facilities means post-harvest losses negate adaptation gains—both of which directly reduce food availability and stability. Thus, without addressing these barriers, climate information cannot translate into food security outcomes for most smallholder farmers.

Table 4: Barriers to using climate change information

BARRIERS TO USING CLIMATE CHANGE INFORMATION	Freq	%
Limited availability of land for farming	172	95.6
High cost of farm land	174	96.7
Inherited system of land ownership	168	93.3
Poor access to information sources caused by erratic power	166	92.2
Non-availability of credit facilities	168	93.3
High cost of irrigation facilities	172	95.6
Non-availability of farm inputs, e.g., improved seeds	164	91.1
High cost of fertilizer inputs	160	88,9
Inadequate knowledge on how to cope and build resistance	166	92.2
High cost of improved varieties of seeds	166	92.2
Non-availability of farm labour	110	61.2
High cost of farm labour	140	77.8
Lack of access to weather forecast technologies	156	86.7
Government irresponsiveness to climate risk management	154	85.6
Non-availability of storage facilities	134	74.4

Source: Field survey, 2024

3.7 Testing of Hypotheses

Hypothesis one: There is no significant relationship between farmers' socio-economic characteristics and their information needs on climate change.

Results of Chi-Square analysis on the association between farmers' socio-economic characteristics and their information needs and adaptation strategies on climate change.

Results in Table 5 shows that sex (χ^2 = 7.119, p = 0.028, C = 2.166), ethnicity (χ^2 = 19.155, p = 0.014, C = 0.980), and occupation (χ^2 = 40.401, p = 0.000, C = 0.980) were significantly associated with farmers' information needs and adaptation strategies. This agrees with Hasan and Kumar (2019) and Ojo et al. (2024) that socio-economic characteristics influence climate risk perception and adaptation adoption. This implies that arable crop farmers are not homogeneous; their information needs are shaped by gender, ethnicity, and occupation. The significant association with sex suggests male and female farmers have different access to information and decision-making power—a direct food security threat, as women with less climate information face higher crop failure rates. Besides, the strong association with ethnicity indicates that indigenous knowledge systems influence farming practices, meaning culturally insensitive extension could lead to rejection of advisories. The association with occupation suggests full-time versus part-time farmers have different capacities to invest in climate-smart practices. This is due to the fact that socio-economic characteristics determine access to land, credit, information, and decision-making power, consistent with Makate (2019) and Waaswa et al. (2021) that effective climate-smart agriculture requires understanding heterogeneous farmer contexts. Thus, climate information systems must be differentiated by sex, culturally sensitive, and responsive to occupational diversity to enhance food security.

Table 5: chi-square analysis information needs on climate change

Variables	Chi-Square (χ2-value)	P	C	D.F	Decision
Sex	7.119*	0.028	2.166	2	Significant
Ethnicity	19.155**	0.014	2.285	8	Significant
Occupation	40.401**	0.00	0.980	4	Significant

Source: Field survey, 2024

4.0 Conclusion and recommendation

Based on the findings of the study, it was concluded that arable crop farmers in Osun State access climate information primarily through farmers' associations, social media, religious groups, and mobile phones, rather than formal extension. Most of the respondents had moderate information needs, with critical requirements including deforestation, weather information, timing of farm operations, irrigation, and crop diversification, among others. The majority of the respondents perceive significant benefits from climate information, especially for planting schedules and crop selection. However, major barriers persist: high land and irrigation costs, limited land, lack of credit, erratic power, inadequate coping knowledge, and government unresponsiveness. Farmers value climate information but cannot act due to poverty, poor infrastructure, weak extension, and policy gaps. Climate-smart agriculture requires reliable, localized information plus financial resources, land security, and institutional support. To enhance food security, interventions must strengthen farmer associations and religious groups as information channels, provide targeted training, subsidize credit and inputs, invest in rural electrification and weather technologies, implement land reforms, and ensure government accountability in climate risk management.

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