PRINT ISSN 1119-8362
Electronic ISSN 2659-1499

Full-text Available Online at
https://www.ajol.info/index.php/jasem
https://www.bioline.org.br/ja

J. Appl. Sci. Environ. Manage.
Vol. 28 (11) 3671-3677 November, 2024

Preparedness of Maize Farmers against Climate Change Risks in Saki-West Local Government Area, Oyo State, Nigeria

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ABSTRACT: Farmers must be prepared to face climate change risks to ensure sustainable maize production. This paper aimed to investigate maize farmers' preparedness against climate change risks in Saki-West Local Government Area, Oyo State, Nigeria using appropriate standard methods with 113 respondents through a questionnaire survey. The study found that respondents observed increasing rainfall ($\bar{x}$=1.50) and temperature ($\bar{x}$=133). Respondents primarily prepared for climate change by purchasing drought-resistant varieties and agrochemical inputs ($\bar{x}$=3.27). The study found that farmers had difficulty in preparing for climate change due to a lack of access to extension agents ($\bar{x}$=3.58), credit ($\bar{x}$=3.47), and government policy ($\bar{x}$=3.43). The multiple linear regression model found that participation in farmers' associations (β = -2.407, t=0.001) and access to extension agents (β = -4.645, t=0.002) were substantially associated with farmers' readiness for climate change risks. Therefore, improved extension services are recommended to the farmers.

DOI: https://dx.doi.org/10.4314/jasem.v28i11.22

Cite this Article as: OGUNJINMI, K. O; JOSHUA, Y; ADEOSUN, K. G; UMUNNA, M; ADENUGA, O. O; OGUNLUSI, A. O; FAKOYA, E. O; OGUNJINMI, A. A; IBRAHIM, R. A (2024). Preparedness of maize farmers against climate change risks in Saki-West Local Government Area, Oyo State, Nigeria. *J. Appl. Sci. Environ. Manage.* 28 (11) 3671-3677

Dates: Received: 21 September 2024; Revised: 27 October 2024; Accepted: 04 November 2024 Published: 15 November 2024

Keywords: adaptation; climate change; determinants; preparedness; risks

Climate change is a universal phenomenon. Agricultural productivity in Africa is typically more susceptible to climate change (Elum *et al.* 2017), due to over-reliance on rain-fed agriculture (Antwi-Agyei and Stringer, 2021) in developing countries like Nigeria. Studies reveal that variability often occurs in the mean values of rainfall and temperature, as climate determines water availability for the growth and production of crops, which directly affects the yield of crops (Ayanade and Oluwatimilehin, 2023). The primary causes of climate change are natural processes and the consequences of human activity. Climate change poses a concern to rural farmers from land preparation to processing, marketing, and

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consumption. In Africa, Rice, maize, cassava, and potatoes are staple crops that form the backbone of many food production systems, feeding millions of people (Ayanade and Oluwatimilehin, 2023). Specifically in Nigeria, the effect of climate change is felt mostly on maize being a staple food crop. It has numerous potential benefits and uses (Tajudeen *et al.*, 2022). Maize cultivation is highly vulnerable to climate change influences, including temperature variations, irregular rainfall patterns, and increased occurrence of extreme weather events which can lead to a reduction in maize yields, especially in regions already experiencing water stress or heat waves (Azadi *et al*. 2019). Despite the immense significance of proper adaptation strategies, their adoption by rural farmers is very often impeded by barriers or other determinants that make the adoption of preferred responses hard or even impossible (Ackerl *et al*, 2023). Small-scale farmers' ability to adapt and cope with the changing climatic conditions depends on some socio-economic factors both at the household and community level (Jabik, 2024) while limited access to extension and lack of credit services could be main barriers to Climate Change adaptation (Teshome *et al*., 2021). Crucial to the enhancement of the performance of smallholder farmers is the role of extension agents among other stakeholders (Akinnagbe and Akinbobola, 2024). In addition, farmers who received weather information from government extension agents were more likely to be aware of climate change (Madaki *et al*.., 2023).

A growing volume of research has been conducted on maize farmers' adaptation to climate change (Babatolu and Ogunniya, 2020; Abate and Shiferaw, 2021; Gbadebo *et al*., 2022; Esibuo *et al*. 2024). It is critical to explore how over 70 percent of Nigerian farmers who rely heavily on agriculture for a living prepare to adapt to climate change hazards, as adaptation is the final resort. These adaptive solutions aim to reduce climate-related hazards and increase maize production. Consequently, this study's objective investigate maize farmers' preparedness against climate change risks in Saki-West Local Government Area, Oyo State, Nigeria.

MATERIALS AND METHODS

Study area: The study was conducted in Saki-West Local Government Area (LGA) of Oyo State, Nigeria. It is located between latitude: 8° 40' 3" N and longitude: 3° 23' 38" E. It covers a total area of 2,014 square kilometres and has an average temperature of 28 degrees Celsius. The Local Government Area has two distinct seasons: dry and wet. Additionally, the area has extensive forests. Saki-west experiences a hot season lasting for 2-8 months, with daily highest temperatures above 91°F on average. The people's economic enterprises include farming, hunting, commerce, wood carving, and craft production.

Sampling method: The Krejeic and Morgan (1960) sample size determination algorithm selected 113 maize producers among 159 registered smallholder maize farmers in the Local Government Area.

Data collection: This study conducted a quantitative survey using a questionnaire. A three-point response scale was used to measure the farmers' perception of climate change indicators in the last five years as increasing (3), decreasing (2), and no change (1) (Uddin *et al*., 2017; Madaki *et al* ., 2023). The assigned weights were added (3+2+1=6) and divided by 3 (number of assigned weights) to get the mid-values of 2.00. Values equal to 2.00 or above were considered a favourable perception while less than 2.00 was considered unfavourable perception. Sources of information and causes of climate change were measured as agree (3) slightly agree (2) and disagree (1). In addition, climate risks experienced by the respondents were measured as very severe (3), severe (2), and not severe (1). Factors preventing farmers' preparedness against climate change risks were measured as an extreme barrier (4), moderate barrier (3), somewhat a barrier (2), and not a barrier (1) while farmers' preparedness was measured as always (4), somewhat (3), slightly (2) and never (1). The higher the mean values, the higher the proportion of farmers' responses to each item.

Data analyses: Data obtained were subjected to descriptive and inferential statistics. Frequency count, mean scores, and percentages were used to abridge and present the data to achieve the research objectives. Chi-square and Pearson Product Moment Correlation were used to show the association and strength of the relationships between variables while a multiple linear regression was used to obtain the determinants of the respondents' sources of information for preparedness against climate change risks. The most coherent variable among farmers' sources of information was evaluated using a multiple regression test, in which sets of each predictor value were weighted, with the weights representing each predictor's proportionate contribution to the final prediction. Hence, the multiple regression analysis is of this form:

$$y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_7x_8$$

Where y assumed the dependent variable (Preparedness of farmers against climate change risks). The predictors as used here are explained below:

$X = X_1$ = family and friend, X_2 = access to extension agents, X_3 = research institute, X_4 = access to radio, X_5 = access to television, X_6= access to print media, X_7 = access to social media.

The data obtained were analysed using Statistical Package for Social Sciences (SPSS) for Windows version 23 (IBM SPSS, 2015).

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents: Descriptive analyses in Table 1 showed that the mean age of the respondents was 48.8 years. This suggested that the respondents were of working age and might help with effective climate change adaptation planning. This result is similar to Ogunwale *et* al. (2020) who reported a mean age of 50.8. The majority (77%) of the respondents were males. This could suggest that maize production in the study area was dominated by male folks. This study supports Aminu *et al*. (2020) who reported 58% of males in related research. In addition, the majority (79.6%) of the respondents were married, with an average household size of nine people. This shows that there are options to alleviate labour limitations involved in adaptation preparation. This study is in tandem with Azeeze and Oyekanmi (2021) who reported an average of 10 persons in a similar survey. Furthermore, the majority (88.5%) of the respondents practised mixed cropping. This could suggest a climate change adaptation measure. Respondents reported an average yearly income of ₦243,875 from maize enterprise, on an average farm size of 7.5ha. Low income may limit the ability to purchase adaptation resources, whereas higher farm size may allow for more diversification to on-farm adaptation measures. More than half (55.75%) of the farmers had an average of eight years of farming experience. This could indicate that the farmers were experiencing and preparing to adjust to climate change hazards. The data also revealed that most (99.1%) farmers were deprived of access to extension services. This indicates a weak interaction between farmers and extension agents. This study agrees with Gbadebo *et al*. (2022), who reported that 82% of their respondents had no access to extension services, while Soom *et al.* (2024) observed that all of their respondents had no access to extension services in a similar study. In addition, 85.8% were not members of the farmers' group. This implies that such farmers may not be able to collaborate to prepare for climate change threats at the community level. This result is in tandem with Aminu *et al*. (2020) that 86% of their respondents had no membership in the farmers' group.

Table 1: Socio-economic characteristics of the respondents

Socio-economic characteristics	Frequency (f)	Percentage (%)	Mean ($\bar{X}$)
Sex			
Male	87	77	
Female	26	23	
Age (year)			
<35	17	15.0	
35-44	28	24.8	
45-54	29	25.7	48.75
55-64	21	14.2	
>65	18	16.0	
Marital status			
Single	3	5.3	
Married	90	79.6	
Divorced	5	4.4	
Widowed	12	10.6	
Farming experience(year)			
<5	34	30.09	
5-10	63	55.75	
>10	16	14.15	
Household size			
<5	22	19.4	
5-10	66	58.41	9.0
>10	25	22.2	
Average annual income (₦)			
<51,000	3	2.65	
51,000-100,000	8	7.1	
101,000-150,000	32	28.32	
>150,000	70	62	₦243,875
Farm size (ha)			
<5	43	38.1	7.5
5-10	70	61.9	
Access to extension service	1	0.9	
Membership in farmers' association	83	73.5	
Access to credit	14	12.4	

Sources: Field study, 2023

Perception of the respondents about climate change indicators: Results in Table 2 showed that more than half of the respondents perceived that rainfall ($\bar{x}$= 2.50) and temperature ($\bar{x}$=2.38) were increasing. This study specifically revealed that more than half of the respondents (54%) observed that rainfall and temperature increased (52.2%) while drought was decreasing (52.2%). This suggests that variations in these climate indicators are the driving force behind climate change. This finding is similar to Falaki *et al*. (2013) and Adetayo (2022). However, Belay *et al*., (2022) reported an increased temperature (71.9%) and a decreasing rainfall (53.15%). This may indicate that the perception of climate change varies. In addition, the occurrence of storms and heat waves was noticeably unchanged while hail was decreasing ($\bar{x}$= 1.74). Based on this study, the farmers had a favourable perception towards rainfall ($\bar{x}$= 2.50), temperature ($\bar{x}$= 2.38), drought ($\bar{x}$= 2.11), and occurrence of floods ($\bar{x}$=2.00), since their mean values are higher than or equal to the cut-off point (2.00). This implies that the respondents had a favourable perception of climate change.

Table 2: Perception of maize farmers about climate change indicators

Indicators of climate change	Increasing- f (%)	Decreasing f (%)	No change f (%)	Mean ($\bar{x}$)
Rrainfall	61(54.0)	48(42.5)	4(3.5)	2.50
Temperature	59(52.2)	38(33.6)	16(14.2)	2.38
Drought	28(24.8)	59(52.2)	37(32.7)	2.11
Floods	38(33.6)	38(33.6)	37(32.7)	2.00
Storm	27(23.9)	47(41.6)	39(34.5)	1.89
Heat waves	29(25.7)	31(27.4)	53(46.9)	1.78
Hail	5(4.4)	74(65.5)	34(30.1)	1.74

Source: Field Survey, 2023 Cut-off point =2.00

A favourable perception could positively influence farmers' readiness for adaptation to climate change risks. This finding is consistent with Dimelu *et al.* (2018) that 86% of their respondents had a favourable attitude towards climate change. In addition, the respondents had unfavourable perceptions towards storms (1.87), heat waves (1.78), and hail (1.74). This suggests that these climate change indicators may not significantly affect maize production in the study area.

Sources of information on climate change: Table 3 shows that respondents obtained information on climate change from various sources, with family and friends ($\bar{x}$=1.49), farmers association ($\bar{x}$=1.42), and radio ($\bar{x}$=1.41) being the main sources.

Table 3: Source of information on climate change

Sources	Always used (f %)	Occasional used (f %)	Never used f %)	Mean ($\bar{x}$)
Family and friends	66(58.4)	36(31.9)	11(9.7)	1.49
Farmers' association	67(59.3)	26(23.0)	20(17.7)	1.42
Radio	55(48.7)	49(43.4)	9(8.0)	1.41
Television	36(31.9)	60(53.1)	17(15.0)	1.17
Social media	31(27.4)	37(32.7)	44(38.9)	0.91
Print media	21(18.6)	42(37.2)	49(43.4)	0.78
Research Institutes	10(8.8)	15(13.3)	88(77.9)	0.31
Extension agents	2(1.8)	17(15.0)	94(83.2)	0.19

Source: Field study, 2024

Most (83.2%) farmers never obtained information from extension agents or research institutes (77.9%). The result of this study corroborates Ogunwale *et al.* (2022) that families and friends (94.2%) and radio-(78.3%) while Onyeneke *et al.* (2023) reported radio (82%) and fellow farmers (55%) as the common sources of climate change information In addition, most (77.9%) of the respondents never obtained climate change information from the research institute and extension agents (83.2%).

This indicates that climate change information is not widely disseminated through these media. This finding is in tandem with Gbadebo *et al*. (2022) that only 15% of their respondents obtained information on climate change from the extension agents. In addition, social media, print media, and the internet were not popularly utilized to source information on climate change, this could hint that the majority of the respondents may lack access to these mediums and formal education. This finding is inconsistent with Nguyen (2023) that social media (98.3%), social networks (76.9%), and newspapers (75.4%) were used among his respondents. One possible explanation is that his responders were elites.

Causes of climate change: The results in Table 4 show that respondents were aware of the causes of climate change. The respondents identified deforestation ($\bar{x}$=2.69) and bush burning ($\bar{x}$=2.66) as the primary causes of climate change. This could indicate that the farmers are aware that climate change is a possible outcome of human activities. The result obtained in this study is consistent with Dimelu *et al.* (2018), Adigun and Adelasoye, (2021); Azeez and Oyekanmi, (2021), and Madaki *et al.* 2023). In addition, the study showed that ozone depletion and natural causes were regarded as contributors to climate change while the least perceived cause was the old nature of the earth. This is an indication that the farmers had little knowledge of these causes (Madaki *et al* 2023).

Table 4: Causes of climate change

Causes	Agree (f %)	Slightly agree (f %)	Disagree (f %)	Mean ($\bar{x}$)
Deforestation	80(70.8)	31(27.4)	2(1.8)	2.69
Bush burning	85(75.2)	19(16.8)	8(7.1)	2.66
Ozone depletion	51(45.1)	47(41.6)	12(10.6)	2.40
Natural causes	54(47.8)	41(36.3)	18(15.9)	2.32
The old nature of the earth	32(28.3)	48(42.5)	31(27.4)	2.01

Climate change risks experienced by the farmers: Results in Table 5 showed that the respondents experienced various risks of climate change. The mean ($\bar{x}$) scores of the risks range from 1.86 to 2.55. Findings from this study revealed that pest and disease outbreak ($\bar{x}$=2.55), unemployment/ idleness ($\bar{x}$) =2.24 and food shortage ($\bar{x}$) =2.24), decreased yield ($\bar{x}$) =2.23) were the major consequences of climate change. It can be inferred that climate change could undermine efforts to accomplish the first and second Sustainable Development Goals (SDGs).

Furthermore, any statements with a mean value greater than or equal to 2.00 were regarded as having a high effect, whereas mean values less than 2.00 were regarded as having a low effect. Based on these findings, eleven (11) out of fifteen (15) statements were regarded as having a high effect, while four statements were below the cut-off point and considered to have low effects. It can be deduced that the respondents experienced high climate change risks (Azeeze and Oyekanmi, (2021); Belay *et al.* (2022), Abaje and Magaji (2022) and Esibuo *et al*. (2024).

Table 5: Climate change risks experienced by the farmers

Climate change risks	Very severe effect F(%)	Severe effect F(%)	Not a severe effect F(%)	Mean ($\bar{x}$)
Pest and disease outbreak	73(64.6)	32(28.3)	5(4.4)	2.55
Unemployment/ idleness	65(51.0)	26(61.9)	6(6.2)	2.24
Food shortage	46(40.7)	49(43.4)	18(15.9)	2.24
Decreased agricultural yield	35(31.0)	70(61.9)	7(6.2)	2.23
Increased water pollution	47(41.6)	40(35.4)	26(23.0)	2.19
Premature ripening of crops	43(38.1)	45(39.8	25(22.1)	2.16
Decreased income-generating activities	38(33.6)	57(50.4)	18(15.9)	2.09
Shortage of water for agriculture	33(29.2)	56(49.6)	23(20.4)	2.06
Post-harvest losses	31(27.4)	58(51.3)	22(19.5)	2.04
Changes in the agricultural calendar	33(29.2)	52(46.0)	28(24.8)	2.04
Soil erosion	43(38.1)	29(25.7)	41(36.3)	2.02
Shortening of the crop cycle	30(26.5)	53(46.9)	29(25.7)	1.99
Decrease soil fertility	30(26.5)	52(46.0)	30(26.5)	1.98
Crop failure	33(29.2)	56(49.6)	7(5.4)	1.93
Damage to infrastructure	40(36.3)	60(46.5)	30(26.8)	1.86

Source: Field Survey, 2023, Cut-off point=2.00

Preparedness of respondents against climate change risks: The result in Table 6 revealed that the mean ($\bar{x}$) for farmers' preparedness against climate change ranges from 3.27 to 1.76. The study shows that purchase of early maturing varieties ($\bar{x}$=3.27), agrochemical inputs ($\bar{x}$=3.27), diversification of livelihood ($\bar{x}$=2.91), and purchase of drought-resistant varieties ($\bar{x}$=2.67) and construction of stronger farm structures ($\bar{x}$= 2.50) were the major ways the respondents prepare against climate change risks. However, the least action considered was the use of weather forecast information ($\bar{x}$= 1.76).

Table 6: Preparedness of respondents against climate change risks

Items	Always F(%)	Somewhat F(%)	Slightly F(%)	Not F(%)	Mean ($\bar{x}$)
Purchase of early maturing varieties	69(61.1)	19(16.8)	13(11.5)	11(9.7)	3.27
Purchase of agro-chemical inputs	57(50.4)	40(35.4)	7(6.2)	8(7.1)	3.27
Diversification of livelihood	35(31.0)	48(42.5)	16(14.2)	13(11.5)	2.91
Purchase of drought-resistant varieties	30(26.5)	38(33.6)	24(21.2)	20(17.7)	2.67
Construction of stronger farm structures	31(27.4)	21(18.6)	35(31.0)	26(23.0)	2.50
Insurance	17(15.0)	35(31.0)	43(38.1)	18(15.9)	2.45
Use of early warning signs	27(23.9)	23(20.4)	30(26.5)	32(28.3)	2.38
Erosion of control measures	13(11.5)	21(18.6)	33(29.2)	46(40.7)	2.01
Formation of self-help group	7(6.2)	21(18.6)	36(31.9)	49(43.4)	1.88
Use of weather forecasting information	10(8.8)	15(13.3)	27(23.9)	60(53.1)	1.76

Source: Field study, 2023 cut-off point=2.50

According to these findings, respondents used a variety of strategies to prepare for climate change adaptation. Nonetheless, it is possible to conclude that respondents made an average provision for adaptation because they were well-prepared in five (5) of the ten items.

Barriers to adaptation: The results in Table 7 showed that several factors hindered the farmers' preparedness for adaptation. These include lack of access to farm credit ($\bar{x}$=3.58), lack of access to extension agents ($\bar{x}$=3.47), and unfavourable policies on the availability of farm inputs ($\bar{x}$=3.43). This study is in agreement with Aminu *et al*. (2020); Ayanlade and Oluwatimilehin (2023) that access to extension, market, lack of capital, and credit services are part of institutional characteristics expected to improve the adoption measures and reduce the negative impacts of changing climate. In addition, inadequate storage facilities ($\bar{x}$=3.11) and inadequate information on adaptation ($\bar{x}$=2.96) were also among the constraints while poor access to land ($\bar{x}$=2.35) was the least ranked constraint.

Table 7: Barriers to adaptation

Barriers	EB f(%)	Mb f(%)	Sb f(%)	Nb f(%)	Mean ($\bar{x}$)
Lack of access to farm credit	86(76.1)	12(10.6)	9(8.0)	6(5.3)	3.58
Lack of access to extension agents	77(68.1)	19(16.8)	10(8.8)	7(6.2)	3.47
Poor policies on the availability of farm inputs	68(60.2)	29(25.7)	13(11.5)	3(2.7)	3.43
Inadequate storage facilities	44(38.9)	40(35.4)	26(23.0)	3(2.7)	3.11
Inadequate information on adaptation	20(17.7)	14(12.4)	29(25.7)	50(44.2)	2.96
Poor access to land	14(12.4)	37(32.7)	38(33.6)	23(20.4)	2.35

Source: Field study 2023, Eb= Extreme barrier, Mb=Moderate barrier, Sb= somewhat a barrier, Nb= Not a barrier

Relationship between farmers' preparedness against climate change and selected socioeconomic characteristics: A Pearson product-moment correlation test was conducted to see the strength of the relationship between the socioeconomic variables measured at the interval level and the preparedness of the respondents against climate change risks. Results in Table 8 revealed that there was a significant relationship ($p<0.05$) between age ($r=0.052$, $p=0.000$), household size ($r= 0.031$, $p=0.000$), farm experience ($r=-0.111$, $p=0.000$) and farm size ($r=-0.106$, $p=0.042$, $p>0.01$). This implies that an increase in these variables tends to positively influence farmers' ability to prepare against climate change. This suggests that increasing farmers' age, household size, agricultural experience, and farm size may help farmers prepare adequately for climate change risks.

These results show that the strength of the relationship was positive but weak (Evans, 1996). However, there was no significant relationship between average annual income (r=-0.260, p=0.470) and the respondents' preparedness against climate change risks. This suggests that farmers' preparation for adaptation improves as they experience a decrease in average annual income. This is a weak and negative association.

Table 8: Test of the relationship between respondents' socioeconomic characteristics and preparedness against climate change risks

Socioeconomic characteristics	r-value	p-value	Decision
Age	0.052	0.000	Significant
Household size	0.031	0.000	Significant
Farm size	0.106	0.042	Significant
Farming experience	0.111	0.000	Significant
Average annual income	0.260	0.470	Not significant

Source: Field Survey, 2023; < 0.05 level of significance

Sources of information as the determinants of farmers' preparedness against climate change risks: To identify sources of information as determinants of farmers' preparedness against climate change risks, a multiple linear regression analysis was conducted to assess how change in the combination of two or more predictor variables predicts the level of change in farmers' preparedness against climate change, this was reported in Table 9 with a standardized regression coefficient, t-statistical value, and values of constant and adjusted R^2 value. The coefficients of determination of sources of information of climate change were adjusted R^2 of 0.491 and R^2 value of 0.421.

Table 9: Sources of information as the determinants of farmers' preparedness against climate change risks

Sources of information	β-value	t-value
Membership of farmers' association	-2.407	0.001**
Family and friends	-4.645	0.002**
Access to extension agents	0.302	0.737
Research Institute	0..363	0.706
Access to radio	-2.344	0.009*
Access to television	-1.219	0.291
Access to print media	-1.692	0.071
Access to social media	0.307	0.071
R	0.491	
R^2	0. 241	
Adjusted R^2	0.149	
F change	2.626	
Standard error	2.446	
Significance	0.01	

Source: Field Survey, 2023 p<0.05 level of significance

When combined, these variables explained 42.1% of the variance in the respondents' sources information as a determinant of preparedness against climate change risks, three (3) independent variables had statistically significant beta coefficients (membership of farmers association = -2..407, t= 0.001**, p<0.01) and access to extension agents= -4.645, t=0.002**, p<0.01 and radio=-2.344, t=0.009*, P<0.05). These variables effectively explained the variation in the dependent variable. According to the findings, the key factors and primary motivators for exposure to these sources of information. In addition, membership of a farmers' association and access to extension agents could offer the opportunity to make adequate preparation and thereby enhance their adaptive capacity.

Conclusion: Adequate preparation against climate change is vital for sustainable production of maize. This study assessed the preparedness of maize farmers against climate change risks in Saki-west Local Government Area of Oyo State. Respondents were more aware of rainfall, temperature, and flood occurrences, most likely because deviations in these elements could cause economic loss. Farmers also faced considerable risks from climate change and made preparations to adapt to climate change. This indicates that their preparedness could reduce their vulnerability to climate change risks. The government should strengthen extension agents' services while also implementing favourable climate change adaptation policies.

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