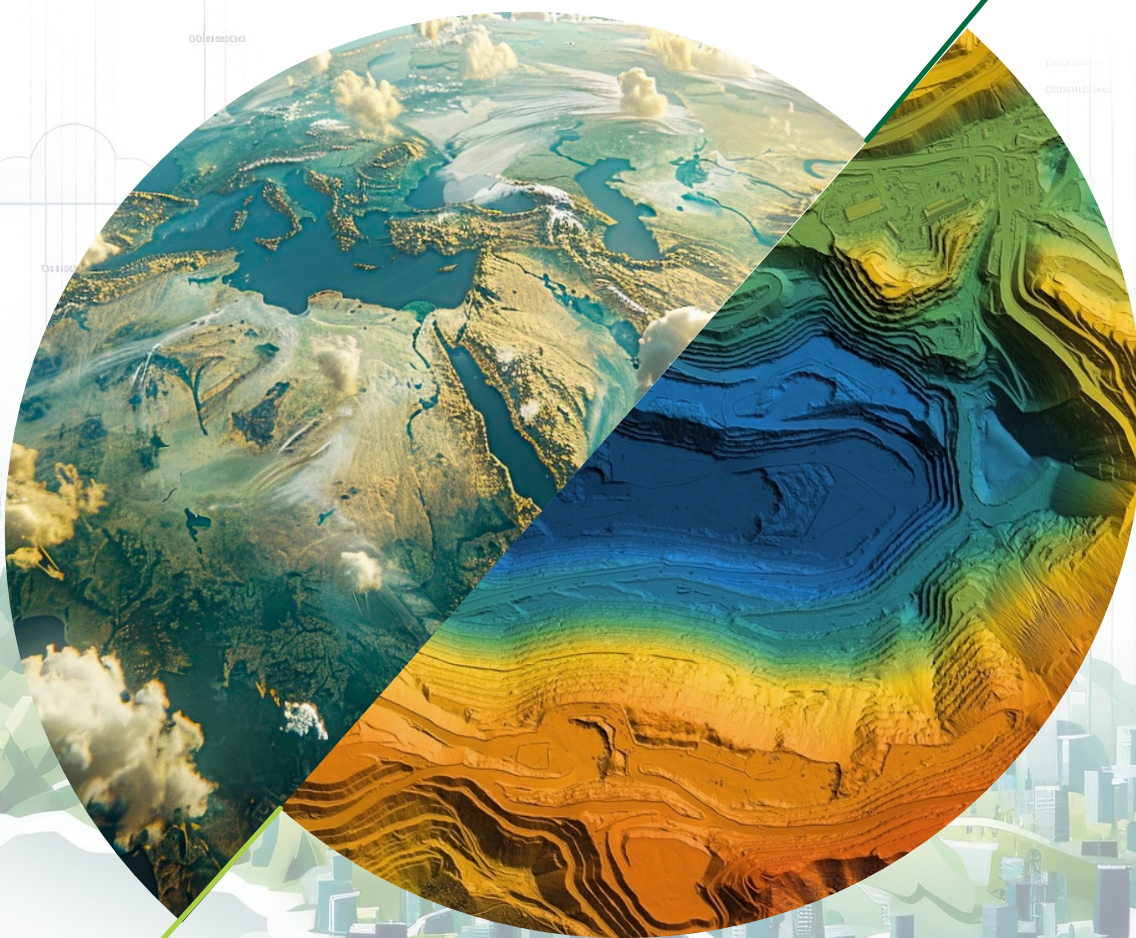


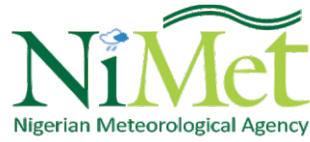
# GIS/REMOTE SENSING QUARTERLY EVALUATION BULLETIN

A PUBLICATION OF THE NIGERIAN METEOROLOGICAL AGENCY

Dec 2023 – Feb 2024



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# **GIS/REMOTE SENSING QUARTERLY EVALUATION BULLETIN**

December 2023 – February 2024

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## **Our Mandate**

Our core mandate is to observe, collate and analyze meteorological data to provide timely and accurate reporting of weather and climate information for socio-economic development and safety of lives and properties.

## **Our Vision**

To be a World Class provider of Weather and Climate services for safety and sustainable national socio-economic development.

## **Our Mission**

To observe Nigerian Weather and Climate and provide Meteorological, Hydrological, and Oceanographic Services in support of National needs and International Obligations

## **Who We Serve**

Aviation, Agriculture, Building and Construction, Commerce, Health, Hydrology, Marine, Oil and Gas, Sports, Social Events, Power and Energy, Telecommunication and more...

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# Preface



The Nigerian Meteorological Remote Sensing Bulletin aims to publish high-quality, Open-Access publications to benefit the earth and atmospheric observation community, open to everyone in need of them. The Bulletin focuses on the theory, science, and technology of remote sensing, as well as interdisciplinary research with earth and atmospheric science and information science.

Topics of particular interest include, but are not limited to:

- Agriculture, forestry and range
- Atmospheric science and meteorology
- Ocean and inland water remote sensing
- Remote sensing of energy, water and biogeochemistry cycles
- Natural hazards/ disaster and environmental sciences and
- Bio geosciences remote sensing, etc.

**Professor Charles Anosike**

Director General/CEO NiMet &  
Permanent Representative of Nigeria  
with WMO

# Introduction

The Nigerian Meteorological Remote Sensing bulletin serves the remote community with the publication of results on theory, science, applications and technology of remote sensing of Earth resources and environment. Thoroughly interdisciplinary, this bulletin focuses on new concepts, new results, new development of remote sensing. The bulletin publishes on basic theory of remote sensing, remote sensing technology and applications. The emphasis of the bulletin is on biophysical and quantitative approaches to remote sensing at local to global scales. Areas of interest include, but are not necessarily restricted to:

- Geography and land information
  - Geology and geosciences
  - Hydrology and water sciences
  - Remote sensing image processing and analysis
  - Atmospheric science and meteorology
  - Oceanography
  - Disaster monitoring
  - Geographic Information system, GIS etc.
- Quantitative and Inversion-agriculture, forestry and range
  - Ecology
  - Earth and environment science

# Preamble

**T**he GIS/Remote Sensing Monthly Evaluation between December 2023 and February 2024 reveals the extent of Nigeria's vulnerability to floods and dust haze. This assessment relies on monthly rainfall, soil moisture index, relative humidity and other relevant remote sensing data. By overlaying Nigeria's Digital Elevation Model onto the spatial rainfall distribution, states prone to flooding are identified and also states under the influence of dust haze are presented in the bulletin.



# CHAPTER ONE

## December 2023

### 1.0 Rainfall Distribution

#### 1.1 Rainfall Distribution for December 2023

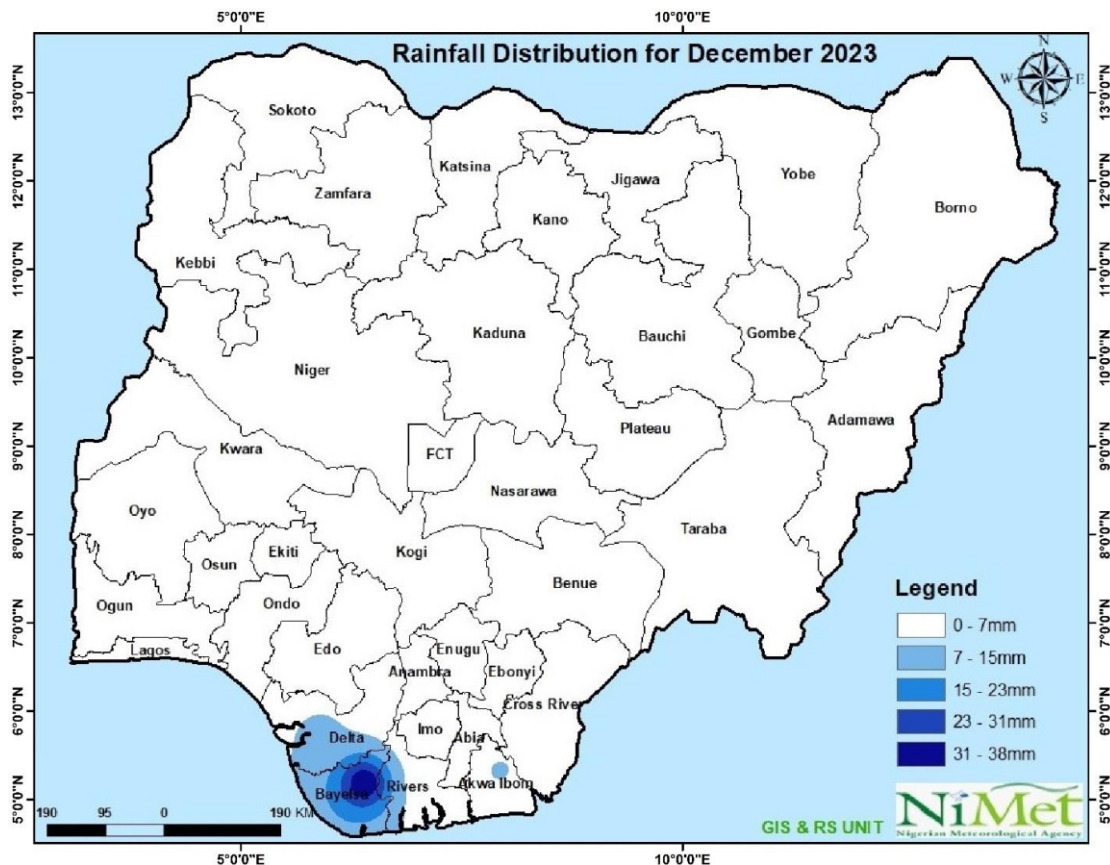


Figure 1: The rainfall amount for December 2023 is illustrated here. December precipitation showing the amounts indicate the geographic distribution of precipitation for the country.

**1.1.1 OBSERVED FEATURES:** The precipitation distribution in December 2023 indicates varying rainfall amounts across the country, ranging from 0mm to 38mm. The Northern region through the North Central experienced no rainfall during the period. Likewise, the South-Western and South-Eastern

region, notably, did not record any measurable rainfall. Conversely, the South-South region recorded rainfall amount ranging from 7mm to 38mm, with specific observations of 7mm-15mm over Akwa Ibom, Delta, Bayelsa and Rivers States. 31mm – 38mm of rainfall was observed over Bayelsa and

parts of River State during the period.

**1.1.2 RECOMMENDATIONS:** State Emergency Management Agencies in the South-South region are

advised to access and disseminate NiMet's forecast to vulnerable and flood-prone communities to mitigate the impacts of flooding.

## 1.2 DIGITAL ELEVATION MODEL OF NIGERIA

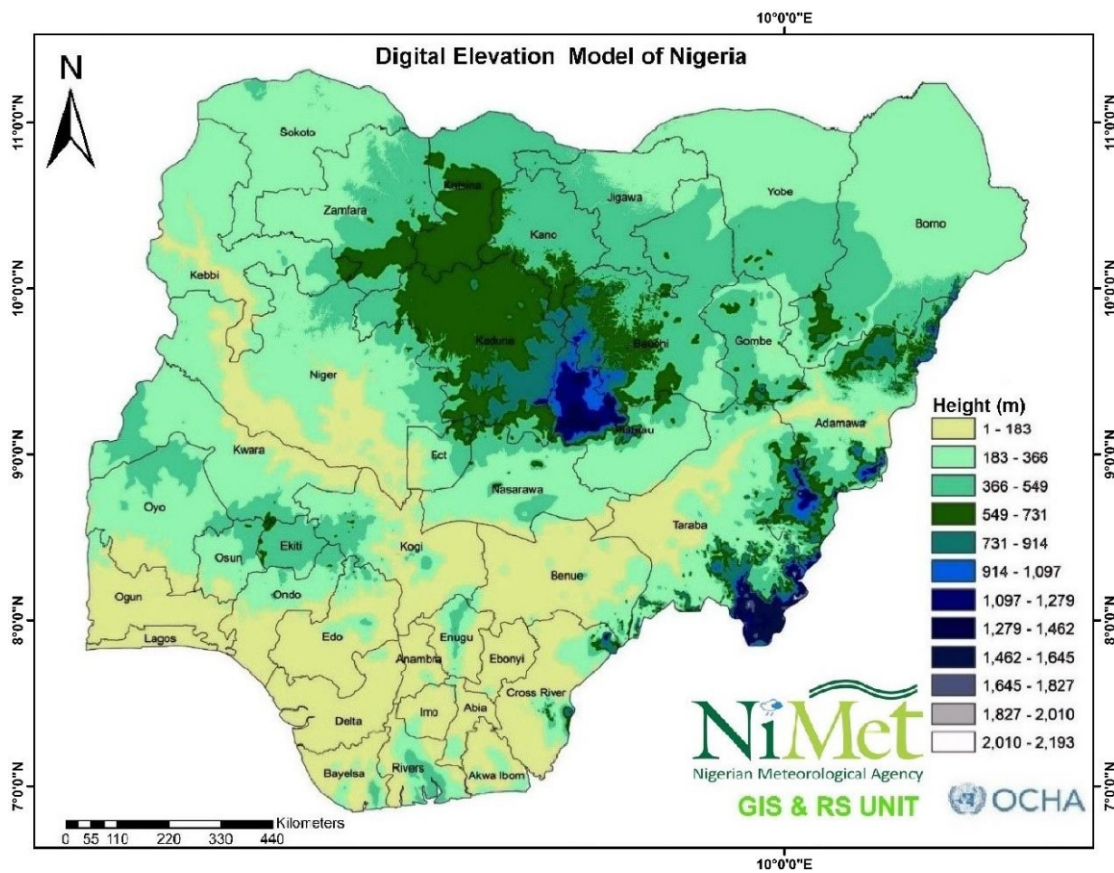


Figure 2: Digital Elevation Model for Nigeria, depicting the geographical positions of high and low areas within the country

### 1.2.1 OBSERVED FEATURES:

A Digital Elevation Model (DEM) represents the Earth's topographic surface devoid of vegetation, buildings, and other surface structures. DEMs are widely utilized to portray the natural terrain without plant cover and human-made features. They consist of a grid of

elevation values referenced to a common vertical datum, typically measured in meters, providing a continuous depiction of elevation across a topographic area as illustrated in Figure 2. Elevations range from 1 meter to 2193 meters. The highest elevations are observed across regions in Bauchi,

Plateau, Kaduna, Taraba, Adamawa, and Cross River State, while the lowest points are located in Lagos, Delta, and sections of Ondo, Edo, Bayelsa, Rivers, and Akwa Ibom states.

### **1.2.2 RECOMMENDATIONS:**

Elevated areas above sea level and areas with steep slopes are vulnerable to erosion and landslides. In the event of heavy rainfall, it is crucial for local authorities and residents in these regions to be mindful of these potential risks.

**Flooding:** Areas with low elevation are naturally at risk of flooding in Nigeria. Lagos, Delta, and portions of Ondo, Edo, Bayelsa, Rivers, and Akwa Ibom states have low elevation and therefore vulnerable to flooding. Preparedness for potential flooding and construction of effective drainage systems are important adaptation measures in such areas.

### **Infrastructure Development:**

Thorough planning is crucial when constructing physical infrastructure in

areas with varying elevations. In hilly and mountainous terrains, it is imperative to implement adequate engineering measures to ensure stability such as appropriate strength of materials and soil profile analysis.

**Ecological Concerns:** Mountainous regions often host unique ecological systems. To protect these natural environments, it is essential to consider conservation efforts such as, biodiversity, climate change adaptation and adopt sustainable practices such as afforestation

### 1.3 LOCATION OF WET AREAS FOR DECEMBER 2023

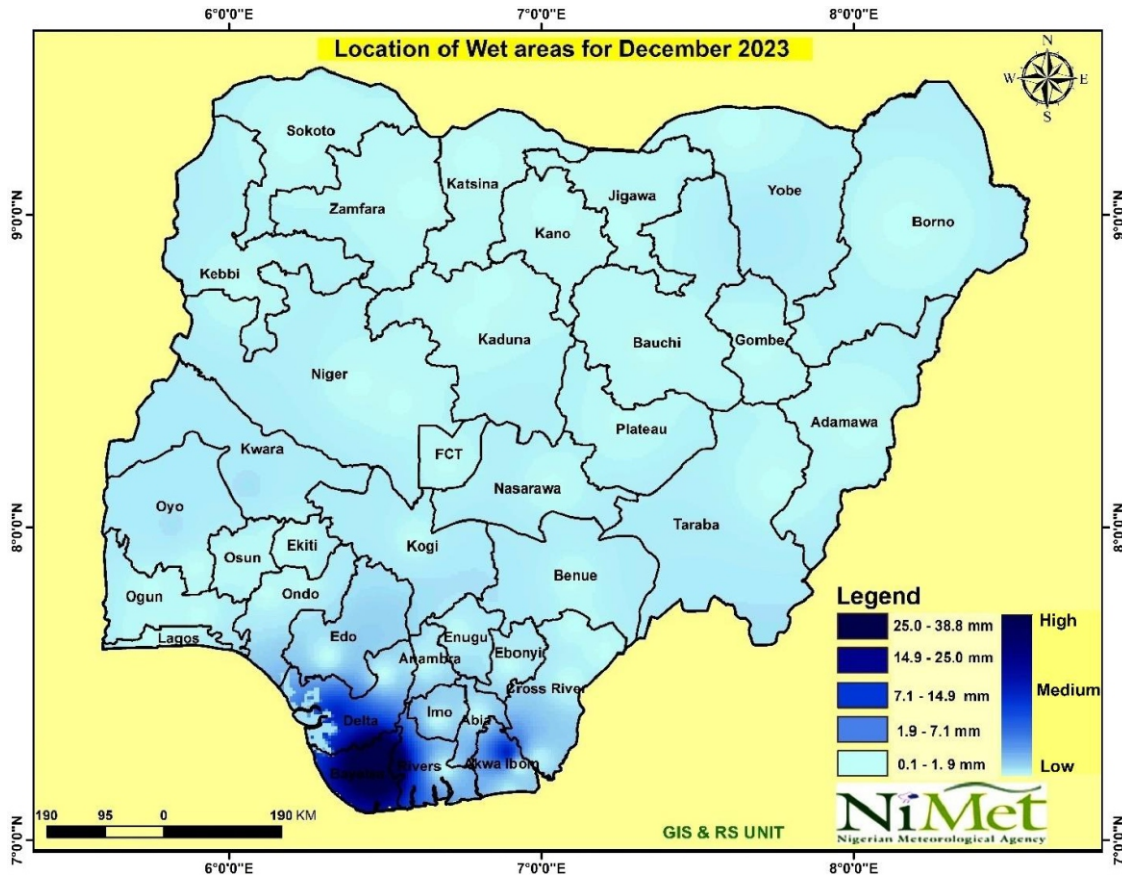


Figure 3: Map indicating high, medium and low wetness area over the country.

Table 1: Classification of flood Risk According to Geopolitical zones

S/N	Geo-political Zones	States	Early Warning
<b>South West</b>			
1		Ogun	Low Risk
2		Lagos	Low Risk
3		Osun	Low Risk
4		Ondo	Low Risk
5		Oyo	Low Risk
6		Ekiti	Low Risk
<b>South East</b>			
		Imo	Low Risk
1		Ebonyi	Low Risk
2		Anambra	Low Risk
3		Abia	Low Risk
4		Enugu	Low Risk
<b>South South</b>			
		Delta	Medium-High Risk
1		Rivers	Low-Medium Risk
2		Akwa Ibom	Low-Medium Risk
3		Bayelsa	High Risk
4		Edo	Low Risk
5		Cross River	Low Risk
<b>North Central</b>			

1		Kwara	Low Risk
2		Benue	Low Risk
3		Kogi	Low Risk
4		Kaduna	Low Risk
5		Plateau	Low Risk
6		Niger	Low Risk
7		Abuja	Low Risk
<b>North East</b>			
1		Taraba	Low Risk
2		Borno	Low Risk
3		Yobe	Low Risk
4		Kebbi	Low Risk
5		Bauchi	Low Risk
6		Gombe	Low Risk
<b>North West</b>			
1		Jigawa	Low Risk
2		Kano	Low Risk
3		Kebbi	Low Risk
4		Katsina	Low Risk
5		Sokoto	Low Risk
6		Zamfara	Low Risk
7			

### 1.4 LOCATION OF HIGH RISK AREAS FOR DECEMBER 2023

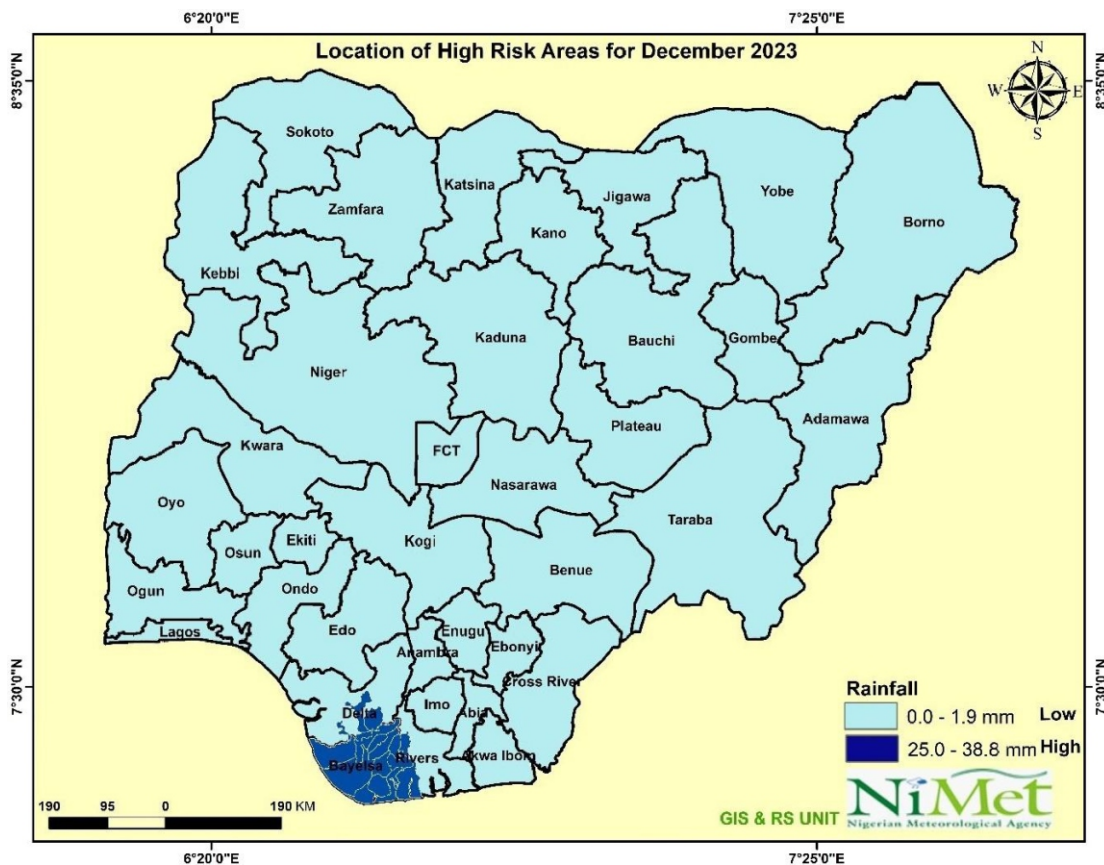


Figure 4: Map Depicting Location of High Risk Areas in Nigeria

#### **1.4.1 OBSERVED FEATURES:**

Further scrutiny of potential flood risk zones has identified certain local government areas with an elevated susceptibility to potential flood incidents. Particularly, regions in Bayelsa, Delta, and Rivers states displayed characteristics suggesting a predisposition to high-risk flooding, as determined by their respective land sizes and topographical features.

#### **1.4.2 RECOMMENDATIONS:**

##### **Plans for Evacuation:** Local

authorities are advised to formulate and share evacuation protocols with residents in vulnerable areas, identifying secure shelter locations and escape routes.

##### **Promoting Community Awareness:**

Residents are encouraged to follow guidance from local authorities and stay informed about weather forecasts. State Meteorological Inspectors (SMI)

should effectively disseminate information, ensuring that emergency contact details for local response teams and services are easily accessible to the public.

Residents in high-risk areas should take precautionary measures to protect valuable properties.

**Keep Up with the News:** Consistently monitor local news and weather reports, paying attention to guidance provided by emergency services and local authorities. It is crucial to stay updated on weather and flood information from NiMet and Nigeria Hydrological Service Agency (NIHSA). Local authorities should initiate and communicate evacuation plans for vulnerable areas, identifying safe shelters and evacuation routes before flooding occurs.

**Table 2: Location of Local Government Areas for December 2023**

S/N	LGA	STATE	AREA(SQ.KM)
1	Sagbama		952.82
2	Yenegoa		707.65
3	Nembe		837.84
4	Kolokuma/Opokuma		357.53
5	Ogbia		694.32
6	Brass		1315.55
7	Ekeremor		1840.05
8	Southern Ijaw	Bayelsa	2700.78
9	Abua/Odual	Rivers	640.878
10	Akuku Toru		1416.50
11	Ahoada East		406.26
12	Ahoada West		435.20
13	Ughelli North	Delta	767.22
14	Patani		230.14
15	Isoko South		716.12
16	Bomadi		207.92

## 1.5 SOIL MOISTURE INDEX FOR DECEMBER 2023

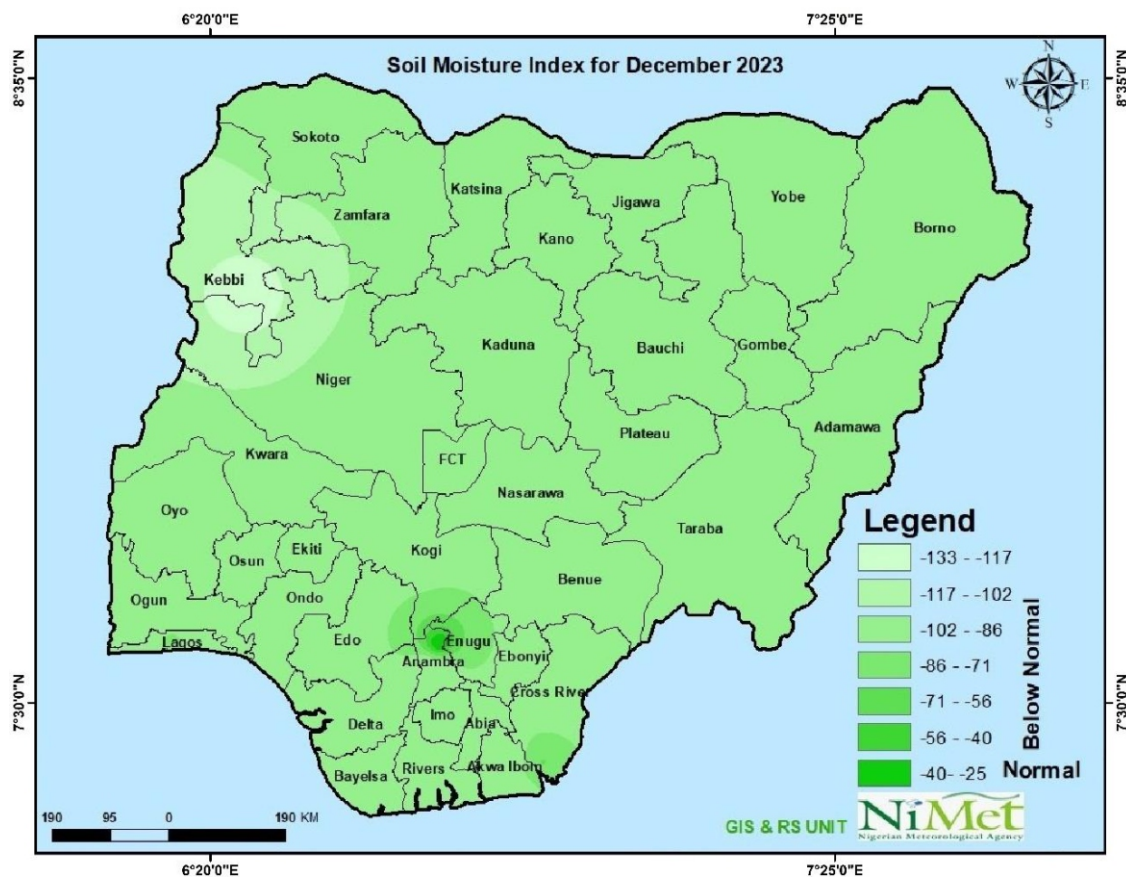


Figure 5: The Soil Moisture Index across Nigeria for December 2023 which depict areas of soil moisture saturation that may be susceptible to flood.

### 1.5.1 OBSERVED FEATURES:

The Soil Moisture Index (SMI) is an important factor that directly or indirectly affects the water cycle. It is influenced by the rainfall distribution in a specific area. SMI is computed by comparing the current soil moisture to the permanent wilting point and residual soil moisture relative to the field capacity. The SMI is a key parameter in flood forecasting, incorporating factors such as wetness, water retention, and observed rainfall.

The SMI analysis, illustrated in Figure 5, offers insights into the range of soil moisture conditions nationwide across the country in December 2023. This classification ranges from normal (-40 to -25) to below normal (-40 to -133). While interpreting the SMI alongside average rainfall data it is expected that regions with negative or low positive average rainfall are likely to experience drier conditions.

However, as seen in the SMI map (Figure 5), most places have negative values



falling below normal condition indicating little or no likelihood for flood occurrence. Nonetheless, parts of Enugu and Anambra states show small changes of flood risk falling under the normal condition.

**1.5.2 RECOMMENDATIONS:**

Based on the Soil Moisture Index (SMI)

data for December 2023, regions with elevated SMI values, particularly in the South-South and part of the South-East areas, may experience slight wetness. It is important to take adequate precautions and implement measures to mitigate the impact of flooding in these regions.

**1.6 RELATIVE HUMIDITY DISTRIBUTION**

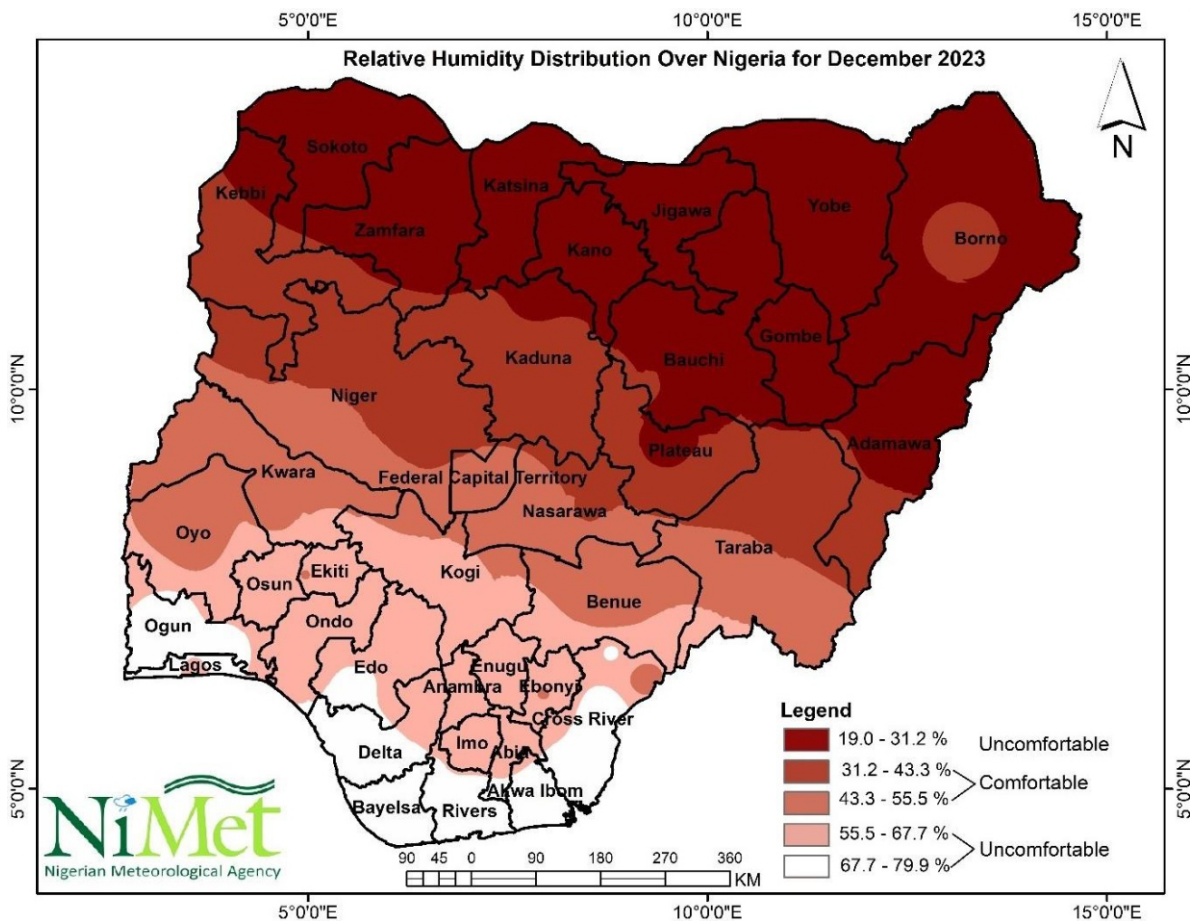


Figure 6: The Relative Humidity Distribution over Nigeria for December 2023 Showing Areas of Comfortable and Uncomfortable Levels Respectively.

### 1.6.1 OBSERVED FEATURES

Humidity is the amount of water vapor in the air. In most places, humidity levels in the air are reasonably stable throughout the year.

Knowing what a comfortable humidity level is outside is crucial as it helps determine how to carry on with activities of the day.

A comfortable humidity is the amount of moisture in the air that's not only appropriate but conducive to a healthy existence.

For many people, the humidity level considered comfortable is between 30 percent and 50 percent. Humidity levels are variable, with more humidity during the rainy season and less during the harmattan. Humidity levels also vary from place to place and seasonally.

Humidity is the amount of water vapor in the air. In most places, humidity levels in the air are reasonably stable throughout the year.

The following are the features observed concerning atmospheric moisture distribution over the country, in the month of December 2023:

- The RH in the Sahel savannah zone of the country was between 19.0% and 31.2%, which is not comfortable level outside.
- Good humidity between 31.2% and 43.3% was observed in the Sudan savannah zone of the country.
- In the Guinea savannah zone of the country, the relative humidity ranged between 43.3% and 55.5%, which is also good.
- Uncomfortable outdoor level of relative humidity between 55.5% and 67.7% was observed mainly around the Tropical Forest of the country.
- High humidity between 67.7% and 79.9% mainly was observed around the Rain Forest of the country, which is beyond comfortable humidity level outdoor.

### 1.6.2 RECOMMENDATIONS:

By maintaining the proper humidity levels, one will have a healthier sleeping and living environment.

One's respiratory health will improve, one will get sick less often, and one will feel more comfortable in one's surroundings.

When air is dehydrated, one is more likely to have issues with his/her hair or skin drying out, and experience cracked furniture.

It's important to know what a comfortable humidity level is outside because it helps beware of allergic

reactions that may arise.

If too much moisture in the air, a home may become infested with pests and dust mites. Furthermore, excess humidity can encourage mildew and mold to grow.



## CHAPTER TWO

# January 2024

### 2.1 Rainfall Distribution

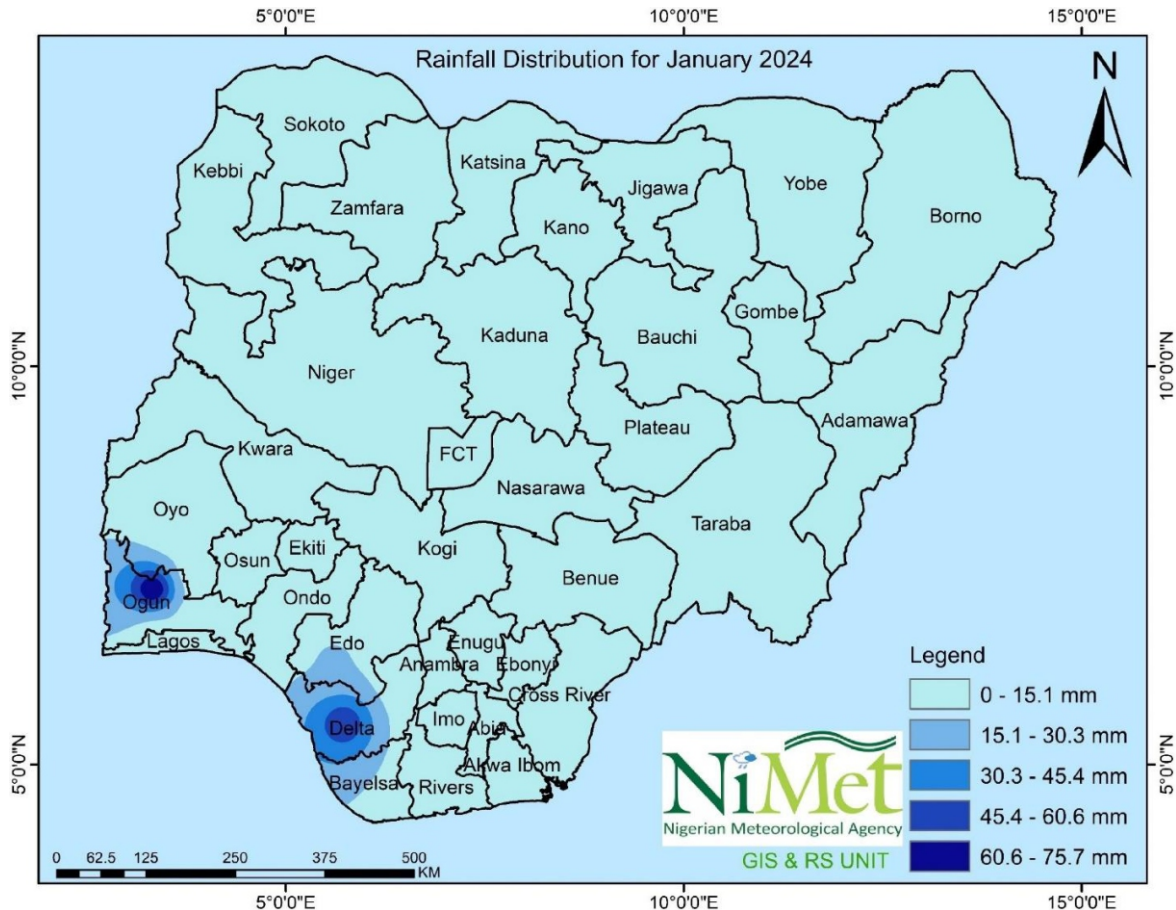


Figure 7: The rainfall amount for January 2024 is illustrated here, January precipitation showing the amounts indicate the geographic distribution of precipitation for the country

#### 2.1.1 OBSERVED FEATURES:

Analysis of the rainfall distribution over the country for the month of January 2024 shows that the amount of rainfall received ranged from 3.8mm to 76.2mm. Little or no rains were observed over most part of the country from the north down to the southern region (0mm – 15.1mm). However, some places

over the southwest and coastal region of the country such as Ogun, Oyo, Edo, Delta and Bayelsa experienced rainfall of between 15.1mm – 30.3mm and 30.3mm – 45.4mm respectively. Likewise, parts of Ogun and Delta state experienced rainfall ranging from 45.4mm – 75.7mm during this period.

**2.1.2 RECOMMENDATIONS:**

State Emergency Management Agencies in the Southwest and South-South regions are advised to access

and disseminate NiMet's early warning forecasts to vulnerable and flood-prone communities to mitigate the impacts of flooding.

**2.2 DIGITAL ELEVATION MODEL (DEM)**

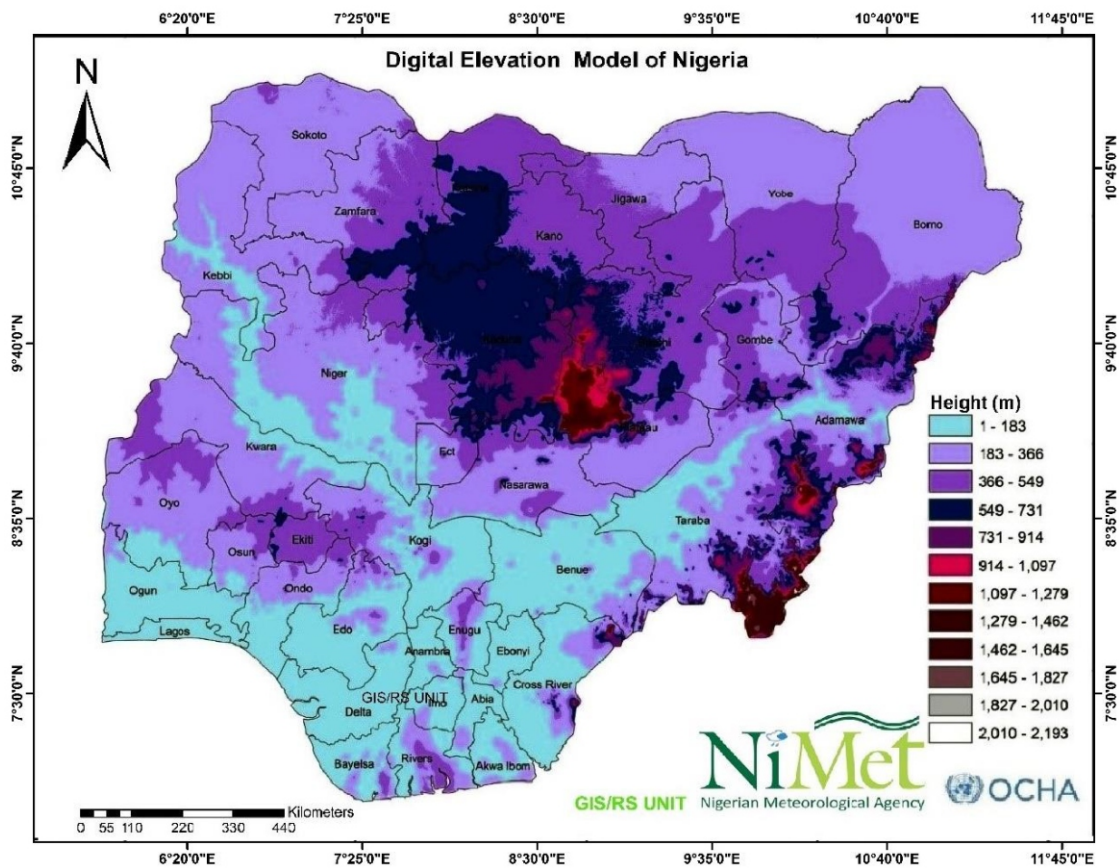


Figure 8: Digital Elevation Model for Nigeria, showing the geographical positions of high And low land areas in the country.

### 2.2.1 OBSERVED FEATURES

A Digital Elevation Model (DEM) represents the Earth's topographic surface devoid of vegetation, buildings, and other surface structures. DEMs are widely utilized to portray the natural terrain without plant cover and human-made features. They consist of a grid of elevation values referenced to a common vertical datum, typically measured in meters, providing a continuous depiction of elevation across a topographic area as illustrated in Figure 8. Elevations in Nigeria range from 1 meter to 2193 meters. The highest elevations are observed across regions in Bauchi, Plateau, Kaduna, Taraba, Adamawa, and Cross River states, while the lowest points are located in Lagos, Delta, and sections of Ondo, Edo, Bayelsa, Rivers, and Akwa Ibom states.

### 2.2.2 RECOMMENDATIONS:

Elevated areas above sea level and areas with steep slopes are at higher risk of erosion and landslides. Local authorities and residents in such areas are advised to be mindful of these hazards when there is heavy and prolonged rainfall.

**Flooding:** Areas with low elevation such as Lagos, Delta, and portions of Ondo,

Edo, Bayelsa, Rivers, and Akwa Ibom states, are naturally at risk of flooding in the event of heavy rainfall. Preparedness for possible flooding by dissemination of early warning information from NiMet and NIHSA, and the provision of effective drainage systems are advised. Adequate arrangements for evacuation and emergency health care should be made by local authorities in these flood-prone areas as part of the preparations for possible flooding.

### Infrastructure Development:

Thorough planning is crucial when constructing infrastructure in areas with varying elevations. In hilly and mountainous terrain, it is imperative to implement adequate engineering measures, (such as soil profile examination, appropriate strength of materials etc.) to ensure stability.

**Ecological Concerns:** Mountainous regions often host unique ecological systems. To protect these natural environments, it is essential to consider conservation efforts and adopt sustainable practices.

### 2.3. LOCATION OF WET AREAS FOR JANUARY 2024

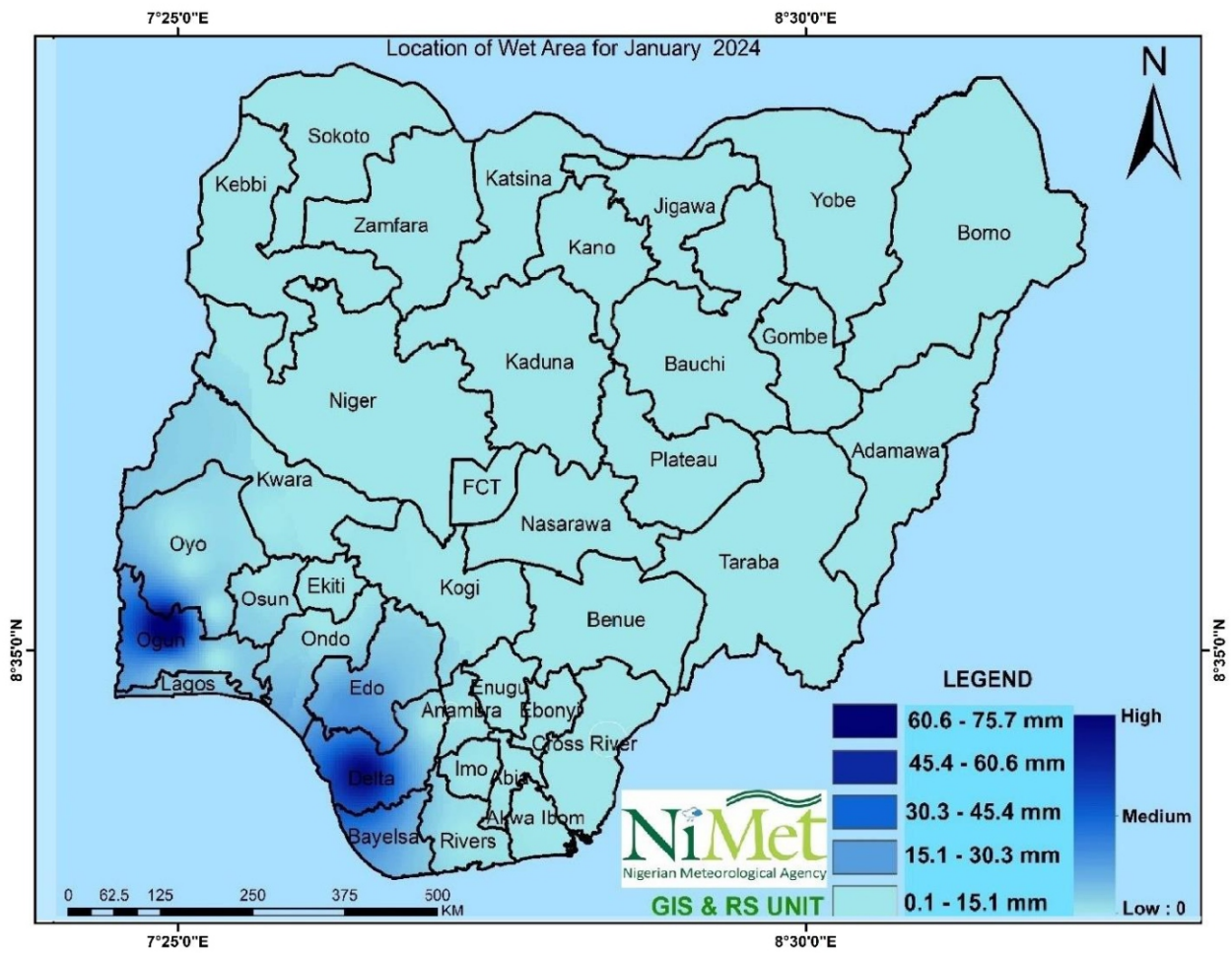


Figure 9: Map indicating high, medium and low wetness area over the country.

**Table 3: Classification of flood Risk Areas According to Geopolitical zones**

S/N	Geo-political Zones	States	Early Warning
	<b>South West</b>		
1		Ogun	Medium - High Risk
2		Lagos	Low Risk
3		Osun	Low Risk
5		Ondo	Low Risk
6		Oyo	Low - Medium Risk
7		Ekiti	Low Risk
	<b>South East</b>		
		Imo	Low Risk
1		Ebonyi	Low Risk
2		Anambra	Low Risk
3		Abia	Low Risk
4		Enugu	Low Risk
	<b>South South</b>		
		Delta	Medium - High Risk
1		Rivers	Low Risk
2		Akwa Ibom	Low Risk
3		Bayelsa	Low - Medium Risk
4		Edo	Low - Medium Risk
5		Cross River	Low Risk
	<b>North Central</b>		
1		Kwara	Low Risk
2		Benue	Low Risk
3		Kogi	Low Risk
4		Kaduna	Low Risk
5		Plateau	Low Risk
6		Niger	Low Risk
7		Abuja	Low Risk
	<b>North East</b>		
1		Taraba	Low Risk
2		Borno	Low Risk
3		Yobe	Low Risk
4		Kebbi	Low Risk
5		Bauchi	Low Risk
6		Gombe	Low Risk
	<b>North West</b>		
1		Jigawa	Low Risk
2		Kano	Low Risk
3		Kebbi	Low Risk
4		Katsina	Low Risk
5		Sokoto	Low Risk
6		Zamfara	Low Risk



## 2.2.4 LOCATION OF HIGH RISK AREAS FOR JANUARY 2024

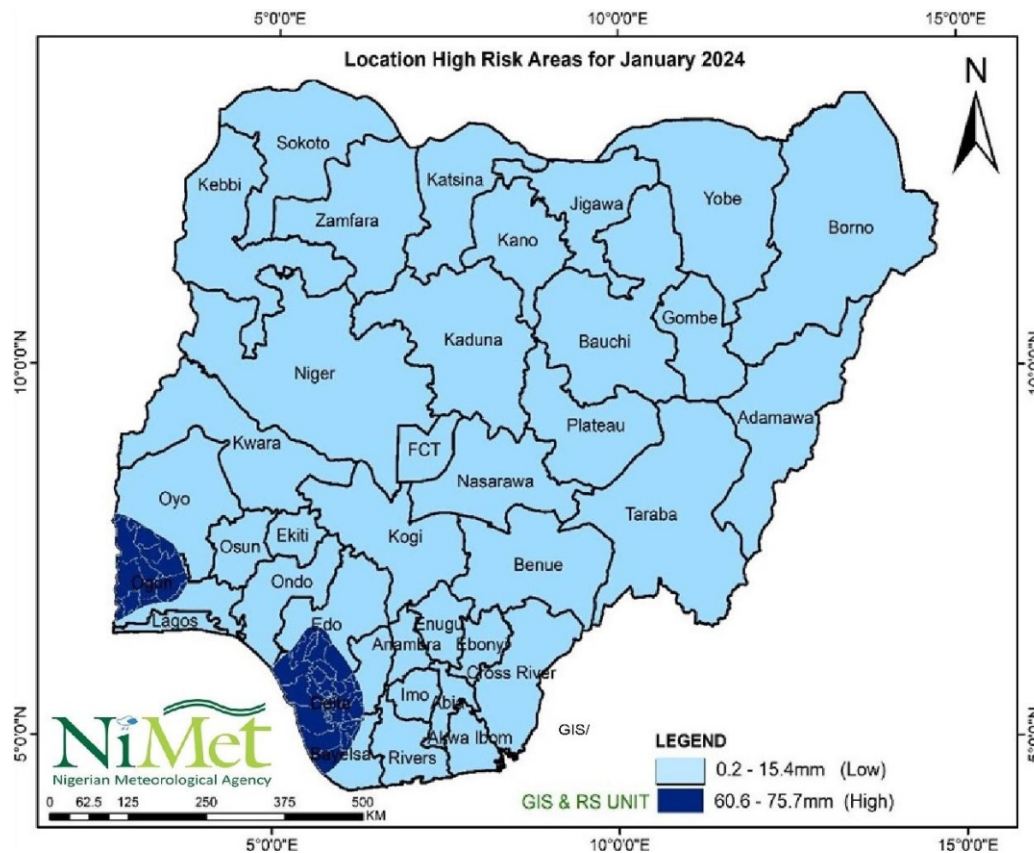


Figure 10: Location in Nigeria showing local government areas with high risk of flood incidence

### 2.4.1 OBSERVED FEATURES:

Local government areas in the country with high level of vulnerability to flood incidents are depicted in Figure 4. Parts of Delta, Bayelsa, Ogun, Oyo, and Edo states are at high risk level of flooding, as determined by their respective land sizes and topographical features.

### 2.4.2 RECOMMENDATIONS:

#### Plans for Evacuation:

Local authorities are advised to formulate and share evacuation protocols with residents in vulnerable areas,

identifying secure shelter locations and escape routes in the event of flooding.

#### Promoting Community Awareness:

Residents are encouraged to follow guidance from local authorities and stay informed about weather forecasts. State Meteorological Inspectors (SMI) should effectively disseminate information, ensuring that emergency contact details for local response teams and services are easily accessible to the public.

Residents in high-risk areas should take

precautionary measures to protect valuable properties.

**Keep Up with the News:** Consistently monitor local news and weather reports, paying attention to guidance provided by emergency services and local authorities. It is crucial to stay updated

on weather and flood information from NiMet and Nigeria Hydrological Service Agency (NIHSA). Local authorities should initiate and communicate evacuation plans for vulnerable areas, identifying safe shelters and evacuation routes before flooding occurs.

**Table 4: Location of Local Government Areas for January 2024**

S/N	LGA	STATE	AREA(SQ.KM)
1	Sapele	Delta	430.20
2	Udu		166.20
3	Ughelli North		832.51
4	Ughelli South		771.61
5	Ukwuani		84.35
6	Uvwie		112.70
7	Warri North		1728.05
8	Warri South		587.31
9	Warri South West		1694.59
10	Bomadi		129.00
11	Burutu		1935.47
12	Ethiope East		380.55
13	Ethiope West		538.41
14	Ekeremor	Bayelsa	1816.14
15	Kolokuma/Opokuma		138.32
16	Sagbama		591.34
17	Southern Ijaw		1442.26
18	Yenegoa		6.67
19	Ekeremor		1816.14

20	Abeokuta South	Ogun	56.80	
21	Ado-Odo/Ota		81.16	
22	Egbado North		1868.90	
23	Egbado South		719.43	
24	Ewekoro		631.39	
25	Ifo		321.86	
26	Ikenne		60.93	
27	Imeko-Afon		1821.13	
28	Ipokia		342.56	
29	Obafemi-Owode		1367.47	
30	Odeda		1312.74	
31	Remo North		94.76	
32	Shagamu		141.53	
33	Abeokuta North		775.76	
34	Abeokuta South		56.80	
35	Ado-Odo/Ota		81.16	
36	Egbado North		1868.90	
37	Egbado South		719.43	
38	Ewekoro		631.39	
39	Ifo		321.86	
40	Ikenne		60.93	
41	Imeko-Afon		1821.13	
42	Egor		Edo	76.32
43	Ikpoba-Okha			859.31
44	Oredo			251.12
45	Orhionmwon			1404.09
46	Ovia North East			933.63
47	Ovia South West			270.07
48	Egor			76.32
49	Ikpoba-Okha			859.31
50	Ibarapa Central			689.96
51	Ibarapa East			500.99
52	Ibarapa North			946.29
53	Ido	57.58		
54	Iseyin	47.45		
55	Iwajowa	410.37		
56	Oluyole	7.82		
57	Ibarapa Central	689.96		
58	Ibarapa East	500.99		
59	Ibarapa North	946.29		
60	Ido	57.58		

## 2.5 SOIL MOISTURE INDEX

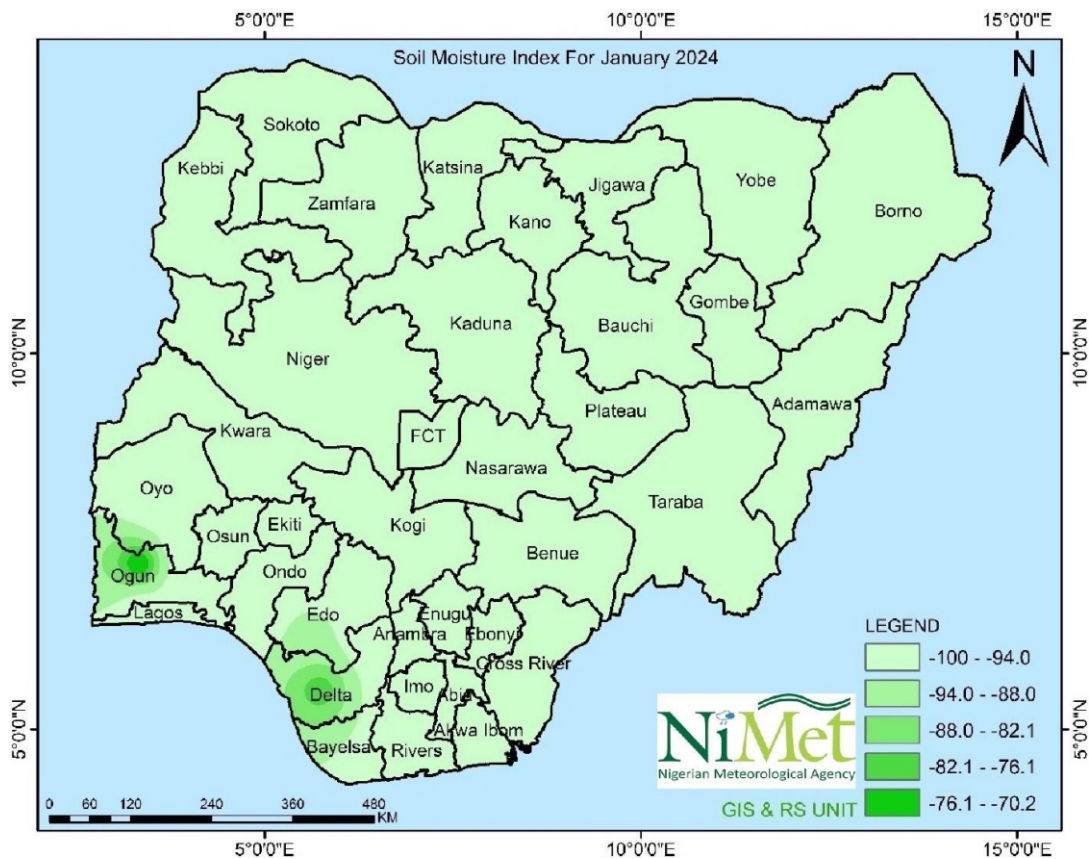


Figure 11: The Soil Moisture Index across Nigeria for January 2024 which 2023 which depict areas of soil moisture saturation that may be susceptible to flood

### 2.5.1 OBSERVED FEATURES

The moisture content of the soil in any area is one of the factors that determine the likelihood of flooding when it rains in the area. The chances of flooding are high when the soil is saturated with water. Soil moisture saturation is quantified in terms of Soil Moisture Index (SMI). It is influenced by the rainfall amount received in a particular location. SMI is computed by comparing the current soil moisture to the permanent wilting point and residual soil moisture relative to the field

capacity. Incorporating factors such as wetness, water retention, and observed rainfall, the soil moisture index has become an essential parameter in forecasting flood.

The Soil Moisture Index analysis illustrated in Figure 11, shows the range of soil moisture conditions across the country in January 2024. Essentially, the values are predominantly negative ranging from -70.2 to -100 which generally falls under the 'below normal condition'.

Combining the soil moisture index with

the average rainfall data, reveals areas of the country that may experience dry or wet soil conditions. It is expected that regions with negative average rainfall are likely to experience drier conditions. As seen in Figure 11, most places in the country have negative SMI values (i.e., below normal conditions). This implies that flooding is unlikely during the period.

### 2.5.2 RECOMMENDATIONS:

Based on the Soil Moisture Index (SMI) data for January 2024, regions with elevated SMI values, particularly in parts of South-South and South-west areas are advised to take precautionary measures to mitigate the impact of flooding in these regions.

## 2.6 RELATIVE HUMIDITY DISTRIBUTION

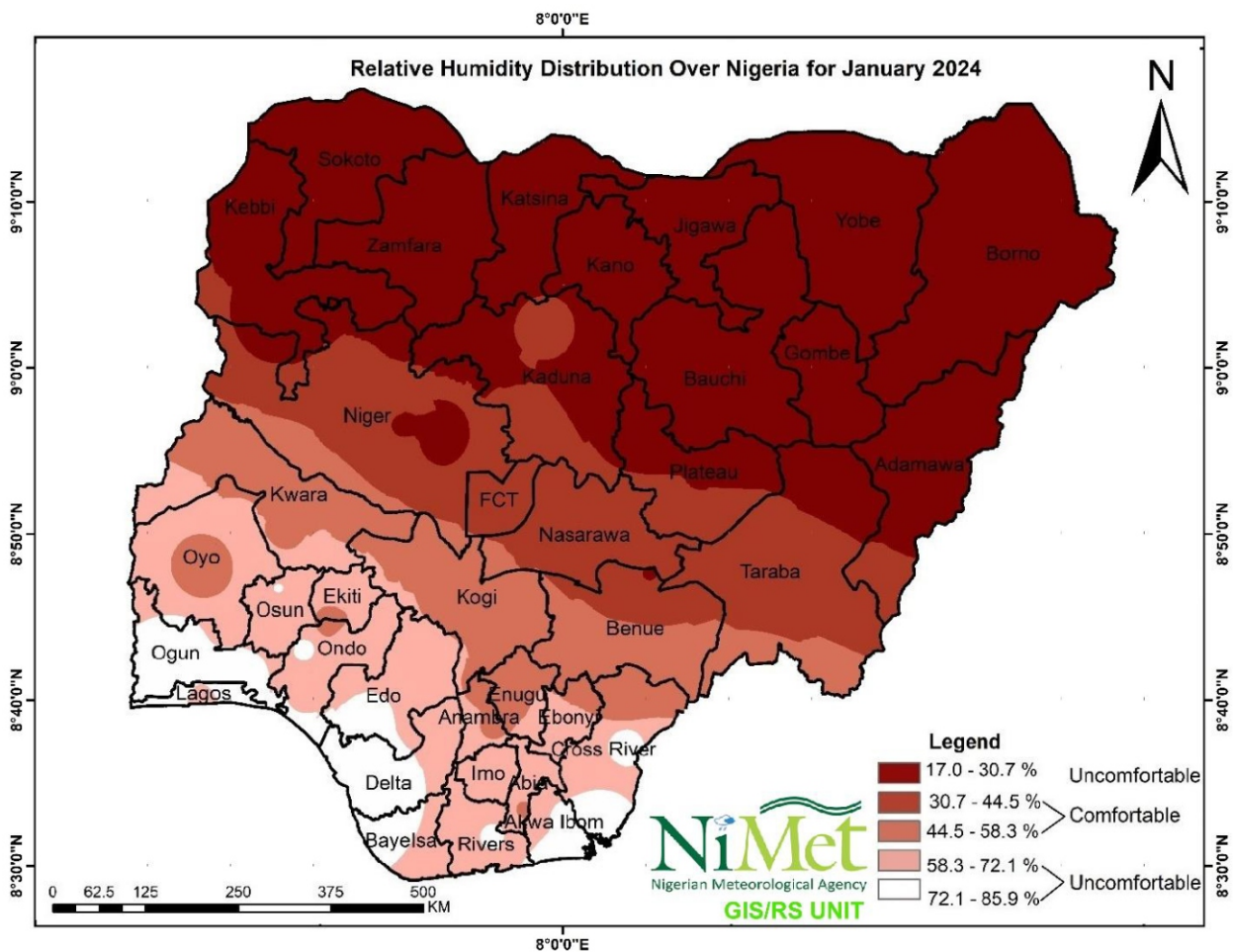


Figure 12: The Relative Humidity Distribution over Nigeria for January 2024 Showing Areas of Comfortable and Uncomfortable Levels Respectively.

### 2.6.1 OBSERVED FEATURES

Humidity is the amount of water vapor in the air. In most places, humidity levels in the air are reasonably stable throughout the year.

Knowing what a comfortable humidity level is outside is crucial as it helps determine how to carry on with activities of the day.

A comfortable humidity is the amount of moisture in the air that's not only appropriate but conducive to a healthy existence.

For many people, the humidity level considered comfortable is between 30 percent and 50 percent. Humidity levels are variable, with more humidity during the rainy season and less during the harmattan. Humidity levels also vary from place to place and seasonally.

Humidity is the amount of water vapor in the air. In most places, humidity levels in the air are reasonably stable throughout the year.

The following are the features observed concerning moisture distribution over the country, in the month of January 2024:

- Low humidity mainly around the Sahel savannah of the country with

Relative Humidity range between 20.0% and 32.4%

- Fairly good humidity mainly around the Sudan savannah of the country with the Relative Humidity range between 32.4% and 44.8%
- Good humidity mainly around the Guinea savannah of the country with the Relative Humidity with relative humidity range between 44.8% and 57.2%
- Fairly good humidity mainly around the Tropical forest of the country with relative humidity range between 57.2% and 69.5%
- High humidity mainly around the Rain forest of the country with relative humidity range between 57.2% and 69.5%

However, these atmospheric conditions may improve in February 2024.

### 2.6.2 RECOMMENDATIONS:

By maintaining the proper humidity levels, one will have a healthier sleeping and living environment.

One's respiratory health will improve, one will get sick less often, and one will feel more comfortable in one's surroundings.

When air is dehydrated, one is more likely to have issues with his/her hair or

skin drying out, and experience cracked furniture.

It's important to know what a comfortable humidity level is outside because it helps beware of allergic reactions that may arise.

If too much moisture in the air, a home may become infested with pests and dust mites. Furthermore, excess humidity can encourage mildew and mold to grow.



## CHAPTER THREE

# February 2024

### 3.1 Rainfall Distribution

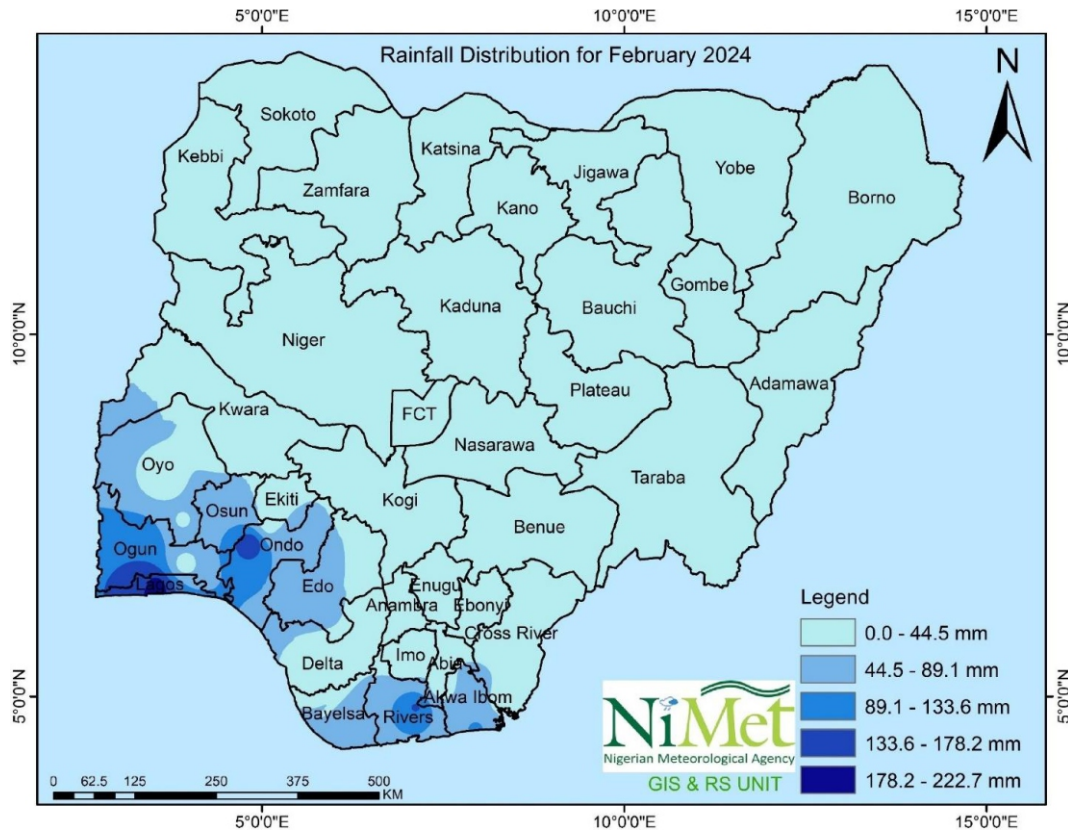


Figure 13: The rainfall amount for February 2024 is illustrated here, February precipitation showing the amounts indicate the geographic distribution of precipitation for the country.

#### 3.1.1 OBSERVED FEATURES:

In February 2024 the amount of rainfall received across Nigeria ranged from 0mm to 222.7mm. Little or no rains were observed over most parts of the country. From the extreme north through the central, to the south eastern states, the rainfall amounts recorded were between 0mm and 44.5mm. However, substantial rainfall amounts ranging from 44.4mm to 133.6mm were

experienced over Oyo, Osun, Ekiti, Ondo, and Ogun in the southwest and Edo, Delta, Bayelsa, Rivers and Akwa Ibom state in the south - south region. Lagos and parts of Ogun and Ondo states experienced the highest rainfall of 133.6mm to 222.7mm during the month.

#### 3.1.2 RECOMMENDATIONS:

State Emergency Management Agencies in the South-South region are advised to access and disseminate



NiMet's early warning forecasts as well as Flood Outlook from Nigeria Hydrological Agency (NIHSA) to

vulnerable and flood-prone communities to mitigate the impacts of flooding.

## 3.2 DIGITAL ELEVATION MODEL

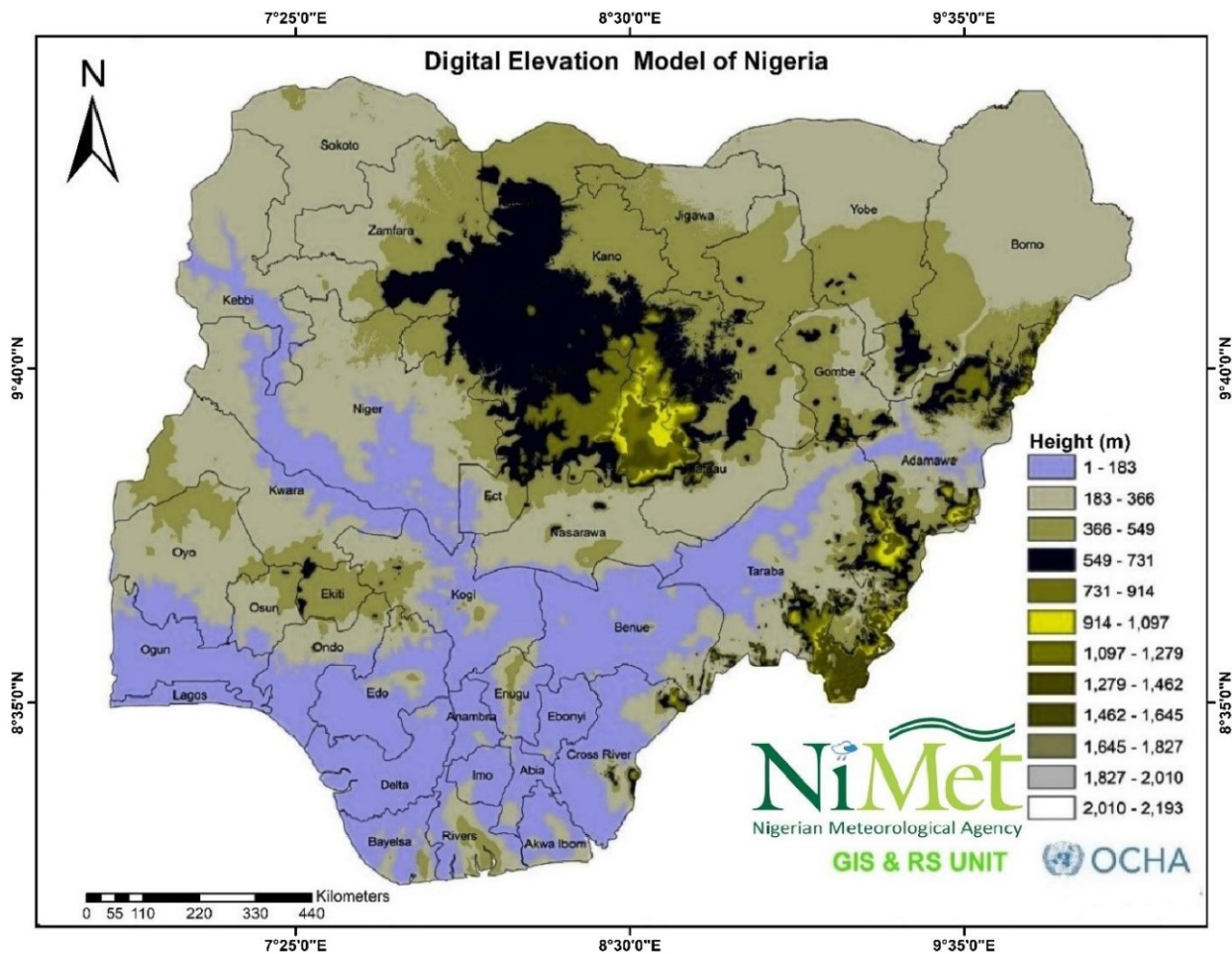


Figure 14: Digital Elevation Model for Nigeria, depicting the geographical positions of high and low areas within the country.

### 3.2.1 OBSERVED FEATURES

A Digital Elevation Model (DEM) represents the Earth's topographic surface devoid of vegetation, buildings, and other surface structures. DEMs are widely utilized to show the natural terrain without plant cover and human-made features. They consist of a grid of

elevation values referenced to a common vertical datum, typically measured in meters, providing a continuous depiction of elevation across a topographic area as illustrated in Figure 14. Elevations range from 1 meter to 2193 meters. The highest elevations are observed across regions

in Bauchi, Plateau, Kaduna, Taraba, Adamawa, and Cross River State, while the lowest points are located in Lagos, Delta, and sections of Ondo, Edo, Bayelsa, Rivers, and Akwa Ibom states.

### **3.2.2 RECOMMENDATIONS:**

Elevated areas above sea level and areas with steep slopes are susceptible to erosion and landslides. Local authorities and residents in such areas are advised to be mindful of these hazards, especially during heavy rainfall.

**Flooding:** Areas with low elevation, such as Lagos, Delta, and portions of Ondo, Edo, Bayelsa, Rivers, and Akwa Ibom states, are naturally vulnerable to flooding. Provision of proper drainage systems and clearing of water ways before the onset of rainy season in the flood-prone areas are strongly advised. Relevant authorities should develop flood emergency plans for each community in the flood-prone areas. Public enlightenment on flood emergency procedures should be provided by Emergency Agencies.

### **Infrastructure Development:**

Infrastructure development in areas with varying elevations require proper

planning. It is particularly important to ensure that houses are not built on flood plains or natural flood channels and water ways. In hilly and mountainous terrains, it is need to enforce engineering designs and standards to ensure stability.

**Ecological Concerns:** Mountainous regions often host unique ecological systems. These natural environments should be protected by adopting and implementing standard environmental conservation and sustainability practices.

### 3.3 LOCATION OF WET AREAS FOR FEBRUARY 2024

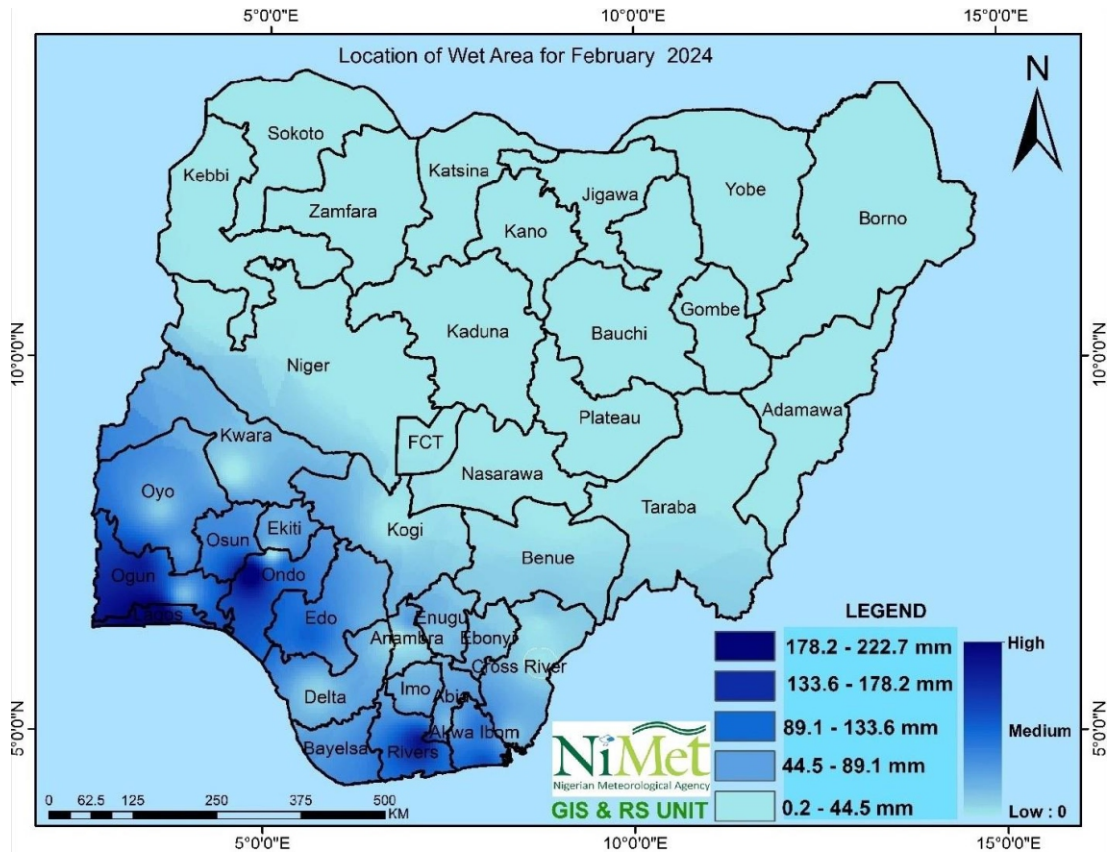


Figure 15: Map indicating high, medium and low wetness area over the country

**Table 5: Classification of Flood Risk Areas According to Geopolitical Location**

S/N	Geo-political Zones	States	Early Warning
<b>South West</b>			
1		Ogun	Medium - High Risk
2		Lagos	Medium - High Risk
3		Osun	Low - Medium Risk
4		Ondo	Medium - High Risk
5		Oyo	Low Risk
		Ekiti	Low Risk
<b>South East</b>			
		Imo	Low Risk
1		Ebonyi	Low Risk
2		Anambra	Low Risk
3		Abia	Low Risk
4		Enugu	Low Risk
<b>South South</b>			
		Delta	Low Risk
1		Rivers	Medium - High Risk
2		Akwa Ibom	Medium - High Risk
3		Bayelsa	Low Risk
4		Edo	Low - Medium Risk
5		Cross River	Low Risk

North Central			
1		Kwara	Low Risk
2		Benue	Low Risk
3		Kogi	Low Risk
4		Kaduna	Low Risk
5		Plateau	Low Risk
6		Niger	Low Risk
7		Abuja	Low Risk
North East			
1		Taraba	Low Risk
2		Borno	Low Risk
3		Yobe	Low Risk
4		Kebbi	Low Risk
5		Bauchi	Low Risk
6		Gombe	Low Risk
North West			
1		Jigawa	Low Risk
2		Kano	Low Risk
3		Kebbi	Low Risk
4		Katsina	Low Risk
5		Sokoto	Low Risk
6		Zamfara	Low Risk

### 3.4 LOCATION OF HIGH RISK AREAS FOR FEBRUARY 2024

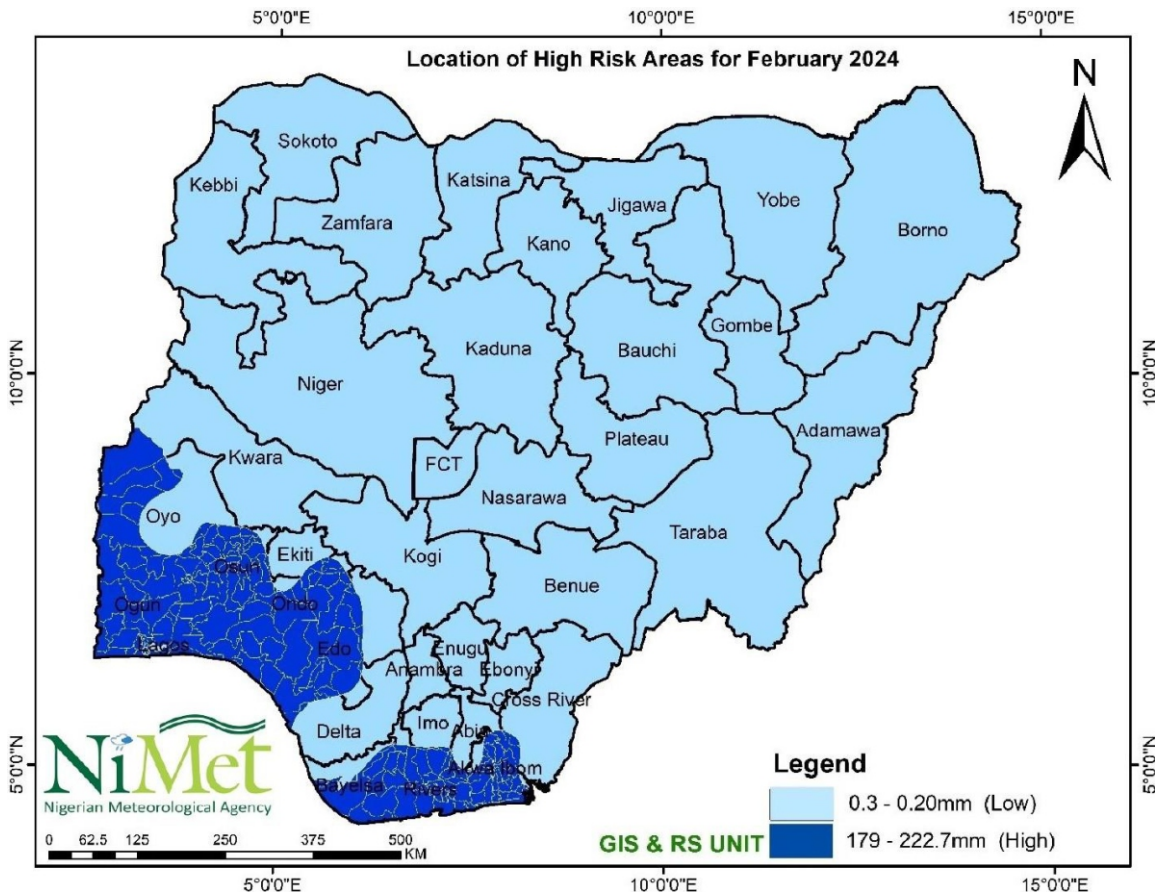


Figure 16: Location in Nigeria showing local government areas with high risk of flood incidence

### **3.4.1 OBSERVED FEATURES:**

Further investigation of potential flood risk zones has identified certain local government areas with an elevated susceptibility to potential flood incidents. The southwest and south - south zones are particularly susceptible to flooding during this period. Based on their respective land sizes and topographical features, Oyo, Osun, Ondo, Ekiti, Ogun, Lagos, Edo, Bayelsa, Delta, Rivers and Akwa Ibom state have high-risks of flooding.

### **3.4.2 RECOMMENDATIONS:**

**Plans for Evacuation:** Local authorities are advised to formulate flood emergency plans, identifying secure shelter locations and escape routes. The evacuation procedures should be communicated to residents in the vulnerable areas early enough before the occurrence of floods.

### **Promoting Community Awareness:**

Residents are encouraged to follow guidance from local authorities and stay informed about weather forecasts. State Meteorological Inspectors (SMI) of NiMet should collaborate with local authorities and community leaders to effectively disseminate information, ensuring that emergency contact

details for local response teams and services are easily accessible to the public. Residents in high-risk areas should take precautionary measures to protect valuable properties.

**Keep Up with the News:** Consistently monitor local news and weather reports, paying attention to guidance provided by emergency services and local authorities. It is crucial to stay updated on weather and flood information from NiMet and Nigeria Hydrological Service Agency (NIHSA). Local authorities should initiate and communicate evacuation plans for vulnerable areas, identifying safe shelters and evacuation routes before flooding occurs.

**Table 6: Location of Local Government Areas for February 2024**

S/N	LGA	STATE	AREA(SQ.KM)
1	Aba South	Abia	13.59
2	Arochukwu		172.12
3	Osisioma Ngwa		48.26
4	Ukwa East		242.72
5	Ukwa West		277.39
6	Abak	Akwa Ibom	178.11
7	Eastern Obolo		122.90
8	Eket		166.13
9	Esit - Eket		169.32
10	Essien Udim		113.20
11	Etim Ekpo		194.58
12	Etinan		172.80
13	Ibeno		243.25
14	Ibesikpo Asutan		175.04
15	Ibiono Ibom		336.03
16	Ika		8.57
17	Ikono		258.63
18	Ikot Abasi		335.60
19	Ikot Ekpene		85.92
20	Ini		213.92
21	Itu		180.17
22	Mbo		230.67
23	Mkpat Enin		350.14
24	Nsit Atai		130.66
25	Nsit Ibom		130.60
26	Nsit Ubium		200.84
27	Obot Akara		0.00
28	Okobo		230.09
29	Onna		163.85
30	Oron		5.40
31	Oruk Anam		544.31
32	Udung Uko		30.13
33	Ukanafun		218.25
34	Uruan		345.61
35	Urue-Offong/Oruko		115.72
36	Uyo		183.55
37	Agege		Lagos
38	Ajeromi-Ifelodun	12.87	
39	Alimosho	Lagos	185.25
40	Amuwo-Odofin		129.97
41	Apapa		20.24
42	Badagry		455.38
43	Epe		1188.99
44	Eti-Osa		192.38
45	Ibeju/Lekki		455.30
46	Ifako-Ijaye		33.35
47	Ikeja		46.99
48	Ikorodu		402.14

49	Kosofe		82.28
50	Lagos Island		8.67
51	Lagos Mainland		23.71
52	Mushin		16.70
53	Ojo		163.22
54	Oshodi-Isolo		44.52
56	Surulere		19.72
57	Abeokuta North		775.76
58	Abeokuta South		56.80
59	Ado-Odo/Ota		862.50
60	Egbado North		1875.26
61	Egbado South		736.27
62	Ifelodun		119.56
63	Ifo		543.45
64	Ijebu East		2182.35
65	Ijebu North		960.26
66	Ijebu North East		213.62
67	Ijebu Ode		143.59
68	Ikenne		146.85
69	Ipokia		577.22
70	Obafemi-Owode		1486.90
71	Odeda		1447.58
72	Ogun waterside	Ogun	974.88
73	Akoko-Edo		137.36
74	Esan West		266.98
75	Ikpoba-Okha		859.31
76	Oredo		251.12
77	Ovia North East		2344.67
78	Ovia South West		2781.31
79	Owan East		922.63
80	Owan West		741.42
81	Uhunmwonde	Edo	1995.42
82	Aiyekire (Gbonyin)		234.63
83	Efon		70.70
84	Ekiti East	Ekiti	62.41
85	Ekiti South West		17.11
86	Ekiti West		9.69
87	Emure		250.67
88	Ise/Orun		329.18
89	Aiyedade		766.87
90	Aiyedire		304.72
91	Atakumosa East		466.11
92	Atakumosa West		373.40
93	Boluwaduro		72.95
94	Ede North		102.34
95	Ede South		216.22
96	Egbedore		270.17
97	Ejigbo		365.52

98	Ife Central	Osun	111.30
99	Ife East		192.74
100	Ife North		905.29
101	Ife South		741.84
102	Ifelodun		119.56
103	Ila		0.27
104	Isokan		439.40
105	Iwo		274.43
106	Obokun		452.07
107	Odo-Otin		218.45
108	Odogbolu		551.63
109	Ola-oluwa		328.11
110	Olorunda		109.05
111	Oriade	424.69	
112	Orolu	109.82	
113	Osogbo	61.30	

### 3.5 SOIL MOISTURE INDEX

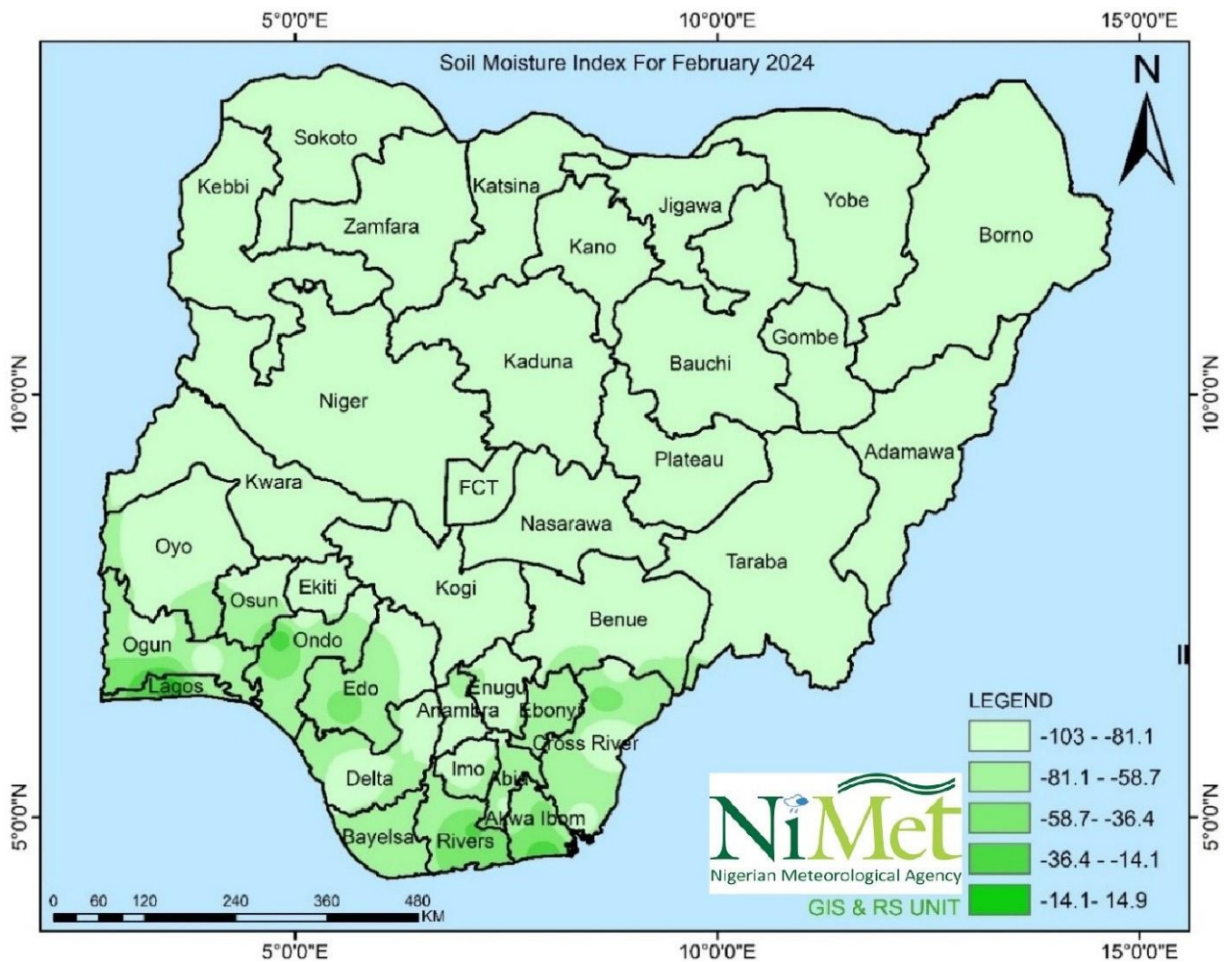


Figure 17: The Soil Moisture Index across Nigeria for February 2024 which depict areas of soil moisture saturation that may be susceptible to flood



### **3.5.1 OBSERVED FEATURES:**

The Soil Moisture Index (SMI) is an important factor that directly or indirectly affects the water cycle and it is influenced by the rainfall distribution in a specific area. It is computed by comparing the current soil moisture to the permanent wilting point and residual soil moisture relative to the field capacity. The SMI is a key parameter in flood forecasting, incorporating factors such as wetness, water retention of the soil, and observed rainfall.

The Soil Moisture Index analysis illustrated in Figure 18, shows the range of soil moisture conditions across the country in February 2024. The values are predominantly negative ranging from -14.1 to -103. This indicates that during the period, soil moisture was below normal across the country.

Putting the Soil Moisture index alongside with the average rainfall data, it is expected that parts of the country with negative average rainfall are likely to experience drier conditions. As seen in the SMI map (Figure 18), slim chances of flood occurrence is anticipated since most places have below normal soil moisture conditions.

### **3.5.2 RECOMMENDATIONS:**

Based on the Soil Moisture Index (SMI) data for February 2024, regions with elevated SMI values, particularly in the South-South, South - West and part of the South-East areas, may experience slight case of flooding. It is therefore important to take necessary measures to mitigate the impact of flooding in these regions.

### 3.6 RELATIVE HUMIDITY

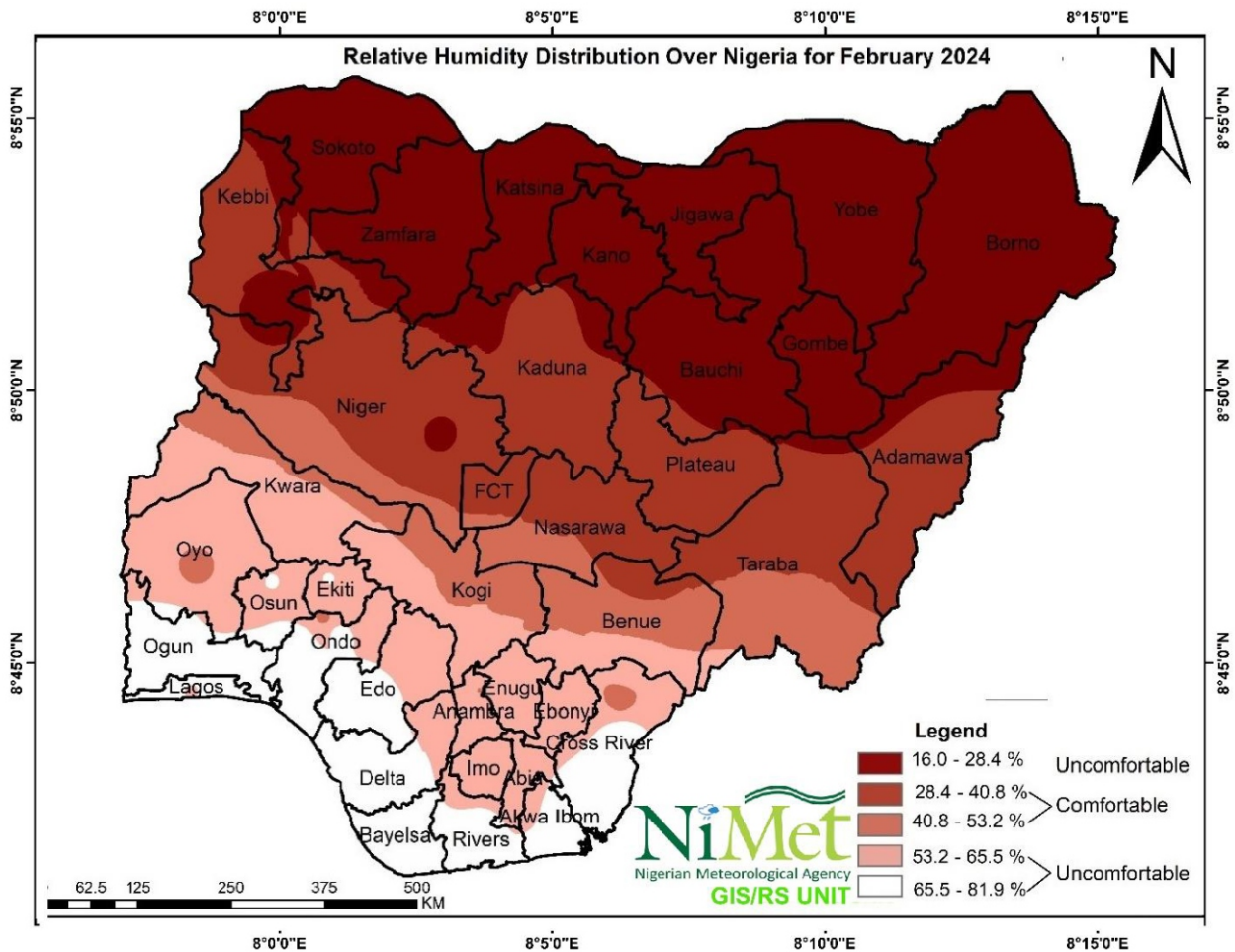


Figure 18: The Relative Humidity Distribution over Nigeria for February 2024 Showing Areas of Comfortable and Uncomfortable Levels Respectively

#### 3.6.1 OBSERVED FEATURES

Humidity is the amount of water vapor in the air. In most places, humidity levels in the air are reasonably stable throughout the year.

Knowing what a comfortable humidity level is outside is crucial as it helps determine how to carry on with activities of the day.

A comfortable humidity is the amount of moisture in the air that's not only appropriate but conducive to a healthy

existence.

For many people, the humidity level considered comfortable is between 30 percent and 50 percent. Humidity levels are variable, with more humidity during the rainy season and less during the harmattan. Humidity levels also vary from place to place and seasonally.

Humidity is the amount of water vapor in the air. In most places, humidity levels in the air are reasonably stable

throughout the year.

The following are the features observed concerning atmospheric moisture distribution over the country, in the month of February 2024:

- The RH in the Sahel savannah zone of the country was between 16.0% and 28.4%, which is not comfortable level outside.
- Good humidity between 28.4% and 40.8% was observed in the Sudan savannah zone of the country.
- In the Guinea savannah zone of the country, the relative humidity ranged between 40.8% and 53.2%, which is also good.
- Uncomfortable outdoor level of relative humidity between 53.2% and 65.5% was observed mainly around the Tropical Forest of the country.
- High humidity between 65.5% and 77.9% mainly was observed around the Rain Forest of the country, which is beyond comfortable humidity level outdoor.

However, these atmospheric conditions may improve in March 2024.

### **3.6.2 RECOMMENDATIONS:**

By maintaining the proper humidity levels, one will have a healthier sleeping and living environment.

One's respiratory health will improve, one will get sick less often, and one will feel more comfortable in one's surroundings.

When air is dehydrated, one is more likely to have issues with his/her hair or skin drying out, and experience cracked furniture.

It's important to know what a comfortable humidity level is outside because it helps beware of allergic reactions that may arise.

If too much moisture in the air, a home may become infested with pests and dust mites. Furthermore, excess humidity can encourage mildew and mold to grow.

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