

Evaluating Farmers' Access Channels to Weather Forecast Information for Climate Change Adaptation in Giwa Local Government Area of Kaduna State

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Doi: <https://doi.org/10.5281/zenodo.15025125>

Abstract

Climate change has emerged as a pressing global issue, posing significant threats to both natural ecosystems and human societies. Despite technological advances, weather and climate remain crucial variables in agricultural production, emphasizing the need for measures to mitigate climate change consequences through research and adaptation. Timely and accurate weather forecast information is a vital coping strategy for farmers, with the Nigeria Meteorological Agency (NIMET) being the leading body responsible for forecasting and disseminating weather information. This study adopted a descriptive survey research design. The study evaluated farmers' channels for accessing weather forecast information in Giwa LGA, Kaduna State, surveying 384 respondents aged 45+ who had lived in the area for at least 30 years. Results showed rainfall irregularity, increasing temperature, increased flooding, and decreasing crop yield as climate change effects, with 84% of respondents accessing weather forecast information via radio (77.5%), discussions with friends (58.6%), and international organizations/NGOs (47.3%). The study recommends improving farmers' access to weather forecast information through cellphone SMS, social media, and empowered extension services.

Key words: Climate change, Channels, Rainfall, Temperature and Weather forecast

INTRODUCTION

Climate change is a global phenomenon with far-reaching impacts, disproportionately affecting developing countries, particularly those in Africa, due to their limited economic capacity to cope. Since the late 19th Century, the global mean temperature has risen by 0.3°C to 0.6°C, with a further increase of 0.2°C to 0.3°C over the last 40 years (Climate Ark, 2007). The Intergovernmental Panel on Climate Change (IPCC, 2022) predicts that global average temperatures will rise by 1.4°C to 5.8°C by 2100. Additionally, the IPCC forecasts that tropical coastal areas will experience increased rainfall, while arid and semi-arid regions will receive less.

A favourable climate is crucial for the development of various sectors in developing countries, including agriculture, health, transport, and water resources. However, these sectors, particularly agriculture, are facing significant challenges due to unpredictable weather conditions, resulting in substantial production losses (Oyekale, 2015). Climate change has aggravated drought, irregular rainfall, flooding, temperature extremes,

and other disasters, hindering economic development (Jones et al. 2000).

IPCC (2014) defines climate change as a persistent alteration in the state of the climate, identified by changes in mean and/or variability, lasting for decades or longer. Climate change is caused by biogeographical/biophysical and human (anthropogenic) factors. Natural processes, such as changes in Earth's orbit, contribute to biogeographical factors, while human activities, including urbanization, population growth, industrial development, deforestation and fossil fuel use, drive anthropogenic factors (Odjugo, 2010).

According to Federal Ministry of Environment (FME 2003), Nigeria is already experiencing ecological problems related to climate change. The Nigerian Environmental Studies Team (NEST, 2004) reported significant impacts on agriculture, land use, biodiversity, health and water resources. Climate change affects agriculture through drought, environmental damage, pest infestations and disease outbreaks (Farauta et al. 2011). To manage these challenges, adaptation strategies are essential. Adaptation involves

adjusting to climate change, moderating potential damage, exploiting opportunities, or coping with consequences (IPCC, 2014).

Adaptation strategies for agriculture in Nigeria include providing accurate and timely weather forecasting, enhancing agricultural extension services and optimizing irrigation infrastructures (Adeshina and Adekunle, 2011). Since Nigerian agriculture is heavily climate-dependent, reliable weather forecasting enables farmers to plan for climate-related challenges. Weather forecasting applies science and technology to predict atmospheric conditions for specific locations and times. Agricultural weather forecasts involve computer-based modeling, providing data and products to farmers, agricultural consultants and industries (Awolala, 2018).

In Nigeria, climate and weather forecasting have evolved from traditional to modern scientific methods. The Nigerian Meteorological Agency (NIMET), in collaboration with agencies like the Nigerian Hydrological Services Agency (NIHSA), has improved forecasting technologies and models.

NIMET provides data on past, present and future atmospheric conditions, enabling farmers to access accurate and reliable scientific weather forecast information. This information includes predictions for rainy season start and end dates, season length, rainy days, cumulative rainfall and dry spell duration. When accessible, this information helps farmers plan for uncertainties during the growing season (Nigeria Climate Review Bulletin, 2016).

However, it is unclear whether farmers are accessing weather forecast information and through what channels. This study aims to evaluate farmers' channels for accessing weather forecast information to cope with climate change impacts in Giwa Local Government Area (LGA), Kaduna State.

MATERIALS AND METHODS

The Study Area

Giwa LGA is located between Latitudes $10^{\circ} 50' 00''$ N and $11^{\circ} 30' 00''$ N of the Equator and between Longitude $7^{\circ} 05' 00''$ E and $7^{\circ} 40' 00''$ E of the Greenwich meridian (Figure 1).

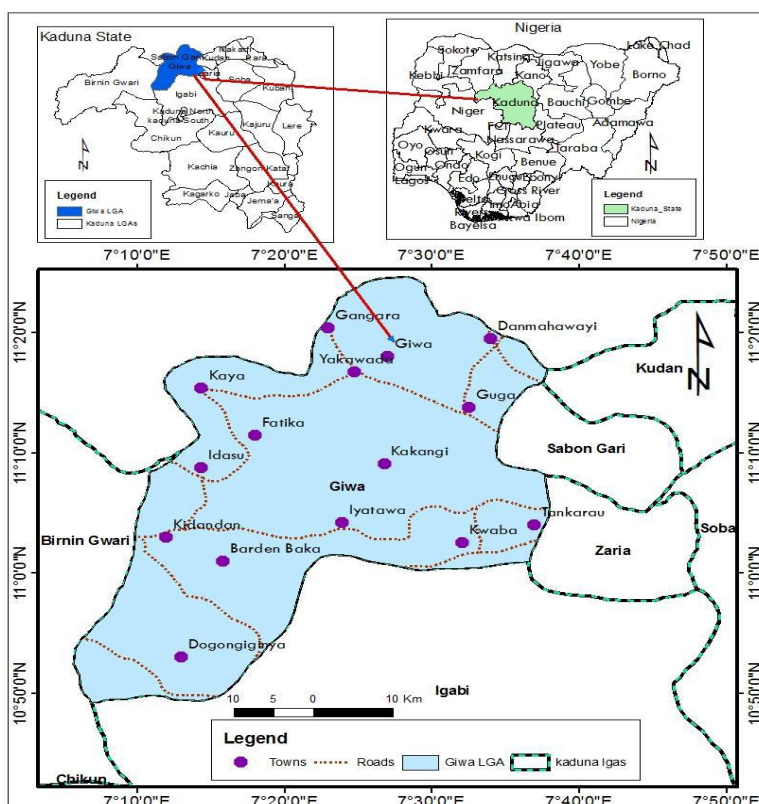


Figure 1: Study Area
Source: Google Earth (2024)

It is one of the 23 LGAs of Kaduna State, Northwestern Nigeria. The LGA is bordered in the North by Funtua and Malumfashi LGAs of Katsina State, Birnin Gwari to the West and Igabi LGA to the South of Kaduna State (Babajo et al. 2018).

The study area has a Tropical continental climate, classified as Aw according to Koppen's classification, characterized by a tropical wet and dry climate. The rainfall pattern is influenced by two air masses: Tropical Continental (cT) and Tropical Maritime (mT). The area receives a mean annual rainfall of approximately 1,100mm (Yakubu and Abbass, 2009). Temperature ranges from a maximum of 30°C to a minimum of 18-23°C. The

local economy is primarily driven by agriculture, with small-scale farmers engaging in crop production and Fulani herdsman practicing animal rearing (Yakubu and Abbass, 2009).

Methods

This study utilized a quantitative research approach, gathering primary data through structured questionnaires administered in the study area. A multistage sampling technique was employed. Specifically, the eleven wards of Giwa LGA were alphabetized and systematically sampled, with every second ward selected for inclusion (as presented in Table 1).

Table 1: Wards in Giwa LGA, Sampled Wards and Sample Size

Wards	Sampled Wards	Population (1991)	Projected 2024	Sample Size
Danmahawayi		12, 361		
Galadimawa	Galadimawa	8, 896	19, 785	36
Gangara		15, 576		
Giwa	Giwa	32, 388	72, 031	130
Idasu		4, 246		
Kadage	Kadage	14, 871	33, 073	60
Kakangi		12, 089		
Kidandan	Kidandan	11, 899	26, 463	48
Panhauya		18, 116		
Shika	Shika	27, 541	61, 251	110
Yakawada		13, 078		
Total		171, 061	212, 603	384

Source: Field Survey, 2024

In the second stage, a purposive sampling technique was employed to select farmers aged 45 and above, who had lived in the study area for at least 30 years and had substantial farming experience. This selection ensured that participants had experienced climatic changes over an extended period. The sample size was determined using the 1991 population census data, due to the limitations of the 2006 census data. The 1991 census reported a population of 171,061 for Giwa LGA (NPC, 1991). With an annual growth rate of 2.6% (World Population Review, 2024), the projected 2024 population was 380,439. Using Krejcie and Morgan's (1970) table, a sample size of 384 was determined for a population between 250,000 and 500,000. This study used 384 respondents as the sample size. The questionnaire administration was proportionate to each sampled ward's population, using Yamane's (1967) method:

$$Pr = \frac{n \times SS}{N}$$

Where: Pr = proportion of respondents;
n = population of each of the selected area
SS = Sample Size; and
N = total population of all the selected areas

A total of 375 completed questionnaires were retrieved out of 384 administered, yielding a response rate of 97.7%. The data were analyzed using descriptive statistics, including percentages and weighted mean, calculated using the following formula:

$$W = \frac{\sum_{i=1}^n w_i X_i}{\sum_{i=1}^n w_i}$$

Where: W = Weighted average
 n = Number of terms to be averaged
 w_i = Weight applied to x number
 x_i = Data values to be averaged

The result from the weighted average were interpreted using an average scale value of 3. Therefore, any mean value which is greater than or equal to 3 were considered accepted and rejected when otherwise.

RESULTS AND DISCUSSION

Socio-demographic Characteristics of the Respondents

Table 2 presents the socio-demographic and economic characteristics of the respondents. The results show that 65% of the respondents fall within the age range of 45-50 years, while 35% are 51 years and above. This age distribution indicates that the respondents are well advanced in age and are able to provide insightful views and experiences on climatic changes in their area and their access to weather forecast information.

Table 2: Socio-demographic Characteristics of the Respondents

Parameters	Options	Respondents (N=375)	Percentages
Age	45 – 50	243	65
	51 years and above	132	35
Gender	Male	286	76
	Female	89	24
Level of Education	SSCE/GII	72	19
	Degree/HND	68	18
	NCE/Diploma	48	13
	No formal Education	187	50
Other occupation	Civil Servant	76	20
	Artisanship	128	34
	Businessman/woman	152	41
	Housewife	19	5

Source: Field Survey, 2024

Table 2 further revealed the socio-demographic and economic characteristics of the respondents. The results indicate that 76% of the respondents are males, while 24% are females. The findings indicate that farming in the study area is predominantly a male occupation, likely attributed to the physically demanding nature of the work. The finding contrasts with Gollin's (2014) claim of a higher female representation in African agriculture. Regarding education, 50% of the respondents had no formal education, 19% had secondary education and 18% held a National Certificate in Education or Diploma as their highest qualification. Despite this, a significant number of respondents had adequate education to access weather forecast information from various channels. Higher education exposure is likely an advantage for farmers in accessing relevant information about farming operations, as supported by Esiobu *et al.* (2014).

In addition to farming, respondents engaged in other occupations, including business activities (41%), artisanship (34%) and civil service (20%). The findings indicate that respondents exhibit a high degree of economic diversification, with multiple income streams and opportunities for knowledge sharing on climate change adaptation strategies. Specifically, this diversity facilitates access to critical weather information, enabling farmers to make informed decisions about their agricultural operations and adapt to the challenges posed by climate change.

Effects of Climate Change on Agriculture

Climate change has profound impacts on farming operations, particularly in Giwa LGA, situated in the semi-arid region of Northern Nigeria. Table 4.2 presents the results of the perceived effects of climate change on agriculture in the study area.

Table 4.2: Perceived Effects of Climate Change on Agriculture in the Study Area

Climate Change Indices	SA (%)	A (%)	I (%)	D (%)	SD (%)	Mean
There is irregularity in rainfall	36	16	12	16	20	3.32
Temperature is increasing	31	33	8	12	16	3.51
Rainfall hardly support crop	25	33	6	20	16	3.31
Floods are increasing	20	34	17	16	13	3.32
There is increased drought	19	10	16	17	38	2.55
Climate affects animals health	19	41	13	17	10	3.52
Crop yield is decreasing	19	40	15	16	10	3.52
There is increased migration	17	40	16	16	11	3.73

***Average Mean = 3.0**

Source: Field Survey, 2024

Climate change is significantly impacting farming operations in Giwa LGA, Nigeria, with 52% of respondents noting that rainfall is becoming increasingly irregular, making agricultural planning challenging and 64% agreeing that temperatures are rising. The mean scores of 3.32 and 3.51, respectively, confirm that irregular rainfall distribution and increasing temperatures are major effects of climate change in the area. Furthermore, 58% of respondents stated that rainfall is insufficient to support crop production, highlighting the challenges faced by farmers in the region, where farming is mostly rain-fed. This is consistent with research indicating that climate change is affecting rainfall distribution and temperature patterns globally, with significant impacts on agriculture, particularly in tropical regions.

Table 2 reveals that 59% of respondents believe climate change has led to decreased crop yields in the study area, with 26% disagreeing. The mean score of 3.52 confirms that crop yields have declined due to climate change impacts. This decline is attributed to rising temperatures, erratic rainfall patterns, and potential droughts, resulting in reduced water availability for crops, affecting staples like

maize, millet, and sorghum. Climate change has also led to increased migration, with a mean value of 3.73. The frequent erratic rainfall has caused declining agricultural yields, water scarcity, and displacement of rural populations. This finding aligns with Lanshima *et al.* (2021), who reported that environmental factors such as desertification, drought, and water source depletion have contributed to mass migration from northern Nigeria.

Level of Farmers Access to Weather Forecast information

Access to weather forecast information is crucial for farmers in planning their farm operations, particularly in the face of climate change impacts in the study area. According to Ikpe (2021), a significant proportion of farmers in Sokoto State (70%) demonstrate a high level of awareness regarding the occurrence and impacts of climate change adaptation, underscoring the widespread recognition of this critical issue among agricultural stakeholders in the region. Figure 2 illustrates the level of access to weather forecast information among farmers.

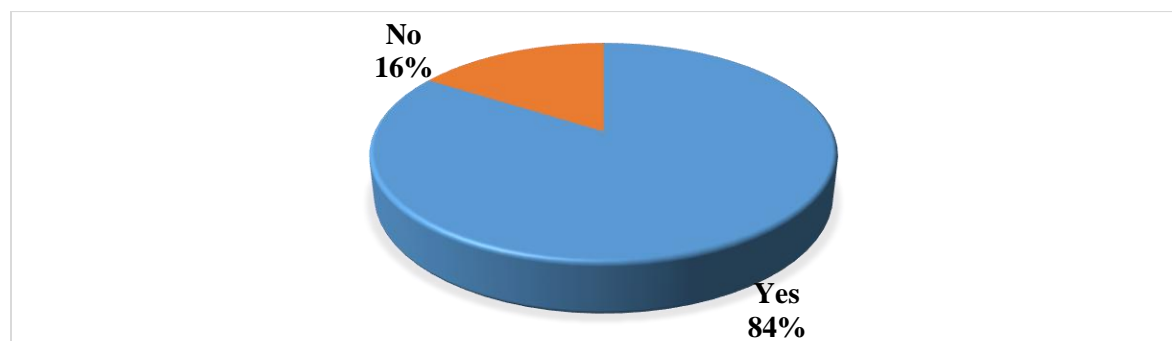


Figure 2: Access to Weather Forecast Information in the Study Area

Source: Field Survey, 2024

Notably, a significant majority (84%) of respondents reported having access to weather forecast information, whereas only 16% indicated that they lacked access to it. The results from Figure 2 reveal that farmers in the study area have access to weather forecast information, primarily sourced from the Nigerian Meteorological Services Agency (NIHSA) and the Nigerian Meteorological Agency (NIMET). Farmers receive various types of weather-related information, including onset and cessation dates of the rainy season, growing season dates, rainfall and temperature predictions, recommended crops, and warnings for floods, excessive rainfall, drought, and other weather-related events, enabling them to make informed decisions about their agricultural activities.

Farmers' Channels of Accessing Weather Forecast Information

Farmers can access valuable information on climate change coping strategies through various channels. Table 3 presents the results of the respondents' channels of accessing weather forecast information. Notably, the majority (48.5%) of respondents disagreed that agribusiness centres serve as a channel for accessing weather forecast information, while 24.2% agreed. Agribusiness centres, which facilitate the sales and marketing of agricultural products, typically communicate new agricultural breakthroughs to farmers during transactions. However, farmers in the study area reported limited access to information from these centres.

Table 3: Farmers' Channels of Accessing Weather Forecast Information.

	Channels	SA (%)	A (%)	I (%)	D (%)	SD(%)	Mean
1	Agribusiness	5.2	19	27.3	32	16.5	2.59
2	Cell phone SMS	4.8	16.5	16.4	33.1	29.2	2.64
3	Discussions with Friends	31.6	24.9	10.5	17.7	15.3	3.79
4	Farmers' Associations	5.1	15.9	13.7	35.6	29.7	2.69
5	Government extension services	7.9	31	14.2	25.8	21	3.0
6	Newspapers	2.6	15.7	15.9	26.5	39.4	2.5
7	Radio	36.6	40.9	11.6	8.5	2.6	3.89
8	Television	11.6	24.1	15.9	25.9	22.6	2.93
9	International organizations and NGOs	25.3	22	16.5	13.2	23	3.16
10	Research Institutions	25	24.3	11.8	19.3	19.6	3.31

***Average Mean = 3.0**

Source : Field Survey, 2024

Table 3 indicates that farmers' associations are not a primary channel for disseminating weather forecast information, with only 21% agreeing and 65.3% disagreeing. This is surprising, given the supportive roles of organizations like the Maize Farmers Association of Nigeria (MAAN) and Rice Farmers Association of Nigeria (RIFAN) in the area. Additionally, the table shows that government extension services are not a significant channel for accessing weather forecast information, with 38.9% agreeing and 46.8% disagreeing. This finding contradicts Cherotich et al.'s (2012) study in Semi-Arid Kenya, where extension services were found to be the second-most important channel for accessing climate information, after radio.

Table 3 reveals that farmers in the study area rarely access weather forecast information through

newspapers, with only 18.3% agreeing and 65.9% disagreeing. This finding is consistent with Feleke's (2015) study in Ethiopia, where newspapers were not a primary channel for accessing weather information. The limited access to newspapers in rural areas and low literacy levels among farmers, who may struggle to read and understand English-language content, are contributing factors.

In contrast, radio emerges as the primary channel for disseminating weather information, with 77.5% of respondents agreeing and 11.1% disagreeing. Radio's widespread availability, affordability, and ease of use make it an ideal platform for reaching rural farmers, as noted by Adjin-Tettey (2013). The World Meteorological Organization (WMO), Food and Agriculture Organization (FAO), and Technical Centre for

Agricultural and Rural Cooperation (CTA) have also recognized radio's importance in transmitting advice to rural farmers since 1992, as reported by Weiss et al. (2000).

Table 3 reveals that television is not a primary channel for disseminating weather forecast information in the study area, with 35.7% agreeing and 48.5% disagreeing. This finding contradicts Kolawole et al.'s (2018) study in Botswana, where television was considered a major channel for accessing scientific weather early warnings.

In contrast, International Organizations and NGOs play a significant role in disseminating weather forecast information to farmers, with 47.3% agreeing and 33.2% disagreeing. Organizations like the Sasakawa Africa Association and Fadama programmes have been providing guidance on new farming techniques and utilizing weather information to inform decision-making and mitigate climate change impacts.

The mean scores range from 2.5 to 3.89, with an average of 3.0. This suggests that, overall, the respondents have a moderately positive perception of the various sources of information.

High-scoring sources:

Three sources stand out with high mean scores:

- i. **Radio (3.89):** Radio emerges as the most trusted source of information, with a mean score significantly higher than the average. This suggests that radio is an effective medium for disseminating information to the target audience.
- ii. **Discussions with Friends (3.79):** Informal discussions with friends also score high, indicating that word-of-mouth and social networks play a crucial role in shaping opinions and disseminating information.
- iii. **Research Institutions (3.31):** Research institutions score higher than the average, suggesting that they are perceived as credible sources of information.

Medium-scoring sources:

Four sources have mean scores close to the average:

- i. **Government extension services (3.0):** Government extension services score exactly at the average, indicating a neutral perception.
- ii. **Television (2.93):** Television scores slightly below the average, suggesting that

it is not perceived as a highly credible source.

- iii. **International organizations and NGOs (3.16):** International organizations and NGOs score slightly above the average, indicating a moderately positive perception.
- iv. **Farmers' Associations (2.69):** Farmers' associations score slightly below the average, suggesting that they may not be perceived as highly effective sources of information.

Low-scoring sources:

Three sources have mean scores significantly below the average:

- i. **Newspapers (2.5):** Newspapers score the lowest, indicating that they are not perceived as a credible or effective source of information.
- ii. **Agribusiness (2.59):** Agribusiness scores slightly higher than newspapers but still below the average, suggesting that it may not be perceived as a trustworthy source.
- iii. **Cell phone SMS (2.64):** Cell phone SMS scores slightly higher than agribusiness but still below the average, indicating that it may not be perceived as an effective source of information.

Implications:

These findings have implications for information dissemination strategies:

- i. **Radio and discussions with friends:** These sources are highly trusted and should be leveraged for information dissemination.
- ii. **Research institutions:** Collaborating with research institutions can enhance the credibility of information.
- iii. **Government extension services:** Improving the effectiveness of government extension services can help increase their perceived credibility.
- iv. **Newspapers and cell phone SMS:** Alternative strategies may be needed to effectively disseminate information through these channels.

By understanding the perceived credibility of various sources, information dissemination strategies can be tailored to effectively reach and engage the target audience.

CONCLUSION

Based on the findings, it is evident that climate change is impacting agricultural production in the study area, manifesting as rainfall irregularity, rising temperatures, reduced crop yields, increased flooding, and human migration, among other effects. To mitigate these impacts, farmers rely on weather forecast information, primarily accessed through radio, discussions with friends, International Organizations, NGOs, and Research Institutions.

However, notable gaps exist in the utilization of modern channels such as agribusiness, mobile phones, newspapers, and television for disseminating weather forecast information. To address the effects of climate change, the following measures are recommended:

1. Farmers should adopt adaptation measures, including: modern irrigation systems, eco-friendly insecticides, cover cropping, hybrid crop adoption and tree planting for shade and windbreaks;
2. Government initiatives: implement climate change policies, promote afforestation, enforce controlled grazing, establish more forest reserves and construct dams for improved water storage;
3. Enhance farmers' access to weather forecast information through: cellphone SMS services, social media platforms, empowered extension services

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