



## **Developing a Weather-Related Climate Vulnerability Index for Residents of Jimeta, Nigeria**

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### **Abstract**

Climate variability presents growing environmental and public health concerns in rapidly developing urban areas, particularly where residents have limited capacity to respond to weather-related hazards. This study developed a Weather-Related Climate Vulnerability Index (CVI) for residents of Jimeta, Adamawa State, Nigeria. The study examined changes in selected meteorological variables and assessed residents' exposure, sensitivity and adaptive capacity to weather-related risks. An integrated geospatial, statistical and vulnerability-assessment approach was adopted. Secondary data comprising Land Surface Temperature (LST), rainfall, solar radiation, relative humidity and wind speed were obtained for 1994, 2004, 2014 and 2024. Landsat satellite imagery was obtained from the United States Geological Survey (USGS) EarthExplorer platform, rainfall data were obtained from the Center for Hydrometeorology and Remote Sensing (CHRS) Data Portal, while ground-based meteorological records were obtained from the Upper Benue River Basin Development Authority. Primary data were collected using a structured questionnaire. Based on a projected 2024 population of 320,239, a sample size of 384 was determined, of which 380 questionnaires were successfully retrieved and analysed. Descriptive statistics, trend analysis, Geographic Information System (GIS) techniques and a standardised CVI based on exposure, sensitivity and adaptive capacity were employed. The results showed that LST increased from 21.3°C in 1994 to 30.0°C in 2024, while rainfall fluctuated, relative humidity declined, solar radiation remained relatively stable and wind speed showed minor changes. The CVI results produced high exposure (0.78), moderate-high sensitivity (0.66) and low adaptive capacity (0.28), resulting in an overall CVI of **0.72**, which indicates high vulnerability. The study recommends strengthening early-warning systems, improving flood management, promoting urban greening, integrating climate risks into urban planning, and enhancing institutional and community adaptive capacity in Jimeta.

*Keywords: Climate Vulnerability Index (CVI), Climate Variability, Meteorological Variables, Weather-Related Health Risks, Jimeta*

### **Introduction**

Climate is expressed through the long-term behaviour and variability of atmospheric conditions such as temperature, rainfall, humidity and wind, and these conditions directly influence the

environmental and socioeconomic conditions within which people live. Changes in these weather conditions can affect human health, water availability, livelihoods, housing conditions and the functioning of urban areas. Recent research increasingly shows that the consequences of climate change are not determined by climatic hazards alone; they also depend on the characteristics of the people and places exposed to those hazards, including their socioeconomic conditions, sensitivity and ability to adapt (Nwankwo et al., 2022; Garba et al., 2022). In this sense, climate vulnerability is spatially and socially differentiated, meaning that people living within the same urban area may experience the same weather conditions but face different levels of risk because of differences in income, occupation, housing, access to services and other forms of adaptive capacity.

Nigeria is particularly relevant to this discussion because climatic variability interacts with rapid urbanisation and existing socioeconomic and environmental challenges. Nwankwo et al. (2022), in their assessment of the relationship between urbanisation and climate-change vulnerability in Nigeria, found that vulnerability varies spatially and is influenced by the characteristics of urban areas. Similarly, Garba et al. (2022) demonstrated that climate vulnerability in Nigerian communities is shaped by the combined effects of exposure, sensitivity and adaptive capacity. These studies indicate that vulnerability assessment should move beyond describing changes in temperature or rainfall and should consider how climatic conditions interact with the social and economic characteristics of exposed populations.

The health implications of changing weather conditions are particularly important in urban environments. Obe et al. (2024), for example, demonstrated the importance of local meteorological conditions in assessing heat stress in Lagos, where rapid urbanisation and high population density contribute to elevated heat-related risks. Similarly, Akinnubi et al. (2024) found a relationship between surface-temperature anomalies and health conditions among populations within the River Niger Basin region, highlighting the importance of temperature-related exposure for human health in West Africa. Evidence from Nigerian urban communities

also indicates that climate-related hazards such as excessive heat, flooding and air pollution can interact with inadequate infrastructure and limited access to services to increase health risks among vulnerable residents.

These concerns are relevant to Jimeta, one of the major urban centres in Adamawa State. The city has experienced substantial urban development and increasing pressure on its environmental resources, while its residents are exposed to weather conditions that vary across seasons and over time. Changes in temperature, rainfall, humidity, solar radiation and wind conditions can have different consequences for residents depending on their location, socioeconomic circumstances, occupation and ability to respond to environmental stresses. However, examining individual meteorological variables separately does not adequately explain the degree to which residents are vulnerable. A household or neighbourhood experiencing high temperature, for example, may not necessarily have the same level of vulnerability as another experiencing similar conditions if the two differ in housing quality, income, access to water, health services, information or other adaptive resources. This reinforces the need for an integrated assessment that combines climatic exposure with the social characteristics that influence sensitivity and adaptive capacity.

Recent vulnerability research in Nigeria supports this integrated approach. Studies have applied composite indices to combine exposure, sensitivity and adaptive-capacity indicators in order to identify differences in vulnerability between locations and population groups (Garba et al., 2022; Nwankwo et al., 2022). The approach has also been applied to climate-related vulnerability assessment using spatial and socioeconomic indicators, demonstrating the usefulness of composite indices for identifying areas and populations requiring greater adaptation attention. More recent work has further shown that climate vulnerability can be strongly differentiated by socioeconomic characteristics and access to resources, reinforcing the importance of developing context-specific rather than purely climate-based assessments.

Against this background, this study develops a Weather-Related Climate Vulnerability Index for residents of Jimeta, Adamawa State, Nigeria. The study examines the spatio-temporal variability

of temperature, solar radiation, rainfall, humidity and wind speed over the 1994–2024 period; assesses residents' vulnerability to weather-related health and environmental risks; and integrates relevant indicators of exposure, sensitivity and adaptive capacity into a composite Climate Vulnerability Index. By combining meteorological evidence with the characteristics of the population exposed to these conditions, the study seeks to identify differences in vulnerability across Jimeta and provide evidence that can support targeted climate adaptation, urban resilience, public-health planning and disaster-risk reduction. The approach is particularly important for a rapidly developing urban area such as Jimeta, where understanding who is vulnerable, where vulnerability is concentrated, and which factors contribute to that vulnerability is more useful for planning than simply documenting changes in climate variables.

### **The Study Area**

Jimeta, as presented in Figure 1, is an urban centre in Adamawa State, northeastern Nigeria, and the administrative headquarters of Yola North Local Government Area. It forms part of the Yola–Jimeta urban area and serves as an important commercial, administrative and transportation centre. The town is located along the River Benue and covers approximately 231.64 km<sup>2</sup>. Its urban landscape has experienced changes in built-up development and vegetation cover, which have influenced local environmental and thermal conditions.

Recent studies provide evidence of changing thermal conditions in Jimeta. Birma and Ezra (2020) examined the relationship between vegetation cover, built-up areas and land surface temperature (LST) in Jimeta, while Salihu (2024) assessed the spatial and temporal variation of LST across Jimeta wards from 1999 to 2021. More recently, Salihu and Dama (2026) examined the relationship between LST and urban-planning indicators in Jimeta using data from 2015 to 2025. These studies demonstrate the importance of urban development and land-cover characteristics in understanding thermal conditions in the town.

Jimeta experiences distinct wet and dry seasons, with variations in rainfall, temperature, humidity, solar radiation and wind conditions between the seasons. The present study examines

these meteorological variables using observations for 1994, 2004, 2014 and 2024, providing a basis for assessing their long-term variability. The area's climatic conditions are also associated with environmental challenges, including flooding and erosion, which have been reported among the environmental concerns affecting residents of Jimeta.

The combination of changing thermal conditions, rainfall variability and environmental pressures makes Jimeta suitable for assessing weather-related climate vulnerability. The study therefore examines how these meteorological conditions interact with residents' exposure, sensitivity and adaptive capacity in developing a Climate Vulnerability Index for the town.

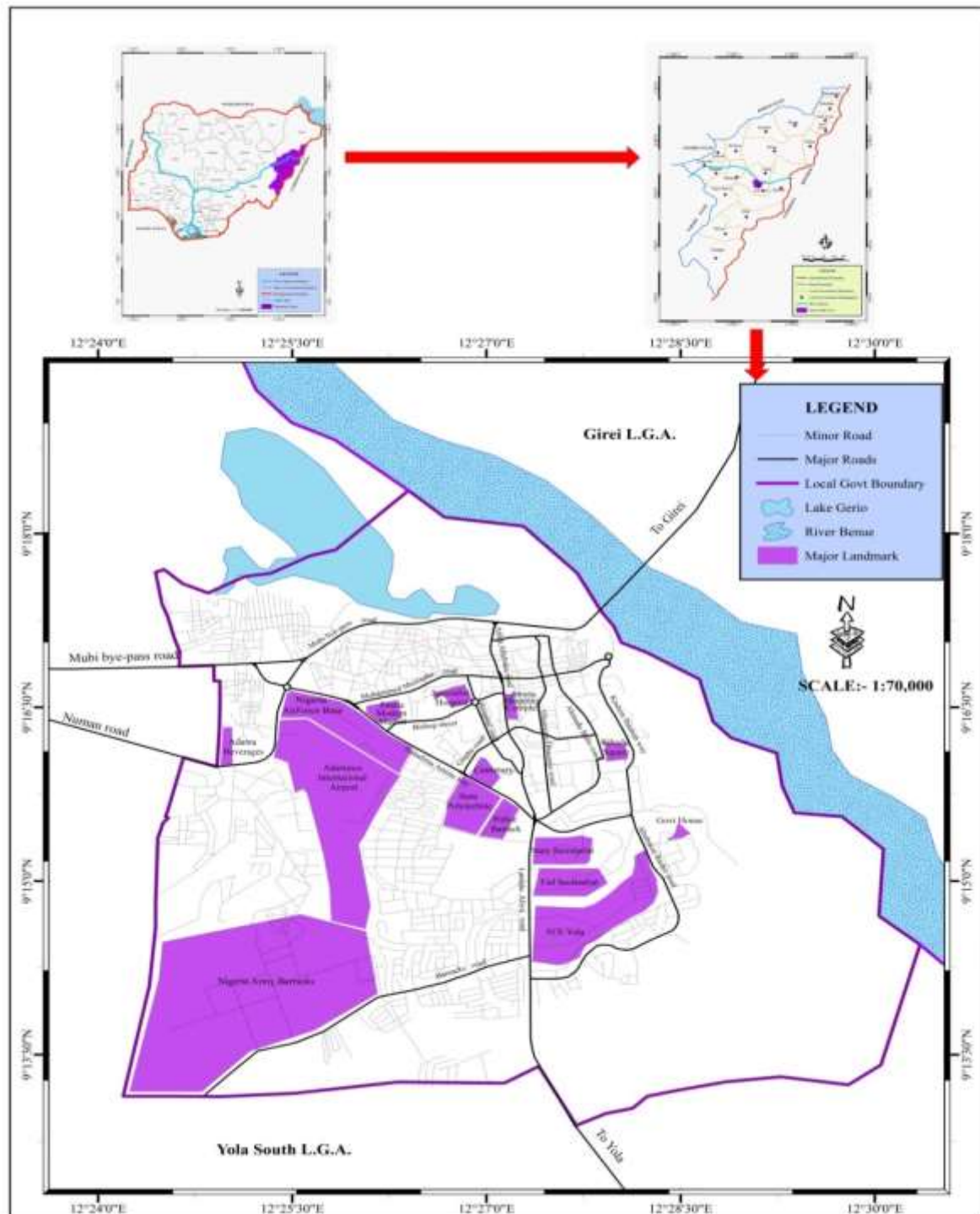


Figure 1: Locational Map of Jimeta, Adamawa State

Source: Modified from ArcMap 10.8, 2026

## Research Design and Methods

This study adopted an integrated geospatial, statistical and vulnerability-assessment approach to examine the spatio-temporal variability of selected weather variables and develop a Weather-

Related Climate Vulnerability Index (CVI) for residents of Jimeta, Adamawa State, Nigeria. The study combined satellite-derived data, rainfall records, ground-based meteorological observations, Geographic Information System (GIS) techniques and household survey data. The climatic component of the study examined temperature, rainfall, wind speed, solar radiation and relative humidity at four decadal observation periods: 1994, 2004, 2014 and 2024. The selection of these years provided a consistent 30-year period for examining changes in weather conditions in Jimeta. The vulnerability component involved the collection of primary data from residents to assess indicators of exposure, sensitivity and adaptive capacity to weather-related hazards. The results from the climatic and socioeconomic components were subsequently integrated to develop the Climate Vulnerability Index.

Both primary and secondary data were used in the study. Rainfall data were obtained from the Center for Hydrometeorology and Remote Sensing (CHRS) Data Portal, while satellite imagery from the Landsat TM, ETM+, OLI and TIRS sensors was obtained through the United States Geological Survey (USGS) EarthExplorer platform. Landsat imagery was used to derive Land Surface Temperature (LST) for the selected years. Ground-based meteorological records comprising wind speed, solar radiation and relative humidity were obtained from the Upper Benue River Basin Development Authority (UBRBDA), Yola. These datasets provided the basis for examining the spatial and temporal characteristics of the selected weather variables in Jimeta. Primary data were collected using a structured questionnaire administered to residents of Jimeta. The questionnaire obtained information required to assess the three principal dimensions of vulnerability: exposure, sensitivity and adaptive capacity. The exposure component considered residents' experience of weather-related conditions and hazards, while sensitivity indicators captured characteristics that may increase the effects of such hazards on residents. Adaptive-capacity indicators assessed residents' ability to anticipate, cope with and respond to weather-related risks. The questionnaire responses were subsequently coded and analysed to generate the socioeconomic component of the Climate Vulnerability Index.

The study population was based on the population of Jimeta. The 2006 population of Jimeta was 198,247 persons (NPC, 2006). Using the adopted annual population growth rate of 2.7%, the population was projected to 320,239 persons in 2024. The projected 2024 population constituted the population used for determining the required questionnaire sample. The sample size was determined using the Cochran sample size formula, which produced a minimum sample size of 384 respondents. A total of 384 questionnaires were therefore administered, of which 380 were successfully retrieved and considered valid for analysis, representing a retrieval rate of 98.96%.

The questionnaire was administered to residents within the study area using a simple random sampling technique. Residents were selected from the residential areas of Jimeta, with each eligible respondent having an opportunity to be selected for participation in the survey. The use of simple random sampling was intended to reduce selection bias and provide representation of residents across the study area. The retrieved questionnaires were screened, coded and analysed using appropriate statistical techniques before being incorporated into the vulnerability assessment.

The study therefore integrates the results of the 1994, 2004, 2014 and 2024 climatic analyses with information obtained from the 380 valid questionnaire responses. This integrated approach enables the study to assess changes in weather conditions over the 30-year period and examine how differences in exposure, sensitivity and adaptive capacity influence the vulnerability of Jimeta residents to weather-related risks.

The specific data requirements, sources, data types, temporal coverage, and applications are presented in Table 1.

Landsat images were pre-processed through radiometric calibration, atmospheric correction, and image enhancement before extracting Land Surface Temperature using established thermal retrieval algorithms. Spatial analysis was performed in a GIS environment to map and visualize the distribution and variability of temperature and other meteorological variables across the study area. Temporal analysis involved comparing datasets across the selected years (1994, 2004, 2014,

and 2024) to identify long-term trends, spatial patterns, and anomalies in the meteorological variables

**Table 1: Data Requirement and Sources**

| <b>Data Required</b>             | <b>Data Source</b>         | <b>Purpose / Application</b>                                |
|----------------------------------|----------------------------|-------------------------------------------------------------|
| Rainfall                         | CHRS data portal           | To analyse rainfall variability                             |
| Temperature (LST)                | USGS earthexplorer website | To assess spatio-temporal temperature patterns              |
| Wind Speed                       | UBRBDA                     | To analyse wind variability                                 |
| Solar Radiation                  | UBRBDA                     | To analyse solar radiation intensity                        |
| Relative Humidity                | UBRBDA                     | To assess humidity variations                               |
| Climate Vulnerability Indicators | Household Respondents      | To develop the Climate Vulnerability Index (CVI) for Jimeta |

Source: Researcher (2026).

To determine the level of weather-related vulnerability among residents, a Climate Vulnerability Index (CVI) was developed using the Intergovernmental Panel on Climate Change (IPCC) vulnerability framework, which conceptualizes vulnerability as a function of exposure, sensitivity, and adaptive capacity. Exposure indicators comprised meteorological conditions such as temperature, rainfall variability, solar radiation, humidity, and wind speed. Sensitivity indicators included socio-demographic and environmental characteristics that influence susceptibility to climate-related impacts, while adaptive capacity indicators measured the ability of households to prepare for, cope with, and recover from weather-related hazards through factors such as education, income, access to healthcare, access to weather information, housing quality, and social support.

Each indicator was standardized and converted into a vulnerability score on a conceptual scale ranging from 0 to 1, where higher values represented greater vulnerability. Indicators

representing adaptive capacity were inversely transformed so that higher adaptive capacity corresponded to lower vulnerability. Composite scores were then calculated for the three major components (Exposure, Sensitivity, and Adaptive Capacity), after which the overall Climate Vulnerability Index for each respondent was computed using the following equation:

$$CVI = \frac{Exposure + Sensitivity + (1 - Adaptive\ Capacity)}{3}$$

The resulting Climate Vulnerability Index (CVI) values ranged from 0 to 1, where values closer to 0 represented lower vulnerability and values closer to 1 represented higher vulnerability. The computed CVI values were subsequently classified into low, moderate and high vulnerability categories to facilitate interpretation of differences in vulnerability among residents and locations within Jimeta. The classification provided a basis for identifying areas and population groups requiring greater attention in climate adaptation, urban resilience and risk-reduction planning.

Descriptive statistics, particularly frequencies and percentages, were used to summarise the demographic and socioeconomic characteristics of respondents and their responses to the vulnerability indicators. Trend analysis was used to examine the temporal changes in the selected meteorological variables for 1994, 2004, 2014 and 2024. The CVI scores were computed from the selected exposure, sensitivity and adaptive-capacity indicators and were analysed according to the adopted vulnerability classification. The results were presented using tables, charts, maps and narrative interpretation, as appropriate, to show the temporal variation in meteorological conditions and the spatial and socioeconomic differences in climate vulnerability among residents of Jimeta.

## **Results and Discussion**

### **Meteorological Variables**

Table 2 presents the average values of the major meteorological variables in Jimeta for 1994, 2004, 2014 and 2024. The results indicate that the variables changed differently over the 30-year period. Land Surface Temperature (LST) recorded the most pronounced change, increasing from

21.3°C in 1994 to 30.0°C in 2024. This substantial increase indicates a shift towards warmer surface conditions in Jimeta. The finding agrees with Salihi (2024), who identified considerable spatial and temporal variations in LST across Jimeta wards between 1999 and 2021. Salihi and Dama (2026) also found a relationship between LST and urban-planning indicators in Jimeta, suggesting that changes in the urban environment are relevant to local thermal conditions.

Rainfall showed considerable variability, declining slightly from 1,673 mm in 1994 to 1,651 mm in 2004, increasing to 1,924 mm in 2014, and subsequently declining to 1,721 mm in 2024. Thus, the pattern represents fluctuation rather than a consistent increase or decrease. This agrees with Abubakar and Idi (2024), who reported variability in rainfall and temperature conditions across Adamawa State.

Table 2: Jimeta Climate data for 2004, 2014 and 2024

| <b>Meteorological Variables (Average)</b> |                 |                      |                                            |                     |                          |
|-------------------------------------------|-----------------|----------------------|--------------------------------------------|---------------------|--------------------------|
| <b>Year</b>                               | <b>LST (°C)</b> | <b>Rainfall (mm)</b> | <b>Solar radiation (KWh/m<sup>2</sup>)</b> | <b>Humidity (%)</b> | <b>Wind speed (Km/h)</b> |
| 1994                                      | 21.3            | 1673                 | 5.2                                        | 49                  | 5.8                      |
| 2004                                      | 25.7            | 1651                 | 5.4                                        | 47                  | 6.0                      |
| 2014                                      | 29              | 1924                 | 5.3                                        | 45                  | 6.2                      |
| 2024                                      | 30              | 1721                 | 5.4                                        | 41                  | 6.1                      |

Source: Field Survey, 2025

Solar radiation remained relatively stable, ranging between 5.2 and 5.4 kWh/m<sup>2</sup>, while relative humidity declined from 49% to 41%. The simultaneous increase in LST and reduction in humidity suggests increasingly dry and warm conditions during the selected observation periods. Wind speed exhibited only minor fluctuations, rising from 5.8 km/h in 1994 to 6.2 km/h in 2014 before declining to 6.1 km/h in 2024. These changes provide an important climatic basis for

assessing residents' exposure to weather-related risks and developing the Climate Vulnerability Index for Jimeta.

### **Climate Vulnerability Index Parameters**

#### **Perceptions of Climate Change**

Table 3 shows that 58.2% (221 respondents) perceived significant changes in climate conditions in Jimeta over the past 20–30 years, while 41.8% (159 respondents) did not perceive such changes. The majority perception is consistent with the meteorological results in Table 2, particularly the increase in Land Surface Temperature and decline in relative humidity between 1994 and 2024. The finding also corresponds with Salihu (2024), who reported substantial spatial and temporal variations in land surface temperature across Jimeta wards. This suggests that residents' perceptions are partly reflected in observed changes in local thermal conditions.

Regarding the sectors perceived to be most affected, health ranked highest (33.4%), followed by agriculture (27.1%), housing (17.4%) and water resources (14.7%). The prominence of health indicates that residents associate changing weather conditions strongly with their wellbeing. This is consistent with Obe et al. (2024), whose study of heat conditions in Lagos demonstrated the importance of local meteorological conditions to human heat exposure. The reported effects on agriculture and water resources are also relevant to the wider climatic conditions of Adamawa State, where Abubakar and Idi (2024) documented variability in rainfall and temperature. The results therefore indicate that climate change is perceived by many residents as a condition with implications extending beyond temperature to health, livelihoods, housing and water resources.

#### **Household Adaptive Strategies**

Table 4 presents the adaptation measures adopted by residents to reduce the effects of climate-related risks. The most commonly reported strategy was the use of mosquito nets and repellents (26.6%), followed by relocation during floods (22.4%), construction improvements (14.7%), and tree planting or gardening (8.7%). The prominence of mosquito protection suggests that residents

associate changing environmental conditions with increased exposure to mosquito-related risks, while relocation during floods reflects the importance of flooding as a perceived hazard in Jimeta. The use of construction improvements and tree planting also indicates attempts to modify the household environment to cope with weather-related conditions.

**Table 3: Perceptions of Climate Change**

| Question                                                                                                                                       | Response        | Frequency  | Percentage (%) |
|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------|----------------|
| Do you believe that climate conditions in Jimeta (temperature, rainfall, humidity, wind) have changed significantly over the last 20–30 years? | Yes             | 221        | 58.2           |
|                                                                                                                                                | No              | 159        | 41.8           |
|                                                                                                                                                | <b>Total</b>    | <b>380</b> | <b>100</b>     |
| In your opinion, which sector is most affected by climate changes in Jimeta?                                                                   | Health          | 127        | 33.4           |
|                                                                                                                                                | Agriculture     | 103        | 27.1           |
|                                                                                                                                                | Housing         | 66         | 17.4           |
|                                                                                                                                                | Water resources | 56         | 14.7           |
|                                                                                                                                                | Transport       | 15         | 3.9            |
|                                                                                                                                                | Others          | 13         | 3.4            |
|                                                                                                                                                | <b>Total</b>    | <b>380</b> | <b>100</b>     |

**Source: Field Survey, 2026**

However, 9.7% of respondents reported adopting no adaptation measure, indicating that a proportion of residents may have limited capacity or resources to respond to climate-related risks. The perceived effectiveness of the strategies further supports this concern. About 32.4% considered their measures slightly effective, 25.8% considered them not effective, while only 18.7% regarded them as very effective. This pattern suggests that adopting an adaptation measure does not necessarily mean that households consider themselves adequately protected. Garba et al. (2022) similarly demonstrated that socioeconomic conditions and adaptive capacity influence

differences in climate vulnerability among Nigerian communities. The findings therefore indicate that strengthening household adaptive capacity in Jimeta requires attention not only to the availability of coping strategies but also to their effectiveness and residents' ability to sustain them.

**Table 4: Household Adaptive Strategies**

| <b>Question</b>                                                                   | <b>Response</b>                                           | <b>Frequency</b> | <b>Percentage (%)</b> |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|------------------|-----------------------|
| What measures has your household adopted to reduce the impacts of climate change? | Use of mosquito nets / repellents                         | 101              | 26.6                  |
|                                                                                   | Relocating during floods                                  | 85               | 22.4                  |
|                                                                                   | Tree planting / gardening                                 | 33               | 8.7                   |
|                                                                                   | Construction improvements (raised floors, stronger roofs) | 56               | 14.7                  |
|                                                                                   | Use of water storage (tanks, wells)                       | 25               | 6.6                   |
|                                                                                   | None                                                      | 37               | 9.7                   |
|                                                                                   | Others                                                    | 43               | 11.3                  |
|                                                                                   | <b>Total</b>                                              | <b>380</b>       | <b>100</b>            |
| How effective do you consider these adaptation measures?                          | Not effective                                             | 98               | 25.8                  |
|                                                                                   | Slightly effective                                        | 123              | 32.4                  |
|                                                                                   | Moderately effective                                      | 88               | 23.2                  |
|                                                                                   | Very effective                                            | 71               | 18.7                  |
|                                                                                   | <b>Total</b>                                              | <b>380</b>       | <b>100</b>            |

**Source: Field Survey, 2026**

### Policy and Institutional Support

Table 5 shows that 74.2% (282 respondents) had not received any government or NGO support related to climate risk management, while only 25.8% (98 respondents) had benefited from such assistance.

**Table 5: Policy and Institutional Support**

| Question                                                                                               | Response                                 | Frequency  | Percentage (%) |
|--------------------------------------------------------------------------------------------------------|------------------------------------------|------------|----------------|
| Have you ever received any government or NGO support related to climate risk management                | Yes                                      | 98         | 25.8           |
|                                                                                                        | No                                       | 282        | 74.2           |
|                                                                                                        | <b>Total</b>                             | <b>380</b> | <b>100</b>     |
| Do you think government policies and planning in Jimeta adequately address climate-related challenges? | Strongly disagree                        | 97         | 25.5           |
|                                                                                                        | Disagree                                 | 146        | 38.4           |
|                                                                                                        | Neutral                                  | 42         | 11.1           |
|                                                                                                        | Agree                                    | 71         | 18.7           |
|                                                                                                        | Strongly agree                           | 24         | 6.3            |
|                                                                                                        | <b>Total</b>                             | <b>380</b> | <b>100</b>     |
| What policy action do you consider most urgent for reducing climate risks in Jimeta?                   | Flood control infrastructure             | 76         | 20.0           |
|                                                                                                        | Affordable healthcare support            | 61         | 16.1           |
|                                                                                                        | Tree planting / environmental management | 97         | 25.5           |
|                                                                                                        | Early warning systems                    | 71         | 18.7           |
|                                                                                                        | Climate education & awareness            | 52         | 13.7           |
|                                                                                                        | Others                                   | 23         | 6.1            |
|                                                                                                        | <b>Total</b>                             | <b>380</b> | <b>100</b>     |

**Source: Field Survey, 2026**

Furthermore, a majority of respondents believed that existing government policies inadequately address climate-related challenges, with 38.4% disagreeing and 25.5% strongly disagreeing, compared to 25.0% who agreed or strongly agreed. Regarding priority policy actions, tree planting and environmental management (25.5%) ranked highest, followed by flood control infrastructure (20.0%), early warning systems (18.7%), and affordable healthcare support (16.1%). These findings suggest limited institutional support and highlight the need for stronger climate-responsive policies in Jimeta. The results are consistent with the IPCC (2023), which emphasizes the importance of effective governance and ecosystem-based adaptation, and UNDRR (2022), which advocates investment in early warning systems and disaster risk reduction to strengthen community resilience.

### **Climate Vulnerability Index (CVI) for Jimeta (1994–2024)**

The CVI is derived using a standardized scoring approach:

- i. Each indicator is converted to a vulnerability score (0–1 scale conceptually)
- ii. Higher values = higher vulnerability (except adaptive capacity, which is inverted)
- iii. Final CVI = average of the three components:

$$CVI = \frac{Exposure + Sensitivity + (1 - Adaptive Capacity)}{3}$$

Component results based on my findings

- i. Exposure (High): Key findings:
  - i. 63.9% affected by flooding
  - ii. 58.2% experienced property damage
  - iii. Flooding (45%) and heat waves (37.9%) dominant hazards
  - iv. Widespread heat and rainfall extremes

Exposure is very high due to frequent flooding and heat events. Exposure Score (qualitative): 0.78 (High)

ii. Sensitivity (High–Moderate). Key findings:

1. 32.4% households experience climate-sensitive illnesses
2. 26.8% severe flood impacts
3. 25.0% severe effects of flooding
4. Significant heat-related illness (heat stress, malaria, dehydration)

Population is moderately to highly sensitive, especially to heat and flooding. Sensitivity Score: 0.66 (Moderate–High)

iii. Adaptive Capacity (Low). Key findings:

- i. 74.2% lack early warning systems
- ii. 52.9% lack financial recovery capacity
- iii. 59.2% weak community support
- iv. Only 25.8% access climate information
- v. 63.9% say policies are inadequate

Adaptive capacity is very low. Adaptive Capacity Score: 0.28 (Low)

iv. Final Climate Vulnerability Index (CVI)

$$CVI = \frac{0.78 + 0.66 + (1 - 0.28)}{3}$$

$$CVI = \frac{0.78 + 0.66 + 0.72}{3}$$

$$CVI = \frac{2.16}{3}$$

$$CVI = 0.72$$

Where:

0.00–0.39 = Low vulnerability

0.40–0.59 = Moderate vulnerability

0.60–0.79 = High vulnerability

0.80–1.00 = Very high vulnerability

Jimeta exhibits a High Climate Vulnerability (0.72). This is driven primarily by: Rapid urban expansion and heat intensification, High exposure to flooding and heat waves, Weak adaptive capacity (major limiting factor)

Sensitivity is also elevated due to widespread health impacts such as: Heat stress, Malaria, Respiratory illnesses, Water-borne diseases

The most important result is not just the final score, but the imbalance: Exposure = High (0.78), Sensitivity = Moderate–High (0.66), Adaptive Capacity = Very Low (0.28)

This shows that vulnerability in Jimeta is not only climate-driven but structurally driven, mainly due to: Weak early warning systems, Poor institutional support, Limited household resilience

### **Conclusion and Recommendations**

This study examined changes in selected meteorological conditions, assessed residents' vulnerability to weather-related risks, and developed a Climate Vulnerability Index (CVI) for Jimeta. The findings show that the climatic conditions of the town have changed between 1994 and 2024. Land Surface Temperature increased considerably, while relative humidity declined. Rainfall fluctuated across the study periods, whereas solar radiation and wind speed showed relatively small changes. These patterns indicate that residents of Jimeta are experiencing a changing weather environment, although the variables do not all follow the same trend.

The household survey further showed that flooding and heat waves were the major hazards experienced by residents. Respondents associated these hazards with problems including property damage, heat stress, malaria, respiratory illnesses, dehydration and water-related diseases. Although residents have adopted different coping measures, including mosquito

protection, relocation during floods, construction improvements and tree planting, many considered these measures only slightly effective or ineffective.

The vulnerability assessment produced an exposure score of 0.78, sensitivity score of 0.66 and adaptive-capacity score of 0.28. The resulting CVI of 0.72 places Jimeta within the high-vulnerability category. This result shows that vulnerability in Jimeta is not simply a consequence of changing weather conditions. It is also shaped by residents' limited capacity to prepare for, cope with and recover from weather-related hazards. Weak institutional support, inadequate early-warning arrangements, limited access to climate information, financial constraints and insufficient community support further increase residents' vulnerability.

The study therefore concludes that reducing weather-related climate vulnerability in Jimeta requires more than responding to individual hazards after they occur. Greater attention needs to be given to strengthening residents' adaptive capacity while simultaneously reducing exposure and sensitivity through better urban planning, public-health preparedness, reliable climate information and community-based adaptation.

The followings were recommended:

1. Strengthen climate-related public health preparedness. Health authorities should improve surveillance and public awareness relating to heat stress, malaria, respiratory conditions, dehydration and water-related diseases, with particular attention to residents who are more exposed to weather-related risks.
2. Improve household adaptive capacity. Government and relevant development partners should support vulnerable households through affordable healthcare, climate-resilient livelihood opportunities, appropriate financial assistance and accessible risk-protection mechanisms.
3. Integrate climate risk into urban planning. Climate considerations should be incorporated into land-use planning, drainage provision, housing development, infrastructure design

and environmental management in Jimeta, particularly in areas exposed to flooding and excessive heat.

4. Improve early warning and climate information. Accessible and timely information on extreme heat, heavy rainfall, flooding and other weather-related hazards should be provided through channels that residents can easily understand and use. Early warnings should be linked to clear community-level response measures.
5. Strengthen community-based adaptation. Residents should be actively involved in identifying local hazards, planning adaptation measures and monitoring environmental conditions. Community education, tree planting, neighbourhood environmental management and collective flood preparedness can help strengthen local capacity to respond to weather-related risks.
6. Support continued vulnerability monitoring. Future studies should incorporate additional socioeconomic, environmental and geospatial indicators and periodically update the CVI. This would help determine whether adaptation interventions are reducing vulnerability and identify emerging areas of concern in Jimeta and other rapidly growing urban centres.

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