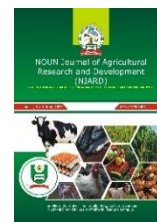




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Farmers' Awareness of Information Sources of Climate Smart Agricultural Practices and Adaptation Strategies to Climate Change in Bayelsa and Delta States, Nigeria

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This study explored farmers awareness of information sources of climate smart agricultural (CSA) practices and adaptation strategies of climate change in Bayelsa and Delta States, Nigeria. It used multi-stage sampling technique to select 598 respondents for the study. The data were collected using questionnaire and interview schedule. It employed descriptive and inferential statistics to analyses the data the study. The findings revealed that a significant majority (77.09%) of farmers were aware of CSA practices, with personal observation (72.91%), friends (62.21%), relatives (52.01%), and radio (51.34%) identified as the primary sources of information. The study found a strong positive relationship between access to reliable information and increased awareness of CSA practices. However, farmers face numerous challenges, including inadequate finance (92.47%), labour scarcity (87.12%), limited access to technical knowledge (85.95%), poor infrastructure (52.17%), soil nutrient depletion (59.03%), pest infestations (64.21%), and rising costs (81.61%) which hinder the full adoption of CSA strategies. Despite these challenges, the study recommended the potential for greater adoption of CSA practices when farmers would be supported with reliable information, financial assistance, and improved infrastructure. The findings suggested that strengthening extension services, providing affordable inputs, and enhancing climate information systems could significantly boost farmers' capacity to mitigate the impacts of climate change, thereby contributing to increased agricultural productivity and food security.

Introduction

Climate change is a pressing issue in today's world, particularly regarding its impact on agricultural production and human existence. This urgency has drawn significant attention both locally and globally (Bolan *et al.*, 2023). Climate change refers to any alteration in climate over time, resulting from both variations in climatic factors and human activities (Giovetti, 2022). He further explained that climatic factors may include rainfall, sunshine, temperature, pressure, wind, and humidity. Human-induced factors

contributing to climate change include urbanization, deforestation, population growth, industrialization, and the release of greenhouse gases (GHGs) (Intergovernmental Panel on Climate Change, 2007). Giovetti (2022) observed that changes in climatic factors can result from natural variability and/or human activities. Similarly, Shivanna (2022) highlighted that human activities have increased greenhouse gas (GHG) emissions, which are considered a primary driver of climate change. This has led to additional warming of



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the Earth's surface, accompanied by several potentially disastrous impacts

Okpara *et al.* (2021) emphasized that climate change significantly impacts agricultural production, agricultural income, and, by extension, farmers specifically and the national economy as a whole. Lindwall (2022) further noted that most effects of climate change tend to be negative. Otim *et al.* (2023) supported this claim, stating that agriculture, among other sectors, is a major contributor to climate change, primarily through the production and release of greenhouse gases. Therefore, addressing climate change requires a pragmatic approach. Climate change has become a global concern due to its negative impacts, manifesting through variations in climate parameters such as cloud cover, precipitation, temperature ranges, sea levels, and vapor pressure (O'Neill *et al.*, 2020).

To address the numerous challenges posed by climate change, particularly in agricultural production, it is essential to develop sustainable coping strategies that can help farmers overcome these issues. While some strategies may originate from the farmers themselves, more reliable solutions can be sourced from accredited authorities, such as Extension Workers in the Ministry of Agriculture. Agricultural extension agents play a crucial role in advising farmers on strategies to mitigate the adverse effects of climate change. By providing guidance on adaptive practices, they help farmers minimize these impacts. Therefore, it is essential for farmers to be aware of various coping strategies to counteract the negative effects of climate change. The services offered by extension agents aim to address farmers' needs in this context, ultimately leading to increased farm productivity. While numerous studies have explored farmers' knowledge, adoption, and constraints in implementing Climate Smart Agricultural (CSA) practices in Nigeria, there remains limited empirical evidence on farmers' awareness and use of information sources related to CSA in the Niger Delta, especially in Bayelsa and Delta States. Much of the existing research focuses on agronomic practices or adaptation strategies, with little attention given to how farmers learn about these practices, the reliability of the information sources, and the extent to which such sources shape their adoption decisions. This study addresses this gap.

Objectives of the study

The overall objective of the study was to analyze Farmers' awareness of information sources of climate smart agricultural practices and adaptation strategies of climate change in Bayelsa and Delta States, Nigeria.

Hypotheses of the study

The study tested the following null hypotheses:

H0i: There is no significant relationship between farmers sources of information and their level of awareness of Climate-Smart Agricultural practices.

H0ii: The number of farmers aware of Climate-Smart Agricultural practices is not significantly different from those who are unaware.

Methodology

The study was carried out in the South-South States of Nigeria. They were: Bayelsa and Delta State.

Bayelsa State, Nigeria

Bayelsa State is situated in southern Nigeria at the heart of the Niger Delta. It was established in 1996 from parts of Rivers State, making it one of the country's newest states. It is made up of 8 Local Government Areas (LGAs) with its capital, Yenagoa, serves as the administrative and cultural hub. The state shares borders with Rivers and Delta states and boasts a coastline along the Atlantic Ocean. Okwuokenye and Iduseri (2019) stated that the State geographically lies within Latitudes 4°15' and 5°23'N and Longitudes 5°15' and 6°45'E with a land area of 21,000Km². It has an estimated population of 2.4 million as at 2024 (Bayelsa State, Nigeria Population Statistics, 2022). Bayelsa plays a vital role in Nigeria's economy because of its abundant natural resources, particularly crude oil and natural gas, though it is poor in infrastructural development (Chukwuma-ekwueme, 2023). Bayelsa State is known for growing crops like: Oil Palm, Rubber, Coconut, Ginger, Rice, Cane Sugar, Citrus, Pine Apples, Banana, Plantain, Yam Cassava, etc. The inhabitants are known for oil prospecting, civil service and majorly fishing (Okwuokenye and Iduseri, 2019).

Delta State, Nigeria

Delta State is located in Nigeria's South-South region and it is a key part of the oil-rich Niger Delta. It was established in 1991 from the former Bendel State with 25 LGAs and Asaba being its capital, while Warri is the economic nerve center (Folami, 2017). The state lies between Longitude 5°00" and 6°45" North and Latitudes 18° and 23° south and it is bordered by Edo, Ondo, Anambra, Imo, Rivers, and Bayelsa states and features a coastline along the Atlantic Ocean (Okwuokenye and Onyemekihian, 2023). Report of Delta State, Nigeria Population Statistics, 2024 stated that its estimated population size stands at 6,037,667 as at 2024 and occupying a land area of 17,698Km². The State is rich in oil and natural gas and significantly contributes to Nigeria's economy (Okwuokenye and Iduseri (2019). Additionally, it boasts fertile land for agriculture, producing crops like cassava, palm oil, and rubber.

Sources of data, data collection and administration of instrument

Both primary and secondary data sources were utilized for the study. The primary data collection involved the use of two instruments: a questionnaire for literate farmers and an interview schedule for illiterate farmers. These instruments were administered directly to the respondents by the researcher, with support from trained enumerators.

Validation of research instrument

The research instrument was validated using the jury method. This involved presenting it to experts in the



field of agricultural extension for their review, critique, and suggestions for improvement. The goal was to ensure the instrument aligned with the study's stated objectives and was fit for its intended purpose.

Sampling technique and sample size

The study utilized a multi-stage sampling technique. In the first stage, two states were randomly selected from the six states in the region. In the second stage, two agricultural zones were randomly chosen from each selected state, resulting in four zones. The third stage involved randomly selecting two Local Government

Areas (LGAs) from each agricultural zone, totaling eight LGAs. In the fourth stage, two villages or communities were randomly selected from each LGA, giving a total of 16 villages. Finally, in the fifth stage, 40 farmers were randomly selected from each village and administered the research instrument, bringing the total number of farmers contacted to 640. Out of these, 598 responses (93.44%) were deemed suitable for analysis. Table 1 provides details of the states, agricultural zones, LGAs, and villages/communities included in the study.

Table 1: Showing states, agricultural zones, LGAs and villages/communities of the study

State	Agricultural zone	LGA	Village/community	No. of farmers
Bayelsa	Bayelsa Central	Kolokuma/Opokuma	Akaibiri	40
			Igbanwa	40
		Yenagoa	Atisa	40
			Yenagoa	40
	Bayelsa West	Sagbama	Ogobiri	40
			Ofofi	40
		Ekeremor	Aleibiri	40
			Ayamassa	40
Delta	Delta North	Ika South	Omumu	40
			Alihami	40
		Aniocha South	Ewulu	40
			Isheagu	40
	Delta Central	Sapele	Amukpe	40
			Ebada	40
			Otokutu	40
		Ughelli South	Ekakpamre	40
				16
				640
Total = 2	4	8		

Analytical techniques

The data for this study were analyzed using both descriptive and inferential statistics. Descriptive statistics, including percentages and means, were employed to analyze the farmers' sources of information, and their awareness of climate-smart agriculture (CSA) practices. Additionally, comparisons were made between farmers who were aware of CSA practices and those who were not. The effects of climate change were analyzed using 5-point Likert scale. It ranged from strongly agree (coded 5), agree (coded 4), neutral (coded 3), disagree (coded 2) and strongly disagree (coded 1). The analysis produced a weighted mean of 3 (obtained as: 5+4+3+2+1 = 15/5 = 3) which implies that any factor with a mean of 3 and above is considered as an effect of climate change. If the factor is less than 3, it implies that, it is not an effect. The challenges farmers face that limit them from adapting to climate change adaptation strategies were analyzed using a 4-point Likert scale, which categorized responses as major challenge, moderate challenge, minor challenge, and insignificant challenge. Responses indicating 50% or more agreement were considered a major challenge limiting farmers from adapting to climate change adaptation strategies. Conversely, responses below 50% suggested that the factor in question was not viewed as a major challenge to the farmers.

Inferential statistics were used to test the study's hypotheses. Hypothesis 1 was analyzed using Pearson Product Moment Correlation (r) The correlation coefficient measures linear association between interval variables. The coefficient usually has a value that ranges between -1 to +1. When "r" = +1, it implies a perfect positive relationship and when it is -1, it implies perfect negative linear relationship between X and Y. The computation of Pearson Product Moment Correlation is specified as:

$$r = \frac{n \sum XY - (\sum X)(\sum Y)}{(\sqrt{n \sum X^2 - (\sum X)^2})(\sqrt{n \sum Y^2 - (\sum Y)^2})} \dots\dots\dots \text{Eq. 1}$$

Decision rule: The Product Moment Correlation Coefficient produces coefficient estimates (X) and standard errors (E). The alternative hypothesis is accepted and the null is rejected when there is statistical significance of the parameter estimate, X (farmers sources of information) on variable Y (level of awareness of Climate-Smart Agricultural practices) (ie values of standard error is less than the half of the value of the parameter estimates).

Binomial test was used to conduct a comparative analysis between the number of farmers who are aware of CSA practices and those who are not (hypothesis 2). This analysis involved a two-tailed binomial test to determine the significance of the difference in proportions between the two groups. The binomial distribution formula is provided below:



$b(x;n,p) = nCx * px * (1-p)^{n-x}$
 where; b = binomial probability; x = total number of successes (aware or not aware)
 p = probability of success on an individual trial;
 n = number of trials.

Results and Discussion

Farmer sources of information to climate smart agricultural practices

Table 2 presents the various sources of information on climate-smart agricultural (CSA) practices using multiple responses that applied descriptive statistics. The results indicated that the primary source of information for farmers was personal observation (72.91%), followed by interactions with fellow farmers who they regarded as friends (62.21%) and relatives (52.01%). Other notable sources included radio (51.34%), television (39.97%), newspapers (25.59%), and extension workers (16.56%). These findings suggest that farmers primarily rely on personal observation, friends, and relatives for information on CSA practices. The prominence of personal observation may be attributed to farmers directly witnessing the effects of climate change on their crops. Additionally, information from friends and relatives is often shared based on their own observations and experiences. This aligns with the findings of Okoro et al. (2018), who also identified personal observation, friends, and radio as key information sources on climate-related issues.

The low reliance on extension workers may be due to an unfavorable extension worker-to-farmer ratio. Access to reliable information on CSA practices is crucial for informed decision-making, increased productivity, enhanced food security, and improved risk management. The findings of Okoro et al. (2018) further support this, highlighting the limited role of extension agents in disseminating CSA-related information.

Table 2: Farmer sources of information to climate smart agricultural practices

Sources of information on CSA practices	Frequency	Percentage
Personal observation by the farmers	436	72.91
Friends	372	62.21
Relations	311	52.01
Radio	307	51.34
Television	239	39.97
Newspaper	153	25.59
Extension workers	99	16.56

Source: Field Survey, 2024, n = 598

Farmers level of awareness on climate smart agricultural practices

Farmers level of awareness on climate smart agricultural practices was analysed using descriptive statistics and the findings indicated that the majority (62.37%) had a high level of awareness (see Table 3). A smaller proportion (22.41%) exhibited moderate awareness, while only a few (15.22%) had low awareness levels. The widespread awareness among farmers can be attributed to the availability of multiple information sources and channels. These results align with the study by Gabriel et al. (2023), which found that a significant number of farmers in the North Central and North West regions had adopted various CSA practices, demonstrating their strong awareness of these practices

Table 3: Farmers level of awareness on climate smart agricultural practices

Level of farmers awareness of CSA practices	Frequency	Percentage
High	373	62.37
Moderate	134	22.41
Low	91	15.22
Total	598	100.00

Source: Field Survey, 2024, n = 598

Farmers understanding of climate smart agricultural practice

Farmers' understanding of climate-smart agriculture (CSA) practices was assessed with descriptive statistics using a multiple-response format, with the results summarized in Table 4. The responses are presented in descending order based on the frequency of practices identified by farmers as key components of CSA. The majority of farmers recognized the use of fertilizers (90.64%), improved crop varieties (87.63%), intercropping or planting different crops simultaneously (84.95%), adjusting planting dates (79.10%), and maintaining organic matter in the soil (75.08%) as important strategies for adapting to the effects of climate change on agricultural production. Additional CSA practices acknowledged by farmers included monitoring soil nutrient levels (72.24%), enhancing crop yield (65.38%), using pesticides (64.38%), and employing irrigation systems (62.04%). These findings suggest that farmers possess a broad and well-informed understanding of various CSA practices that can be implemented to mitigate the impacts of climate change on their farms. These findings are consistent with Gabriel et al. (2023), who reported that many farmers in the North Central and North West regions had embraced diverse CSA practices, reflecting a high level of awareness in mitigating climate change.



Table 4: Farmers understanding of climate smart agricultural practice

S/n	Agricultural practices	Frequency	percentage
1.	Use of fertilizer	542	90.64*
2.	Use of improved crop variety for planting	524	87.63*
3.	Planting of different crops at same time	508	84.95*
4.	Adjustment of planting date	473	79.10*
5.	Availability of organic matter in the soil	449	75.08*
6.	Soil nutrient level	432	72.24*
7.	Crop yield	391	65.38*
8.	Use of pesticides	385	64.38*
9.	Use of irrigation on crops	371	62.04*
10.	Use of herbicides	201	35.12

Source: Field Survey, 2024, n = 598; * major understanding

Comparative analysis of farmers that are aware and those not aware of climate smart agricultural practice

Table 5 presents data on farmers' awareness of climate-smart agricultural (CSA) practices. Descriptive statistics was used for the analysis and results indicated that the majority (77.09%) were aware of CSA practices, while a smaller fraction (22.91%) lacked awareness. This suggests that most farmers recognize climate change and its impacts, making them more aware of CSA practices that can help mitigate its effects on their farms. These findings align with Gabriel *et al.* (2023), who reported a high adoption rate of CSA practices among both male and female farmers, further supporting these results.

Table 5: Showing the number of farmers that are aware and those unaware of climate smart agricultural practice

Number of farmers showing awareness level of CSA practices	Frequency	Percentage
Number of farmers that are aware of CSA practices	461	77.09
Number of farmers that are unaware of CSA practices	137	22.91
Total	598	100.00

Source: Field Survey, 2024, n = 598

Effects of climate change on crops of the farmers

Table 6 presents the effects of climate change on farmers' crops, ranked by severity and was analysed with 4-point Likert scale. The most significant impacts include reduced yield (mean = 4.24), decreased output (mean = 4.12), reduced income (mean = 4.01), and a longer crop production period (mean = 3.37), ranking 1st to 4th, respectively. Additional effects include a longer harvesting period (mean = 3.52), increased hunger (mean = 3.52), crop loss due to wiping/killing (mean = 3.05), and higher production costs (mean = 3.01), ranking 5th to 7th respectively.

These findings suggest that climate change imposes multiple challenges on crop production, including lower yields, financial losses, and higher production expenses. The results align with the findings of Okwuokenye and Ikoyo-Eweto (2023), who identified similar impacts such as decreased yield, increased poverty, rising production costs, and crop loss. Chandler (2023) also reported comparable effects, including reduced yield, income fluctuations, land degradation, and water scarcity, further supporting these findings.

Table 6: Effects of climate change to the farmers

Effects of climate change	Mean	Standard deviation	Ranking
Reduced yield	4.24*	0.65	1 st
Decreased output	4.12*	0.59	2 nd
Reduced farm income	4.01*	0.66	3 rd
Longer period of crop production	3.73*	0.58	4 th
Longer period of crop harvesting	3.52*	0.51	5 th
Rising hunger	3.52*	0.66	5 th
Wiping/killing of crops	3.05*	0.76	7 th
Increase in cost of crop production	3.01	0.77	8 th
Land degradation	2.51	0.60	9 th
Scarcity of water in the soil	2.22	0.51	10 th

(Effect = mean \geq 3.0); Source: Field Survey, 2024

Challenges limiting farmers from adapting to climate change adaptation strategies

Table 7 outlines the key challenges limiting farmers' ability to adopt climate change adaptation strategies in the study area. The analysis was carried out using descriptive statistics and the findings revealed that the most significant constraints include inadequate finance

(92.47%), labor scarcity (87.12%), insufficient technical knowledge (85.95%), and a weak agricultural extension system (83.95%). Limited financial resources prevent farmers from acquiring essential inputs and facilities, which may be too costly. Similarly, a lack of technical know-how hinders their ability to implement various adaptation strategies effectively. Labor shortages drive



up hiring costs, further constraining adaptation efforts. Additionally, poor extension services—likely due to an unfavorable extension worker-to-farmer ratio reduce farmers' awareness of available adaptation strategies. These challenges align with the findings of Ige *et al.* (2021), who also identified financial constraints, labor scarcity, technical limitations, and weak extension services as key barriers to farmers' adoption of climate change adaptation strategies.

The study further identified additional challenges hindering farmers' adaptation to climate change adaptation strategies. These include the high cost of farm inputs (81.61%), limited access to climate information (68.90%), unavailability of disease-resistant crop varieties (67.06%), and pest and disease infestations (64.21%). These findings suggest that the high costs associated with necessary farm inputs, along with increased risks of pest and disease outbreaks, pose significant barriers to farmers in mitigating the adverse

effects of climate change. The results align with Okwuokenye and Ikoyo-Eweto (2023), who also highlighted these factors as key limitations to adaptation efforts. Similarly, Fagariba *et al.* (2018) corroborated the findings on inadequate access to climate information, emphasizing that the accuracy and consistency of meteorological data play a critical role in farmers' ability to adapt effectively.

The study also identified additional challenges hindering farmers' adaptation to climate change adaptation strategies, including soil nutrient depletion (59.03%), poverty and hunger (53.85%), inadequate infrastructure development (52.17%), and lack of motivation (50%). These constraints further limit farmers' ability to implement effective adaptation measures. The findings align with those of Ige *et al.* (2021) and Okwuokenye and Okoh (2024), who also highlighted these factors as significant barriers to farmers' adaptation efforts.

Table 7: Challenges limiting farmers from adapting to climate change adaptation strategies

Challenges limiting farmers adaptation to climate change adaptation strategies	Insignificant challenge	Minor challenge	Moderate challenge	Major challenge
Inadequate finance	(%)	6 (1.00%)	39 (6.52%)	553 (92.47%)*
Scarcity of labour	6 (1.00%)	45 (7.53%)	26 (4.35%)	521 (87.12%)*
Inadequate knowledge and technical know-how knowledge	7 (1.17%)	36 (6.02%)	55 (9.20%)	514 (85.95%)*
Poor agricultural extension system	24 (4.01%)	29 (4.85%)	43 (7.19%)	502 (83.95%)*
High cost of farm inputs	15 (2.51%)	44 (7.36%)	51 (8.53%)	488 (81.61%)*
Inadequate access to climate information	46 (7.69%)	55 (9.20%)	85 (14.21%)	412 (68.90%)*
Non-availability of disease resistant varieties	59 (9.87%)	70 (11.71%)	68 (11.37%)	401(67.06%)*
Pest and disease attack	61 (10.20%)	66 (11.04%)	87 (14.55%)	384 (64.21%)*
Depletion of the soil nutrients	81 (13.55%)	76 (12.71%)	88 (13.38%)	353 (59.03%)*
Poverty and hunger	117 (19.57%)	82 (13.71%)	77 (12.88%)	322 (53.85%)*
Poor infrastructural development	119 (19.90%)	86 (14.38%)	81 (13.55%)	312 (52.17%)*
Lack of motivation	117 (19.57%)	84 (14.05%)	98 (16.39%)	299 (50.00%)*
Seeing improved technologies as a taboo	123 (20.57%)	149 (24.92%)	112 (18.73%)	214(35.79%)*

*(Major challenge $\geq 50\%$); Data calculated from field survey, 2024

Relationship between farmers sources of information and level of awareness of Climate Smart Agricultural practices.

The relationship between farmers' sources of agricultural information and their level of awareness of climate-smart agricultural (CSA) practices (Hypothesis 1) was analyzed using the Product Moment Correlation Coefficient (see Table 8). The null hypothesis stated that there is no significant relationship between farmers' sources of information and their level of awareness of CSA practices. The primary sources of information on CSA practices included personal observation (72.91%), friends (62.21%), relatives (52.01%), and radio (51.34%). Meanwhile, the level of awareness among respondents was categorized as high, moderate, or low, with the majority (62.37%) having a high level of awareness. Theoretically, reliable sources of information positively influence farmers' awareness of CSA practices, leading to better decision-making, increased productivity, enhanced food security, and improved risk

management. The analysis aimed to determine the statistical significance of variable X (sources of information on CSA practices) in relation to variable Y (farmers' level of awareness).

The results indicate that the parameter estimate for variable X (sources of information on CSA practices) is 0.6017, with a standard error (SE) of 0.1156. Notably, half of the parameter estimate (0.3009), calculated as $0.6017/2$, exceeds the standard error (0.1156), confirming statistical significance between variable X (sources of information) and variable Y (level of awareness of CSA practices).

The Product Moment Correlation Coefficient (r) was found to be 0.7276, indicating a strong positive linear relationship between sources of information on CSA practices (X) and farmers' level of awareness (Y). This suggests that increased access to reliable sources of information enhances farmers' awareness of CSA practices. Consequently, the null hypothesis was rejected in favour of the alternative hypothesis, which states that

there is a significant relationship between farmers' sources of information and their level of awareness of CSA practices. These findings concur with Gabriel *et al.* (2023), who noted that farmers in the North Central and North West regions of Nigeria demonstrated high awareness of CSA practices, gained from reliable sources, which in turn facilitated their widespread adoption of mitigation strategies.

Table 8: Parameter estimates of farmers sources of information and level of awareness of climate smart agricultural practices

Variable	Parameter estimates
Parameter estimate of variable X (sources of information on CSA practices)	0.6017
Standard error of variable X	0.1156
'r' (Product Moment Correlation Coefficient)	0.7276
Half of the Parameter Estimate of Variable, X	0.3009
R ²	0.714

Source: Field survey, 2024

Gap between the number of farmers aware of climate-smart agricultural practices and those unaware.

Data on the number of farmers aware and unaware of climate-smart agricultural (CSA) practices is presented on Table 9. Hypothesis 2 was stated as: there is no significant difference between the number of farmers aware of CSA practices and those who are unaware. The

hypothesis was tested using the Binomial test with the propensity score matching method. Propensity Score Matching (PSM) is used to estimate the effect of a treatment, program, or intervention when random assignment is not possible and essentially to reduce selection bias in observational studies. It examined how farmers' sources of information contribute to their level of awareness. The results revealed that the majority (77.09%) of respondents were aware of CSA practices, while the remaining 22.91% were not. This suggests that access to reliable information positively correlates with a higher level of awareness of CSA practices, as it provides valuable insights into managing the effects of climate change.

Statistically, the test proportion was 0.05 (50%), which is used to compare the observed proportion to determine if there is a significant difference between farmers who are aware and those who are not aware of CSA practices. The p-value obtained is 0.000, which is highly significant (a p-value less than 0.05 is typically considered significant at the 1% level). This indicates that the observed proportion of respondents who were aware differs significantly from the test proportion of 0.05. Based on these results, the alternative hypothesis, which states that the number of farmers aware of Climate-Smart Agricultural practices is significantly different from those who are unaware, was accepted, while the null hypothesis was rejected. This finding is consistent with the research by Gabriel *et al.* (2023), which showed a high level of awareness and adoption of CSA practices among farmers in the North Central and Northwest regions of Nigeria

Table 9: Gap between the number of farmers aware of climate-smart agricultural practices and those unaware

Variables	Category	N	Observed proportion	Test proportion	Prob. level
Number of farmers that are aware of CSA practices	Number of farmers aware of CSA practices	461	0.771	0.50	0.000
	Number of farmers unaware of CSA practices	137	0.229		
	Total	100	1.000		

Data calculated from field survey, 2024

Conclusion and Recommendations

In conclusion, this study emphasizes the crucial role that reliable information sources play in improving farmers' awareness and adoption of climate-smart agricultural (CSA) practices. A large proportion of farmers were found to be aware of CSA practices, with personal observation, interactions with friends and relatives, and radio being their primary information sources. The strong connection between access to information and awareness highlights the need for accurate, consistent climate-related information to help farmers combat the negative impacts of climate change on their crops.

However, several challenges, such as limited financial resources, labor shortages, poor infrastructure, and insufficient technical knowledge, were identified as major obstacles preventing farmers from fully adopting CSA practices. Additionally, issues like soil nutrient

depletion, pest infestations, and increasing production costs further hinder their ability to implement effective climate change adaptation strategies. Despite these challenges, the study reveals the potential for greater adoption of CSA practices, particularly when farmers have access to reliable information and adequate support. By addressing these barriers through improved extension services, affordable farm inputs, and better climate information systems, farmers' capacity to adapt to climate change could be strengthened. This, in turn, would contribute to increased agricultural productivity, enhanced food security, and more sustainable farming practices in the face of ongoing environmental changes. Based on the findings, the following recommendations were made to enhance farmers' awareness and adoption of climate-smart agricultural (CSA) practices:



The government, through her agricultural promotional agencies should be consistent and try to increase farmers access to reliable and accurate information on CSA practices and this should be carried out through diverse channels such as radio programs, mobile apps, community meetings, and extension services. This has become necessary since inadequate access to CSA information was a major challenge to some of them. Doing this will ensure that farmers have continuous access to the latest climate-smart practices and strategies.

The Extension Services unit of agricultural stations need to be improved on by addressing the imbalance between the number of extension workers and the farmer population. This can be achieved by increasing the number of trained extension agents and providing them with the necessary resources and tools to support farmers effectively. This will address the challenge of labour scarcity.

There is still the ultimate need for farmers to be provided with financial support and subsidies. This can be achieved by ensuring that stakeholders implement programs that would help to reduce financial barriers, such as subsidies for farm inputs, low-interest loans, or grants aimed at helping farmers purchase climate-resilient crops, tools, and technologies. This will enable farmers to invest in CSA practices without the burden of high costs.

Investment in rural infrastructure, such as roads, storage facilities, and irrigation systems, to ease the adoption of CSA practices needs to be given priority by the government. Adequate infrastructure will help reduce post-harvest losses, lower production costs, and improve access to markets, and;

The farmers also need to be offered incentives such as tax breaks, subsidies, or recognition programs for farmers who successfully adopt CSA practices. This could motivate more farmers to integrate climate-smart strategies into their farming operations.

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