KADUNA JOURNAL OF GEOGRAPHY
2026, VOL. 8, No. 1, 187-198
https://doi.org/10.47514/kjg.2026.08.01.020

Research Article

An Assessment of Farmers' Access and Utilization of Meteorological Information in Kachia Local Government Area, Kaduna State, Nigeria

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ABSTRACT

Climate change and extreme weather events continue to present considerable challenges to agriculture in developing countries. This study evaluated farmers' access to and utilization of meteorological information in Kachia Local Government Area, Kaduna State, Nigeria, amid increasing climate variability and its impact on rain-fed farming. Using a cross-sectional survey design, 384 farmers were selected through multistage sampling. Data were gathered via questionnaires, with secondary climatic data (1970–2024) obtained from the Nigerian Meteorological Agency. Rainfall and temperature patterns were analyzed using linear trend regression, while survey responses were summarized with descriptive statistics. Results showed a fluctuating yet overall rising trend in rainfall (R^2 = 0.0863), with delayed onset between April and May and cessation between September and October. The growing season lasted from 109 to 191 days. Temperature trends indicated a steady increase in maximum temperatures (R^2 = 0691 and 0.0335 for Max and Min), consistent with global climate change patterns. Although 89% of farmers possessed some knowledge of meteorological information, access was limited- only 16% had high access, and 37% had none. Radio was the main information source (68%), with extension services playing a minor role (2%). Meteorological data influenced decisions on planting, crop choice, and harvesting, but poor communication infrastructure, weak extension services, and inadequate dissemination mechanisms hindered the effectiveness of these decisions. The study concludes that, despite high awareness, limited access diminishes usefulness. It recommends strengthening information dissemination and institutional support to enhance agricultural resilience.

ARTICLE HISTORY
Submitted 29 February 2026
Accepted 11 April 2026
Published 18 April 2026

GUEST EDITOR
A. M. Ahmed

KEYWORDS
Climate Change,
Meteorological Information,
Climate Adaptation,
Agriculture

1 Introduction

Climate variability and climate change have increasingly become major challenges to agricultural production worldwide. Global agricultural activities are increasingly threatened by climate change and variability. This is because this sector of the global economy is very sensitive to climate, as crop growth, planting decisions, and harvesting periods largely depend on weather conditions such as rainfall, temperature, humidity, and wind patterns. Significant changes in any of these climatic elements often lead to fluctuations in agricultural productivity and pose serious risks to food security, especially in less-developed countries where farming primarily relies on rainfall (Porter et al., 2021). In Sub-Saharan Africa, where smallholder farmers account for most agricultural production, the ability to anticipate and respond to weather conditions has become vital to maintaining agricultural livelihoods.

Adequate information about meteorological and climate events is essential for helping farmers make informed decisions about farming activities. Weather forecasts, rainfall predictions, and early warning systems enable farmers to choose the right planting times, select suitable crop varieties, and manage water and pest risks. Access to reliable meteorological data has thus become a key part of climate-smart agriculture and risk management strategies in many developing countries (Ouedraogo et al., 2022). Studies indicate that farmers who receive timely climate information are more likely to adopt better agricultural practices and climate-smart adaptation strategies that improve productivity and resilience to climate variability.

Recent studies also revealed that farmers' decision-making process and adaptive capacity are, to a greater extent, influenced by access to meteorological information. For instance, research among smallholder farmers in Ghana found that access to climate information improves farmers' adoption of climate-smart agricultural practices and strengthens their ability to manage climate-related risks. Similarly, Alidu et al. (2022), in their study in Ghana, asserted that sources of climate information, such as mass media, extension services, and government agencies, play a critical role in improving farmers' resilience to climate shocks. In addition, recent research by Ouedraogo et al. (2022) suggests that information and communication technologies (ICTs), including mobile phones and digital advisory services, are increasingly facilitating farmers' access to weather information and improving farm-level climate adaptation strategies.

The major source of livelihood for rural households in Nigeria is agriculture, with most farming activities dependent on rainfall. Therefore, climate variability, including irregular rainfall patterns, droughts, and flooding, poses serious threats to agricultural productivity and food security. According to Hassan and Knight (2023),

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Nigerian farmers' knowledge of climate change and access to climate-related information are strongly influenced by extension services, radio broadcasts, and other communication channels. The research further indicates that farmers increasingly adopt various strategies to cope with climate variability. However, access to reliable weather and climate information remains a critical factor shaping these adaptation strategies.

In Kachia Local Government Area, as in other Local Government Areas in Kaduna State, farming activities depend largely on rainfall and seasonal weather conditions. Farmers in the area cultivate crops such as maize, sorghum, millet, and legumes, which are highly sensitive to climatic fluctuations. Changes in rainfall patterns, delayed onset of rains, prolonged dry spells, and occasional flooding have increasingly affected agricultural productivity in the region. Under such conditions, access to reliable meteorological information becomes essential for improving farm planning, reducing production risks, and enhancing agricultural resilience (Ariko et al., 2023). However, despite the availability of meteorological services in Nigeria through institutions such as the Nigerian Meteorological Agency (NiMet), many farmers at the grassroots level still face challenges accessing and effectively utilizing weather information. Barriers such as limited dissemination channels, low awareness, inadequate extension services, and poor interpretation of technical climate information often limit the effective use of meteorological data in farm decision-making.

Given the growing importance of weather and climate information for climate-smart agriculture, it is necessary to examine how farmers access and use meteorological information at the local level. Understanding farmers' sources of meteorological information, their level of awareness, and the extent to which such information influences farming decisions is critical for improving agricultural advisory services and climate risk management.

Previous studies (Ariko et al., 2023, among others) only looked at the awareness level of farmers of climate change without considering the level of utilization of meteorological information. Therefore, this study assesses farmers' access to and utilization of meteorological information in Kachia Local Government Area of Kaduna State with a view to identifying gaps in information dissemination and improving the integration of meteorological services into agricultural decision-making. This is achieved through these specific objectives, which are to:

i. assess the climatic trend in the study area
ii. examine the utilization of meteorological information in the study area
iii. evaluate the constraints militating against the utilization of meteorological information in the study area.

2 Methodology

2.1 Study Area

Kachia Local Government Area (LGA) is situated in the southern part of Kaduna State in northwestern Nigeria. Geographically, it extends between latitudes 9°33′N and 10°11′N and longitudes 7°10′E and 8°08′E. The area shares borders with Kajuru and Chikun Local Government Areas to the north, Zangon Kataf to the east, Jaba and Kagarko to the south, and Niger State to the west. Administratively, Kachia LGA comprises 12 electoral wards: Agunu, Ankwa, Awon, Bishini, Dokwa, Gidan Tagwai, Gumel, Kachia, Kateri, Kurmin Musa, Kwaturu, and Sabon Sarki (Ghiing), which serve as the geographic units for questionnaire distribution in this study. The region lies within the northern Guinea savanna ecological zone and is part of Nigeria's North-Central Plateau. The terrain is predominantly undulating, with elevations ranging from 700 to 750 meters above sea level. It features isolated hills, low ridges, and gently sloping plains. Several seasonal streams and tributaries, including River Kachia, River Ariko, Ungwanpa River, and Kurmin Taba River, drain the area and ultimately flow into the Gurara River basin. Most of these water bodies are seasonal, flowing primarily during the rainy season (Ishaya, 2014).

The climate of the area is classified as tropical continental, with two main seasons: wet and dry. The rainy season typically lasts from April to October, while the dry season occurs from November to April, often influenced by the Harmattan winds originating from the Sahara Desert. Annual rainfall averages around 1,500 mm, though it fluctuates from year to year. Temperatures tend to remain high year-round, with peaks often exceeding 28°C in March and April, just before the rainy season begins. During the cooler months of December and January, minimum temperatures can drop to about 13°C. The soils mainly consist of ferruginous tropical types formed from weathered basement complex rocks. These soils can support various crops but are vulnerable to erosion and nutrient depletion if not properly managed. The natural vegetation mainly comprises Guinea savanna woodland, with scattered trees, shrubs, and tall grasses whose density varies with seasonal rainfall and human activities such as farming and grazing.

According to the 2006 national population census, Kachia Local Government Area had a population of approximately 244,274 people. The population comprises various ethnic groups, including the Adara, Jaba, Baju, Kuturmi, Koro, Hausa, Fulani, and Igbo. Agriculture is the main economic activity in the area, with most households relying on small-scale farming for their livelihoods.

Farming is mostly rain-fed and features mixed crop-and-livestock production systems. Major crops include cereals like maize, sorghum, and millet, as well as root and tuber crops such as cassava and yams. Cash crops like ginger are also commonly grown, and alluvial soils along river valleys support the cultivation of rice and sugarcane. Due to the heavy reliance on rain-fed agriculture and the increasing variability in rainfall and temperatures, farming systems in Kachia LGA are especially vulnerable to the impacts of climate change. This makes the area a suitable location for studying climate trends and evaluating the adoption of climate-smart agricultural practices among smallholder farmers (Musa, 2004).

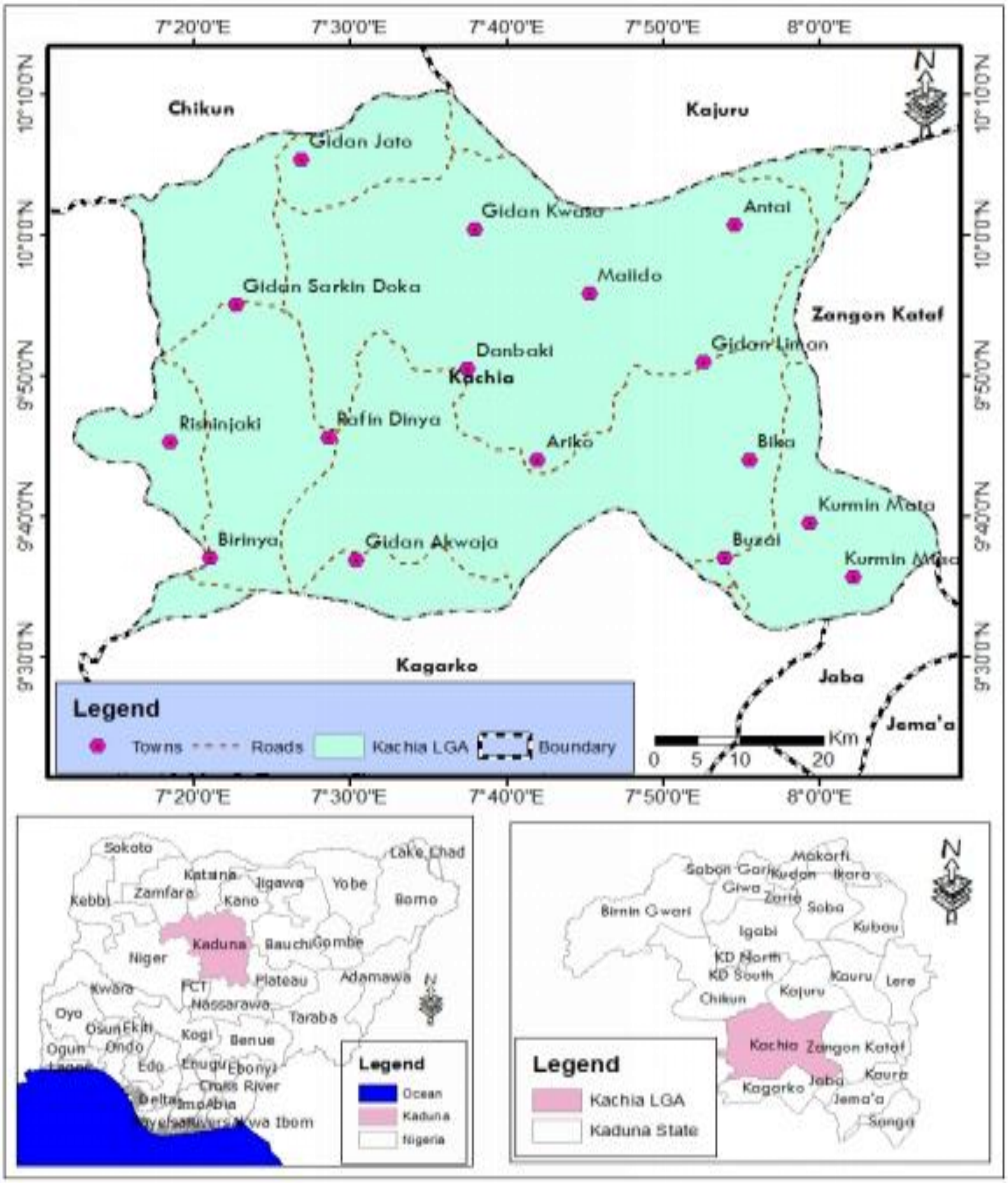

Figure 1: Kachia LGA, Kaduna State
Source: Adapted from the Administrative Map of Kaduna State

2.2 Research Design and Data Sources

A cross-sectional survey research design was used to collect data from a representative sample of farmers to assess their sources and use of meteorological information for agricultural decision-making in the study area. This method is common in agricultural climate-information studies because it allows researchers to evaluate farmers' perceptions, information sources, and responses to climate variability (Hassan & Knight, 2023). The study used two main data sources: secondary climatic data and primary survey data. Historical climate data, including annual rainfall totals and average temperature records from 1970 to 2022, were obtained from the Nigerian Meteorological Agency (NiMet). These data helped in analyzing long-term climate trends and variability, providing a baseline for understanding farmers' knowledge of meteorological parameters. Primary data were gathered through structured questionnaires administered to farmers in the sampled wards within the study area. The questionnaires aimed to collect information on farmers' socio-economic characteristics, knowledge of meteorological data, access to and sources of meteorological information, and challenges faced in obtaining this information. This method ensures proper representation of farming communities (Danmaigoro et al., 2025). Studies show that access to meteorological information influences farmers' ability to adapt to climate variability (Shehu et al., 2024; Madumelu & Okeowo, 2025).

2.3 Sample Size Determination

The sample size for the household survey was determined using the widely used Krejcie and Morgan (1970) sample size determination formula, which is appropriate for large populations. According to the 2006 National Population Census, the population of Kachia LGA was 244,274, projected to 403,749 using the geometric population growth model with an assumed annual growth rate of 3%. Based on the Krejcie and Morgan sampling framework, a sample size of 384 respondents was considered sufficient to represent the population with 95% confidence. This sample size is commonly used in social science surveys involving large populations.

2.4 Sampling Procedure

A multistage sampling method was used to select respondents for the survey. In the first stage, the twelve electoral wards within Kachia Local Government Area were intentionally selected to ensure spatial coverage across the study area. In the second stage, 32 respondents were selected from each ward, for a total of 384. The uniform distribution of respondents across wards was adopted because there was no reliable population data for individual communities to support proportional allocation. Within each ward, respondents were randomly selected from farming households to ensure that farmers actively engaged in agriculture had an equal chance of participating. Only farmers with at least five years of farming experience in the area were included to ensure respondents had sufficient knowledge of climate change and farming practices; this was achieved through snowballing.

2.5 Questionnaire Design and Data Collection

The structured questionnaire consisted of four major sections:

1. Socio-economic characteristics of farmers (age, gender, education, farming experience, and household status).
2. Farmers' knowledge of Meteorological information.
3. Access to meteorological information
4. Sources of Meteorological information.
5. Utilization of meteorological information.
6. Constraint on the utilization of meteorological information

2.6 Data Analysis

To evaluate long-term climate variability in the study area, linear trend regression analysis was employed to examine changes in rainfall and temperature over time. The regression model is expressed in Equation (1):

$$Y = a + bx \tag{1}$$

Where:

Y = climatic variable (rainfall or temperature)
a= intercept
b = slope representing the rate of change in the climatic variable
x = time (year)

A positive value of the slope coefficient indicates an increasing trend, while a negative value indicates a decreasing trend in the climatic variable over time. Descriptive statistics, including percentages, charts, and the mean, were used to analyse the collected data.

3 Results and Discussion

3.1 Meteorological characteristics of the study area

The total annual rainfall (TAR), rainfall onset date, rainfall cessation date, length of the growing season, and temperature of the study area (1970-2024) were analyzed and presented in Figures 2, 3, 4, 5, and 6, respectively.

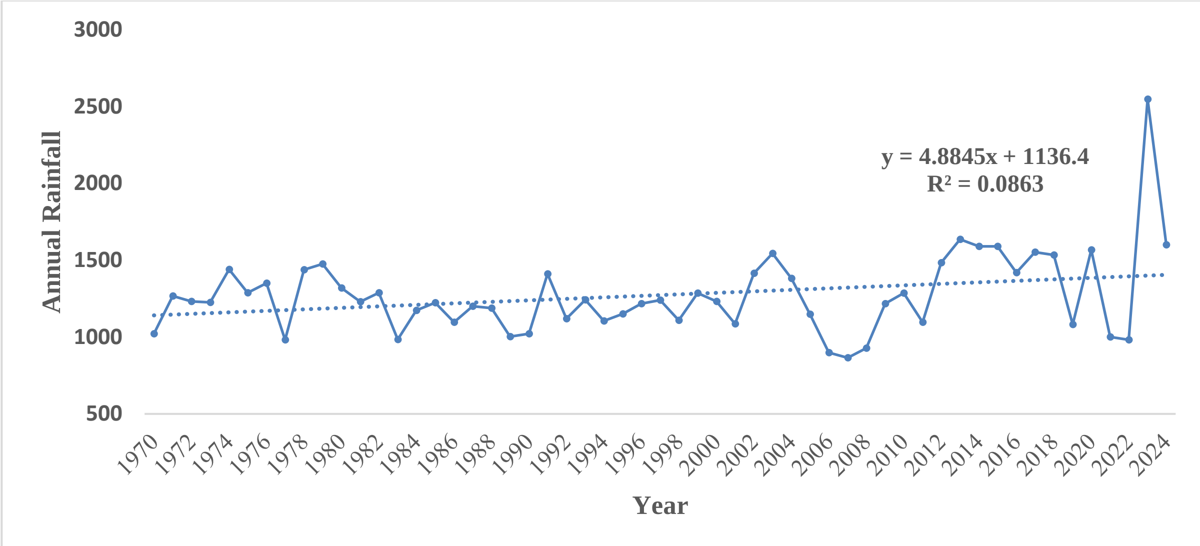

Figure 2: Trends in Total Annual Rainfall for the study area (1970 – 2024)

Rainfall is the most variable of all climatic elements and determines the growing season in developing countries like Nigeria, where agriculture is predominantly rain-fed. Almost every farmer is more interested in expected rainfall than in any other climatic element, as it determines the success or failure of crops. Timely and accurate weather forecasting and sharing is crucial to improving farming activities.

The trend shows a fluctuating yet overall increasing pattern in the TAR over the 51 years examined. The rising TAR aligns with the findings of Umar et al. (2015), who reported an increase in TAR in Sokoto State. According to Ayoade (2004), rainfall has a greater impact on interannual changes in crop yields in tropical environments because it affects plant water supply. The regression equation derived from the trend line indicates that TAR is rising and may continue to do so. This could lead to soil erosion and flooding of farmland. The increasing trend in total annual rainfall matches findings reported in other parts of northern Nigeria (Umar et al., 2015). According to Ayoade (2004), rainfall plays a crucial role in interannual variations in crop yields in tropical regions.

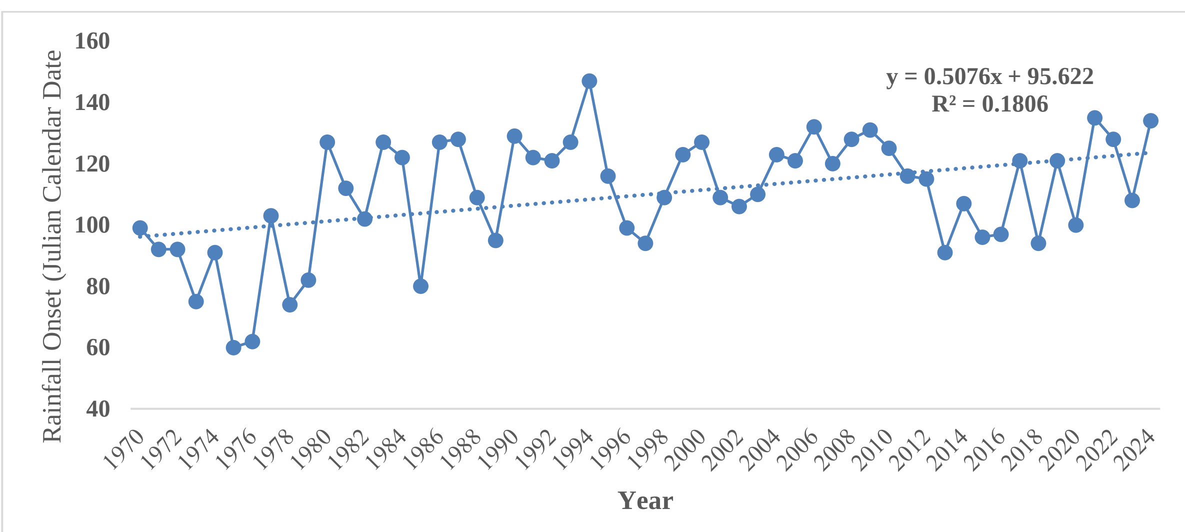

Figure 3: Trend in Rainfall Onset Date in the Study Area (1970-2024)

The rainfall onset in the study area (see Figure 4) shifts from early to relatively late, occurring between the 60th and 150th Julian days (April to May). This variability suggests that the start of the rainy season fluctuates each year, influenced by atmospheric processes such as the movement of the Inter-Tropical Discontinuity (ITD). This highlights the importance of providing farmers with timely and reliable onset forecasts. Studies have shown that access to seasonal climate forecasts significantly improves farmers' ability to make informed planting decisions and reduces the risks associated with false onset (Stern & Cooper, 2011; Hansen et al., 2019).

In most early agrarian communities in developing countries, including Nigeria, farmers often depend on indigenous knowledge to choose planting dates. While this knowledge is useful, it may not always account for increasing climate variability. Combining scientific meteorological data with local knowledge systems has been widely recommended as a more effective way to handle uncertainty (Ajayi et al., 2013). In this study, farmers are encouraged to use early-warning information and rainfall-onset predictions from agencies such as the Nigerian Meteorological Agency (NiMet) to guide land preparation and planting activities.

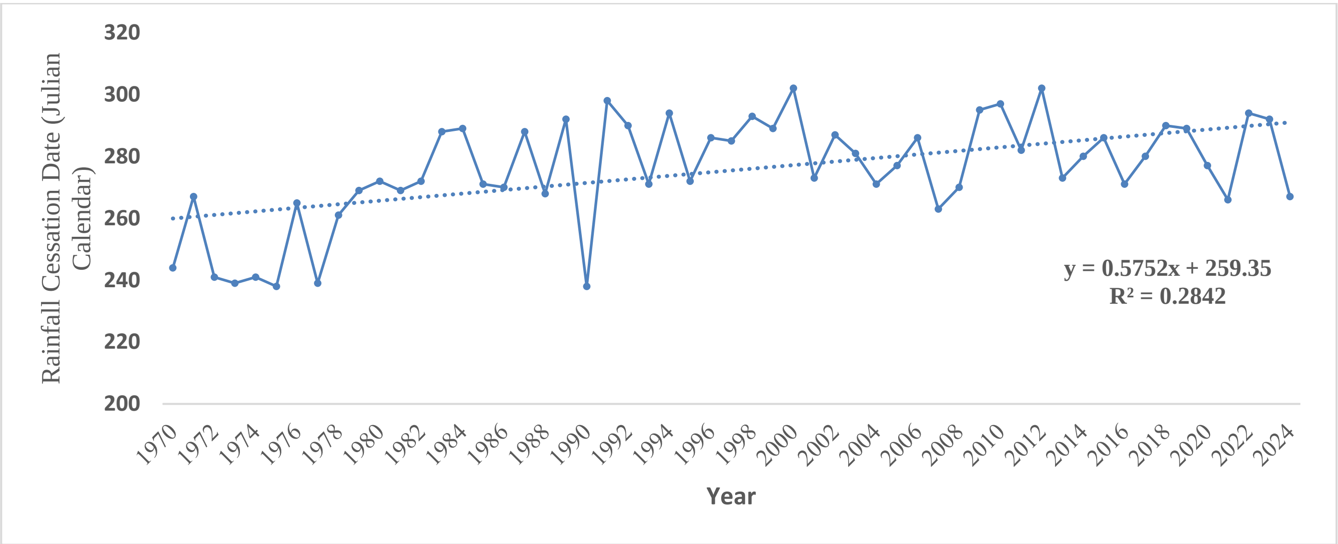

Figure 4: Trend in Rainfall Cessation Date in the Study Area

The cessation of rainfall, occurring between the 250th and 300th Julian days (September to October), highlights the importance of accurate meteorological data. The clustering of cessation around late September and the second week of October indicates a fairly predictable conclusion to the rainy season, which is essential for planning harvest activities. Meteorological advisories on expected cessation dates help farmers plan planting schedules so that crop maturity aligns with sufficient soil moisture availability (Sivakumar, 2006).

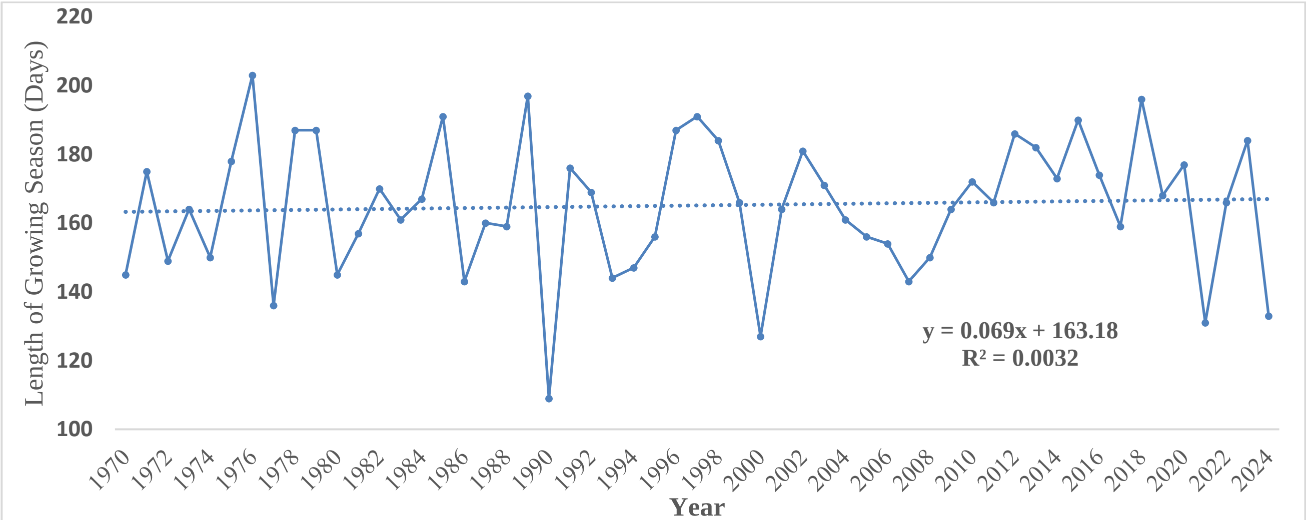

Figure 5: Trend in Length of the Growing Season in the Study Area (1970-2024)

The length of the growing season (LGS), ranging from 109 to 191 days, is another critical parameter that underscores the importance of using meteorological information. This relatively short and variable growing period necessitates careful crop selection and management. Meteorological data on rainfall distribution, dry-spell occurrence, and soil moisture availability can guide farmers in selecting crop varieties well-suited to prevailing climatic conditions (Jones et al., 2017).

In the study area, where rainfall seldom lasts more than six months, the advice to grow crop varieties that mature within 5 to 6 months aligns with best practices in climate-smart agriculture. However, the effectiveness of this approach largely depends on farmers' access to and understanding of weather information. Extension services and climate information platforms, such as mobile phone alerts, radio broadcasts, and community-based climate services, are vital in closing this information gap (Tall et al., 2018).

Furthermore, the utilisation of meteorological information has broader implications for agricultural risk management and food security. Access to reliable climate information enables farmers to anticipate and respond to climate risks, thereby enhancing resilience and reducing vulnerability (FAO, 2019).

Temperature plays a significant role in agriculture. In general, higher temperatures are associated with higher radiation and greater water use. The average maximum and minimum temperature of the area is shown in Figure 3. The trend-line equations for the average annual maximum and minimum temperatures (1970-2023) indicate increasing temperatures ($y = 0.0147x + 31.314$ and $y = -0.0153x + 20.771$, respectively). Temperature trends indicate increasing maximum temperatures, consistent with broader national and regional climate change patterns (IPCC, 2021). However, minimum temperature shows a negative trend, which indicate a decreasing pattern.

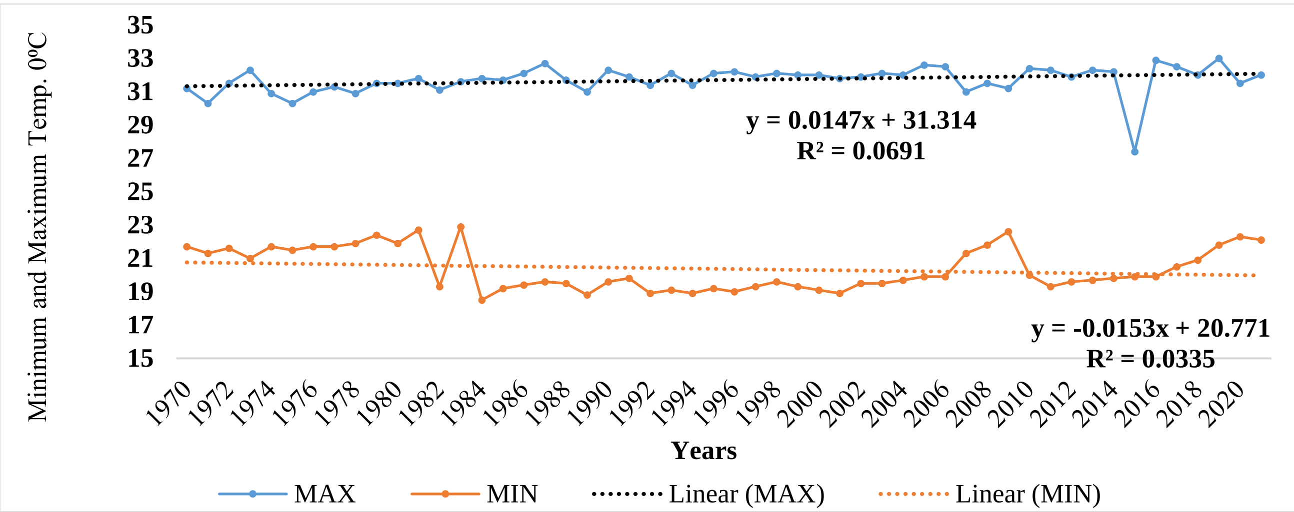

Figure 6: Trends in annual max. and min. temperature for the study area (1970 – 2023)

3.2 Demographic Characteristics of the Farmers

The demographic characteristics of the farmers are shown and discussed in Table 1. The results indicate that 78% of the farmers are male, while 22% are female. Most of the farmers (32%) fall within the age range of 30–40; 28% are between 41 and 50 years old; 15% are between 51 and 60 years old; 19% are between 61 and 70 years old; and 6% are 71 years or older (Table 1). Regarding their social status, 53% are family heads; 3% are village heads; 2% are community leaders, and 42% are just farmers. Most farmers are married (74%); 13% are single; 9% are widowed, and 4% are divorced.

The educational level of the farmers is presented in Table 1. The majority of the farmers (48%) had secondary education; 9% had primary education; 10% had tertiary education; 8% had adult education, while 24% had Koranic education. According to Enete et al. (2011), education has a positive, highly significant relationship with the level of investment in indigenous and emerging climate change adaptation practices. This is expected, as educated farmers better understand and process information from different sources on new farm technologies, thereby increasing their allocation and technical efficiency. 52% of the farmers had 11–20 years of farming experience in the study area; 46% had 11–20 years of experience, and 30% had 21–30 years of experience.

Table 1: Demographic characteristics of the farmers

Sex	Respondents	Percent
Male	301	78
Female	83	22
Total	**384**	**100**
Age		
30 – 40	124	32
41 – 50	108	28
51 –60	57	15
61 – 70	72	19
71 & above	23	6
Total	**384**	**100**
Marital Status		
Married	284	74
Divorced	14	4
Single	50	13
Widowed	36	9
Total	**384**	**100**
Level of Education		
Primary	36	9
Secondary	184	48
Tertiary	40	10
Adult Education	32	8
Koranic	92	24
Total	**384**	**100**
Years of Residency		
1--10	10	3
11--20	201	52
21-30	111	29
>30	62	16
Total	**384**	**100**
Years of Experience		
1--10	37	10
11--20	178	46
21-30	117	30
>30	52	14
Total	**384**	**100**

3.3 *Farmers' Knowledge and Source of Meteorological Information*

The findings indicate a high level of knowledge about meteorological information among farmers in the study area. As shown in Table 2, 26% of respondents have high knowledge, while 63% have some knowledge, indicating that 89% of farmers have some level of understanding of meteorological information. Only 7% are not knowledgeable, and 5% are highly unknowledgeable. This high level of awareness suggests that meteorological variability and extreme weather events are already being experienced and acknowledged by farming households. The results align with broader national observations by the Intergovernmental Panel on Climate Change, which notes that developing countries, particularly in Sub-Saharan Africa, are increasingly experiencing visible climate impacts that raise public awareness. The high level of meteorological knowledge among farmers corroborates broader observations that climate impacts in Sub-Saharan Africa are becoming more evident and widely recognized (IPCC, 2021). However, limited access to extension services restricts farmers' ability to adopt structured and technology-driven adaptation strategies.

However, knowledge does not necessarily translate into utilization or adaptive capacity. While most farmers are aware of climate change, their understanding of mitigation and structured adaptation strategies, as well as their use of this information, may still be limited. This gap becomes more evident when examining the sources of information and the utilization of this information cum constrains faced by farmers.

Radio is the dominant source of meteorological information (68%), followed by television (20%) and newspapers (10%). Only 2% of respondents obtained information from extension officers, while other sources accounted for a negligible proportion (0.5%). The dominance of radio reflects its accessibility, affordability, and penetration in rural communities. This shows that radio remains the most reliable medium for disseminating agricultural advisories. The limited role of extension officers suggests institutional weaknesses in extension delivery systems. This finding is consistent with studies across Nigeria, where extension-farmer ratios remain inadequate. Strengthening extension services could significantly enhance farmers' capacity to interpret and use meteorological information, and to adopt scientifically guided approaches to agricultural planning and effective practices.

Table 2: Farmers' Knowledge of and Source of Meteorological Information

Level of Awareness	Respondents	Percent
Highly Knowledgeable	98	26
Knowledgeable	241	63
Not Knowledgeable	27	7
Highly not Knowledgeable	18	5
Total	**384**	**100**
Farmers' Source of Meteorological Information		
Radio	261	68
Television	75	20
Newspaper	38	10
Extension officers	8	2
Others	2	0.5
Total	**384**	**100**

3.4 Farmers' Access to Meteorological Information in the Study Area

Figure 7 revealed farmers' access to meteorological information in the study area, showing notable disparities in access and reach. The findings suggested that only 16% of farmers have high access to meteorological information, while 47% possess moderate access and 37% have no access at all. This pattern suggests that a significant proportion of farmers operate with inadequate meteorological guidance, which is essential for informed agricultural decision-making. The implication is that farmers without access are particularly vulnerable to weather-related risks such as droughts, floods, and rainfall variability, thereby increasing the likelihood of crop failure and reduced productivity. This finding agreed with Hansen et al. (2011) and Ziervogel and Calder (2003) who opined that limited access to climate information remains a major constraint for smallholder farmers in sub-Saharan Africa, significantly affecting their adaptive capacity. Similarly, Nkiaka et al. (2019) observed that a large proportion of rural farmers lack timely and usable meteorological information, which reduces their ability to respond effectively to climate variability.

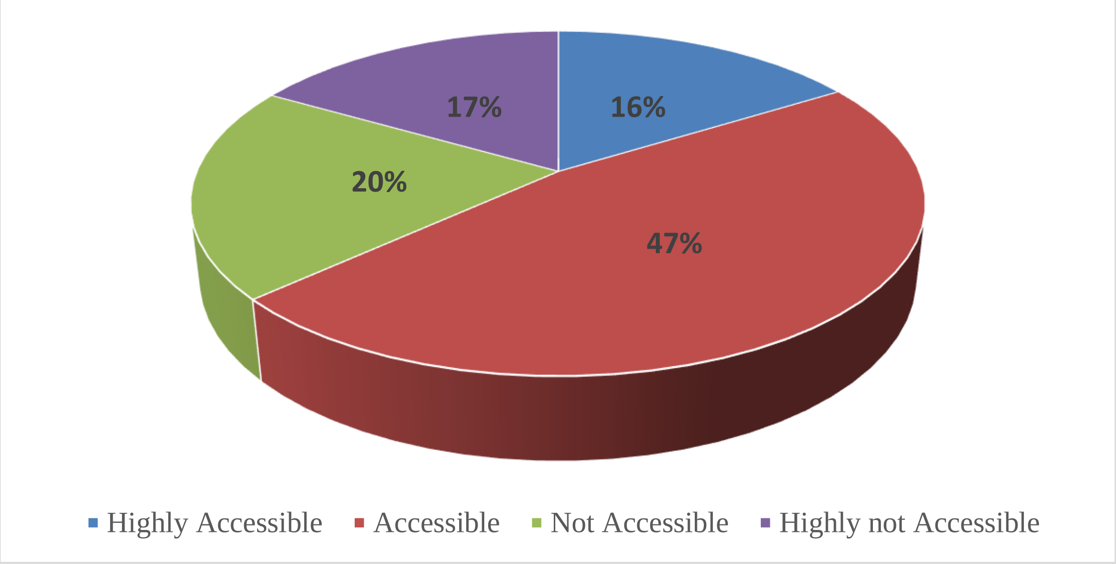

Figure 7: Farmers' Access to Meteorological Information in the Study Area

3.5 Farmers' Utilisation of Meteorological Information for Climate Change Adaptation

The utilisation of meteorological information for agricultural planning and operations is presented in Table 3. The findings revealed a high level of utilization of meteorological information across a range of farming activities. Most pronounced was the determination of planting dates, the most common area of utilization, with the highest mean score ($\bar{x} = 4.50$), ranking first among all identified practices. This underscores the critical importance of rainfall onset and distribution patterns in guiding farmers' decisions on when to commence planting, thereby reducing the risks associated with early or delayed planting. Crop harvesting and storage decisions ranked second, with a mean score of 4.05. This suggests that farmers rely heavily on meteorological information to avoid post-harvest losses from adverse weather, such as unexpected rainfall or excessive humidity. By aligning harvesting periods with favourable weather conditions, farmers are better able to preserve crop quality and extend storage life.

Additionally, the choice of crop type suitable for a specific growing season received an average score of 4.01, indicating a substantial reliance on meteorological information in crop selection. This suggests that farmers are increasingly aware of how climatic factors such as rainfall variability, temperature patterns, and the length of the growing season affect crop performance. As a result, they adjust their crop choices to align with current and expected weather conditions, thereby boosting productivity and resilience. The timing of chemical applications, including fertilizers, herbicides, and pesticides, also seems to be influenced by meteorological data, with an average score of 3.58. Although this is lower compared to other activities, it still indicates moderate use. Proper timing of chemical applications is essential, as weather factors such as rainfall and wind speed can significantly affect the effectiveness of these inputs. For example, rainfall soon after application can wash away chemicals, while strong winds may cause drift and uneven distribution.

Table 3: Farmers' Utilization of Meteorological Information for Agricultural Practice

SN	Activates	Mean ($\bar{x}$) Likert 1-5	Rank
1	Land Preparation	3.20	7th
2	Choice of crop to grow	4.01	3rd
3	Planting date	4.50	1st
4	Weeding Date	3.42	6th
5	Fertilizer and Chemical application	3.58	4th
6	Crop Harvest and Storage	4.05	2nd
7	Marketing	2.05	10th
8	Flood preparedness	3.50	5th
9	Drought Preparedness	2.70	8th
10	Livestock feeding control	1.52	11th
11	Site selection	2.41	9th

Overall, the pattern of responses shows that farmers are increasingly incorporating scientific meteorological information into their agricultural decision-making. This shift indicates a move away from relying solely on indigenous knowledge systems toward a more integrated approach that combines traditional weather-forecasting methods with modern meteorological services. Such a change is vital for enhancing adaptive capacity, especially in the face of growing climate variability and uncertainty. These findings align with the study by Thomas and Sanyaolu (2017), which reported that most arable crop farmers in Oyo State, South-western Nigeria, actively used agro-meteorological services in their farming activities. The convergence of these results underscores farmers' growing recognition of the importance of meteorological information for improving farm management, reducing risks, and boosting overall agricultural productivity.

3.6 *Farmers' Constraint on the utilization of meteorological information*

Table 4 presents the constraints affecting the utilisation of meteorological information for agricultural practices in the study area. Among the twelve identified challenges, However, five emerged as the most significant: limited access to communication infrastructure (4.72), weak agricultural extension services (4.61), poor feedback mechanisms (4.27), inadequate dissemination channels (4.10), and institutional and policy gaps (3.82) are ranked 1st to 5th respectively. Limited access to communication infrastructure, particularly poor network coverage and unreliable electricity supply was identified as the most critical barrier restricting farmers' access to meteorological information. This is in agreement Aker (2011), who emphasized that poor rural communication infrastructure significantly limits access to agricultural and climate information in developing countries. In addition, Mittal and Mehar (2016) argued that inadequate ICT infrastructure remains a key obstacle to the dissemination of weather and market information to farmers.

Table 4: Farmers' Constraint on the Utilization of Meteorological Information

SN	Constrain	Mean	Rank
1	Limited Access to communication Infrastructure	4.72	1st
2	Low literacy Level	3.00	10th
3	Language Barriers	3.40	7th
4	Inadequate Dissemination Channels	4.10	4th
5	Untimely Forecasts	3.50	6th
6	Financial Constrains	3.28	8th
7	Weak Agricultural Extension services	4.61	2nd
8	Institutional and policy Gaps	3.82	5th
9	Technological Limitations	3.01	9th
10	Poor Feedback Mechanism	4.27	3rd
11	Gender Inequality	2.10	12th
12	Cultural Factors	2.62	11th

Weak agricultural extension services, characterized by insufficient personnel and limited training, also constrain effective utilisation of meteorological information. This observation aligned with the assertion by Anderson and Feder (2007), who highlighted that ineffective extension systems in developing countries reduce farmers' access to vital agricultural knowledge, including climate information. Similarly, Deresa et al. (2010) noted that strengthening extension services significantly improves farmers' adoption and use of climate-smart practices. Poor feedback mechanisms and inadequate dissemination channels further weaken the interaction between farmers and meteorological service providers. This supports findings by Tall et al. (2014), who emphasized the importance of participatory communication systems that allow two-way information flow between farmers and climate service providers. Institutional and policy gaps also emerged as a key constraint, limiting coordinated efforts in climate information delivery. This agrees with Vaughan and Dessai (2014), who argued that weak institutional frameworks and lack of supportive policies hinder the effective production and dissemination of climate services in developing regions.

4 Conclusion

The findings from this study enable the study to conclude that meteorological information plays a critical role in agricultural decision-making among farmers in Kachia LGA; Most farmers are aware of climate variability and have basic knowledge of meteorological information, which they actively apply in farming activities such as determining planting periods, crop selection, and harvesting. This presents a growing shift toward climate-smart agricultural practices. Despite this level of utilization of this information, access to meteorological information remains uneven and inadequate for a significant proportion of farmers. The reliance on radio as the primary source of information highlights both its importance and the limited diversification of communication channels. Furthermore, the weak role of agricultural extension services suggests institutional inefficiencies in delivering tailored and actionable climate information. This study also identifies key structural and systemic constraints, including poor communication infrastructure, weak extension systems, and inadequate dissemination and feedback mechanisms. These challenges limit farmers' ability to fully utilize meteorological information for effective agricultural planning and operation.

The study came out with the following recommendation based of the findings:

i. Government and relevant agencies should recruit, train, and deploy more extension officers to bridge the gap between meteorological service providers and farmers.
ii. Government and relevant authorities should improve Communication Infrastructure in rural areas; including mobile networks and electricity supply to improve farmers' access to meteorological information.
iii. Diversification of Information Dissemination Channels through expand use of mobile phone alerts, community platforms, and digital tools should be invested upon by relevant authorities.
iv. The Meteorological Agencies Should Provide localized and timely forecasts tailored to farmers; and promoting Climate Information Literacy by organizing training programs for better understanding of weather data.
v. Government should establish Feedback Mechanisms through Development of two-way communication systems between farmers and information providers.
vi. Policy and Institutional Support is required to improve coordination among agencies.

A study of this nature is not without limitations; First, the cross-sectional survey design limits the ability to determine cause-and-effect relationships between access to meteorological information and agricultural outcomes. Second, relying on farmers' self-reports may introduce response bias, such as recall errors or over- or underestimation of access to and use of meteorological data. Moreover, the study was limited to Kachia Local Government Area, which may restrict how well the findings apply to other regions with different socio-economic or climatic conditions. Lastly, resource and time constraints may have limited the depth of the field investigation and the inclusion of other relevant stakeholders, such as extension agents and policymakers. Despite these limitations, the study offers valuable insights into how meteorological information can support agricultural decision-making amid climate change.

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