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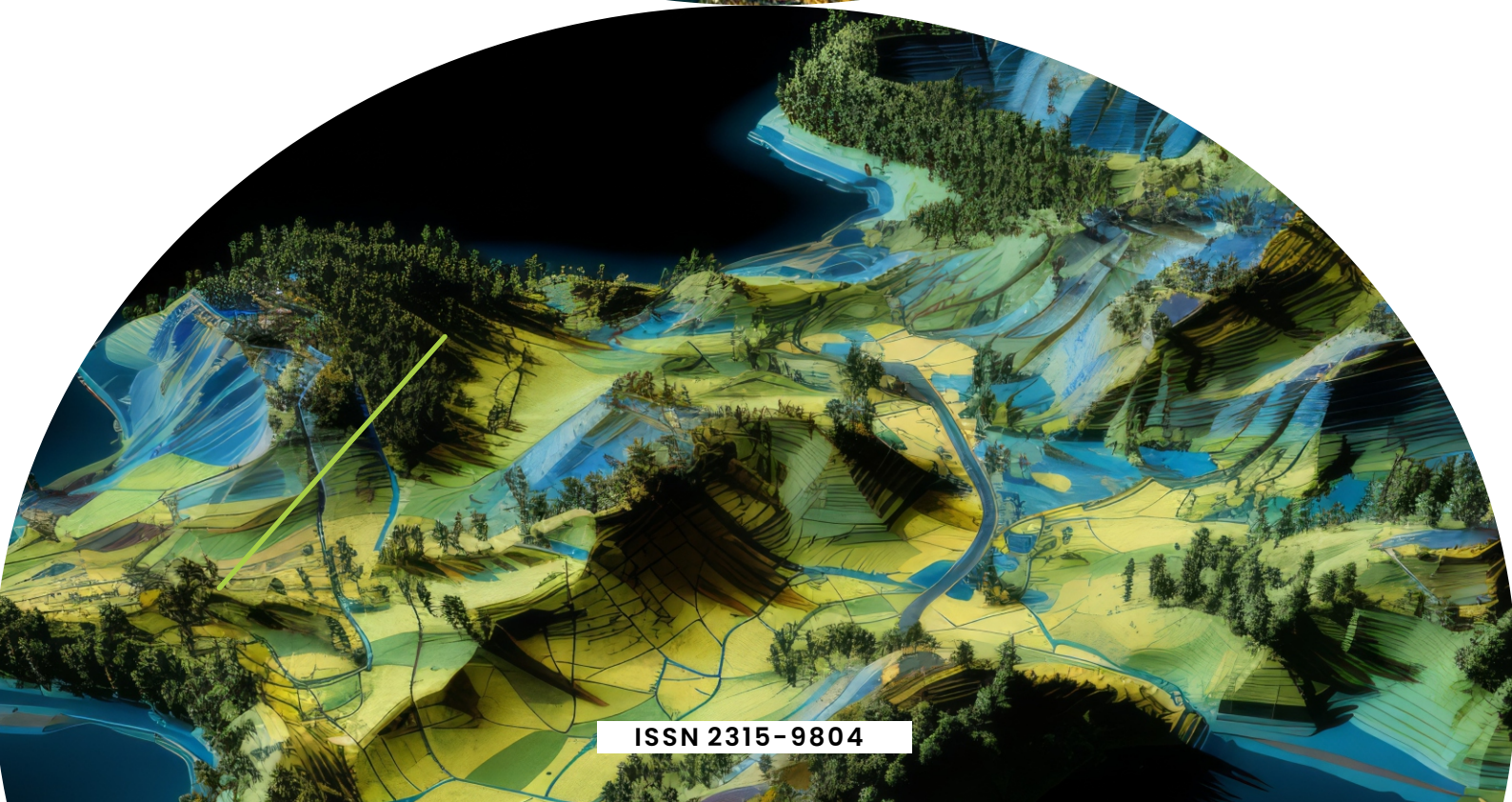
GIS/REMOTE SENSING QUARTERLY EVALUATION BULLETIN

A PUBLICATION OF THE NIGERIAN METEOROLOGICAL AGENCY

2ND QUARTER 2024



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GIS/REMOTE SENSING QUARTERLY EVALUATION BULLETIN

March - May 2024

A publication of Nigerian Meteorological Agency

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...

EDITORIAL

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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:

- Quantitative and Inversion-agriculture, forestry and range
- Ecology
- Earth and environment science
- 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.

Preamble

The 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
March 2024

1.0 Rainfall Distribution

1.1 Rainfall Distribution for March 2024

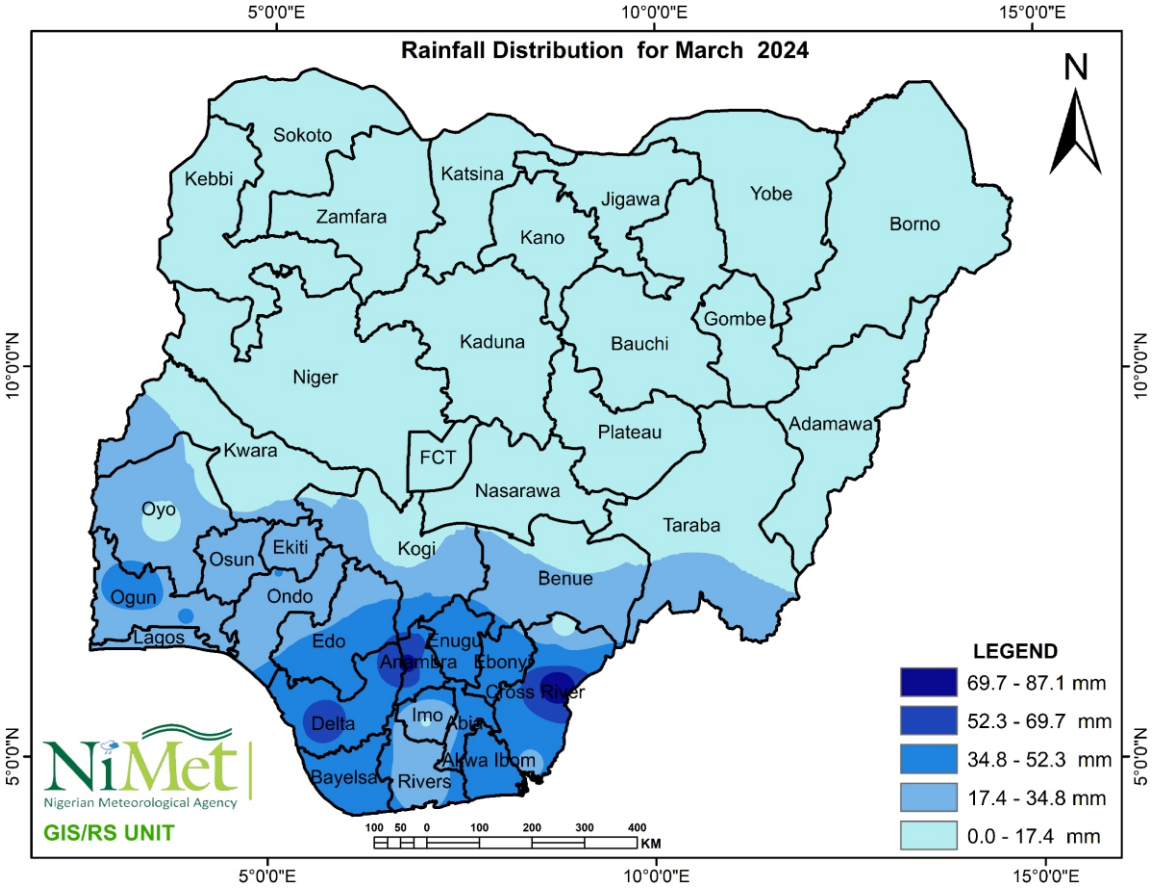

Figure 1: Rainfall Amount for March 2024.

1.1.1 OBSERVED FEATURES: Analysis of the rainfall distribution in March 2024 reveals that not much rainfall activities were experienced over most places across the country, with rainfall values of 87.1mm being the highest recorded value during the period. The northern and central states experienced little or no rainfall amount ranging between 0mm and 17.4mm. However, some parts of Kwara, Kogi and Benue states as well as Oyo, Ondo, Ekiti, Osun, Lagos and parts of Ogun Imo and Rivers states recorded between 17.4mm and 34.8mm of rainfall during the period. On the other hand, the South-East and the South-South region recorded rainfall amounts ranging from 34.8mm to 52.3mm, with particular observation of 52.3mm - 69.7mm over parts of Cross River, Delta,

and Anambra state. 69.7mm – 87.1mm of rainfall was also observed over parts of Cross River state during the period.

1.1.2 RECOMMENDATION: 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

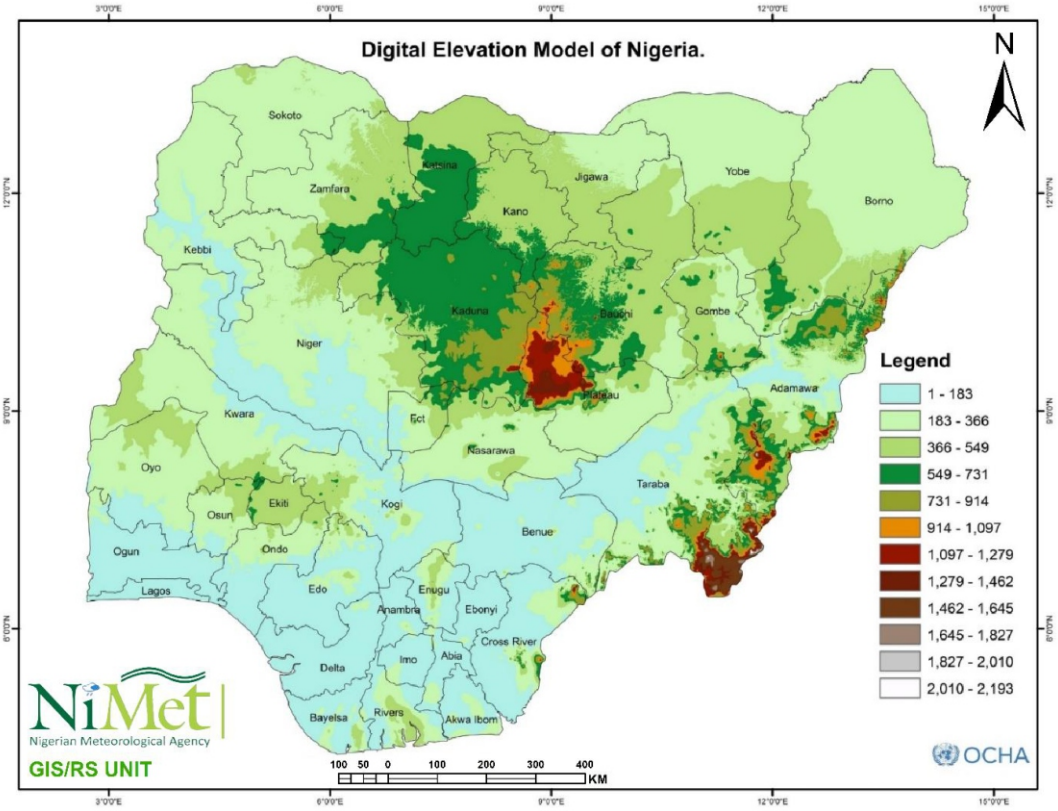

Figure 2: Digital Elevation Model for Nigeria, depicting the geographical positions of high and low areas

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 across the country range from 1 meter to 2193 meters. The highest elevations are observed over parts of 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 MARCH 2024

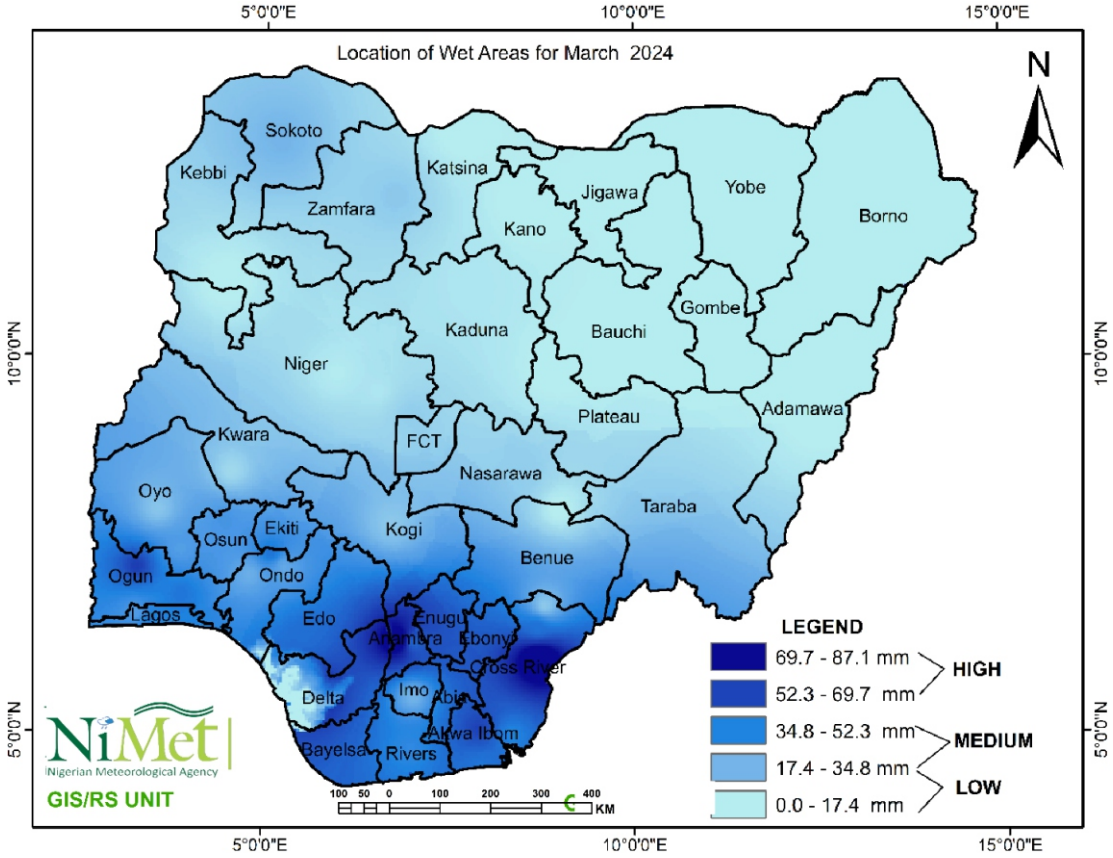

Figure 3: Map indicating Areas of high, medium and low wetness.

Table 1: Classification of flood Risk According to Geopolitical zones

S/N	Geo-political Zones	States	Risk Level
	South West		
1		Ogun	Medium Risk
2		Lagos	Medium Risk
3		Osun	Medium Risk
4		Ondo	Medium Risk
5		Oyo	Medium Risk
6		Ekiti	Medium Risk
	South East		
		Imo	Medium Risk
1		Ebonyi	Medium Risk
2		Anambra	High Risk
3		Abia	Medium Risk
4		Enugu	Medium / High Risk

South South			
		Delta	Low High Risk
1		Rivers	High Risk
2		Akwa Ibom	High Risk
3		Bayelsa	Medium Risk
4		Edo	Medium Risk
5		Cross River	High Risk
North Central			
1		Kwara	Medium Risk
2		Benue	Medium Risk
3		Kogi	Medium Risk
4		Kaduna	Low Risk
5		Plateau	Low Risk
6		Niger	Low Risk
7		Abuja	Low Risk
North East			
1		Taraba	Low Risk Medium 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 – Medium Risk
6		Zamfara	Low Risk
7			

1.4 LOCATION OF HIGH RISK AREAS FOR MARCH 2024

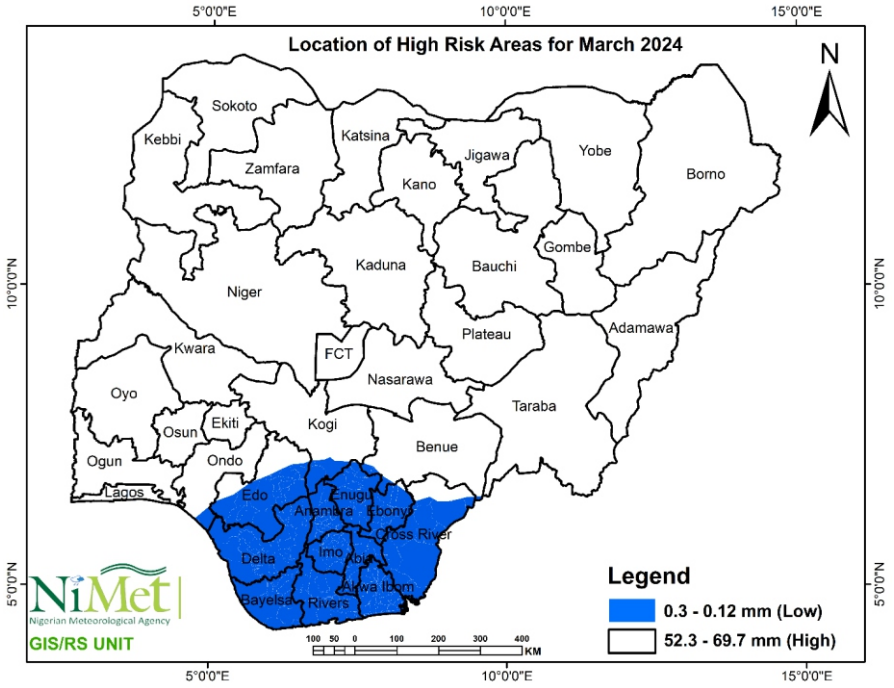

Figure 4: Map Depicting Location of High and Low Risk Areas in March 2024

1.4.1 OBSERVED FEATURES:

Further examination of potential flood risk zones has identified certain local government areas with likelihood to potential flood incidents if precipitation is sustained over the area. Noteable amongst the states are Anambra, Rivers, Akwa Ibom and Cross River.

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: Monitor local news and weather reports regularly, paying attention to guidance provided by emergency services and local authorities. It is important 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 March 2024

S/N	LGA	STATE	AREA (SQ.KM)
1	Aba North	Abia	18.6855
2	Aba South		43.2994
3	Arochukwu		521.159
4	Bende		618.676
5	Isiala-Ngwa North		283.552
6	Isiala-Ngwa South		277.023
7	Obi Ngwa		403.884
8	Ohafia		439.953
9	Ugwunagbo		125.999
10	Ukwa East		282.855
11	Ukwa West		277.388
12	Umu-Nneochi		368.069
13	Umuahia North		227.469
14	Umuahia South		135.252
15	Abak	Akwa Ibom	178.106
16	Eastern Obolo		122.9
17	Eket		166.129
18	Esit - Eket		169.319
19	Essien Udim		289.118
20	Etim Ekpo		220.322
21	Etinan		172.796
22	Ibeno		242.743
23	Ibesikpo Asutan		175.04
24	Ibiono Ibom		336.026
25	Ika		114.651
26	Ikono		262.512
27	Ikot Abasi		335.601
28	Ikot Ekpene		115.859

29	Ini		382.779
30	Itu		180.171
31	Mbo		239.491
32	Mkpat Enin		350.137
33	Nsit Atai		130.663
34	Nsit Ibom		130.599
35	Nsit Ubium		200.844
36	Obot Akara		234.8
37	Okobo		300.885
38	Onna		163.851
39	Oron		52.1065
40	Oruk Anam		544.31
41	Udung Uko		58.6463
42	Ukanafun		218.251
43	Uruan		346.507
44	Urue-Offong/Oruko		115.724
45	Uyo		183.554
46	Abakaliki		463.089
47	Afikpo North		239.026
48	Afikpo South		376.908
49	Ebonyi		438.357
50	Ezza North		413.274
51	Ezza South		263.975
52	Ishielu		694.885
53	Ivo		266.647
54	Izzi		929.018
55	Ohaozara		333.239
56	Ohaukwu		602.177
57	Onicha	Ebonyi	439.057
58	Abi		267.796
59	Akamkpa		5012.19
60	Akpabuyo		779.248
61	Biase		1291.98
62	Boki	Cross River	2569.82

63	Calabar-Municipal		137.446
64	Calabar South		188.493
65	Etung		807.982
66	Ikom		1966.31
67	Obanliku		360.586
68	Obubra		1143.9
69	Obudu		2.60642
70	Odukpani		1353.84
71	Ogoja		347.266
72	Yakurr		658.669
73	Yala		145.92
74	Bakassi		4.16484
75	Aniocha North		404.922
76	Aniocha South		871.457
77	Bomadi		128.996
78	Burutu		1923.37
79	Ethiope East		380.549
80	Ethiope West		538.407
81	Ika North East		468.366
82	Ika South		436.282
83	Isoko North		482.813
84	Isoko South		690.806
85	Ndokwa East		1610.95
86	Ndokwa West		823.047
87	Okpe		481.43
88	Oshimili North		510.657
89	Oshimili South		266.654
90	Patani		226.454
91	Sapele		430.203
92	Udu		166.197
93	Ughelli North		832.506
94	Ughelli South		771.61
95	Uvwie	Delta	112.703

96	Warri North		1842.13
97	Warri South		587.313
98	Warri South West		1693.69
99	Egor		76.3224
100	Esan Central		264.355
101	Esan North East		342.468
102	Esan South East		1306.97
103	Esan West		516.163
104	Etsako Central		504.306
105	Etsako East		148.18
106	Etsako West		504.249
107	Igueben		350.025
108	Ikpoba-Okha		859.31
109	Oredo		251.122
110	Orhionmwon		2415.42
111	Ovia North East		1700.99
112	Ovia South West		1464.03
113	Owan East		192.142
114	Owan West		108.441
115	Uhunmwonde	Edo	1995.42
116	Aboh-Mbaise		176.226
117	Ahiazu-Mbaise		113.912
118	Ehime-Mbano		174.31
119	Ezinihitte		120.43
120	Ideato North		182.232
121	Ideato South		104.183
122	Ihitte/Uboma		108.43
123	Ikeduru		181.191
124	Isu		52.6139
125	Mbaitoli		200.071
126	Ngor-Okpala		542.302
127	Njaba		78.4902
128	Nkwerre	Imo	35.0543

129	Nwangele		69.6638
130	Obowo		86.4259
131	Oguta		422.537
132	Ohaji/Egbema		896.423
133	Okigwe		306.901
134	Orlu		122.759
135	Orsu		75.0878
136	Oru East		131.475
137	Oru West		96.791
138	Owerri-Municipal		56.3177
139	Owerri North		194.006
140	Owerri West		286.433
141	Unuimo		107.676
142	Abua/Odual		716.808
143	Ahoada East		318.438
144	Ahoada West		440.882
145	Akuku Toru		1231.56
146	Andoni		251.147
147	Asari-Toru		115.089
148	Bonny		526.07
149	Degema		979.069
150	Eleme		136.63
151	Emohua		833.588
152	Etche		816.079
153	Gokana		132.754
154	Ikwerre		658.512
155	Khana		558.863
156	Obia/Akpor		257.747
157	Ogba/Egbema/Ndoni		959.192
158	Ogu/Bolo		130.031
159	Okrika		286.498
160	Omumma		158.78
161	Opobo/Nkoro	Rivers	114.824

162	Oyigbo		247.303
163	Port-Harcourt		108.239
164	Tai		160.589
165	Ado		547.351
166	Ado		547.351
167	Kwande		81.3807
168	Ogbadibo		363.373
169	Okpokwu	Benue	121.106
170	Aguata		173.552
171	Anambra East		258.971
172	Anambra West		954.27
173	Anaocha		100.796
174	Awka North		345.52
175	Awka South		173.481
176	Ayamelum		590.574
177	Njikoka		97.4865
178	Ekwusigo		121.991
179	Idemili North		132.478
180	Idemili South		131.333
181	Ihiala		240.972
182	Dunukofia		53.3915
183	Nnewi North		68.6218
184	Nnewi South		154.296
185	Ogbaru		518.146
186	Onitsha North		37.6439
187	Onitsha South		9.92652
188	Orumba North		321.064
189	Orumba South		188.271
190	Oyi	Anambra	135.147
191	Aninri		369.478
192	Awgu		441.555
193	Enugu East		391.933
194	Enugu North	Enugu	93.3048

195	Enugu South		75.283
196	Ezeagu		638.321
197	Igbo-Etiti		333.973
198	Igbo-Eze North		267.815
199	Igbo-Eze South		170.143
200	Isi-Uzo		845.445
201	Nkanu East		759.97
202	Nkanu West		254.864
203	Nsukka		556.327
204	Oji-River		411.416
205	Udenu		256.885
206	Udi		890.89
207	Uzo-Uwani		841.957
208	Ekeremor		1777.12
209	Kolokuma/Opokuma		351.037
210	Nembe		1404.46
211	Ogbia		679.069
212	Sagbama		950.168
213	Southern Ijaw		2698.97
214	Yenegoa	Bayelsa	683.186
215	Ese-Odo		813.382
216	Ilaje		116.235
217	Irele	Ondo	15.6254
218	Ibaji		1335.93
219	Idah		110.737
220	Igalamela-Odolu	Kogi	1362.82

1.5 SOIL MOISTURE INDEX FOR MARCH 2024

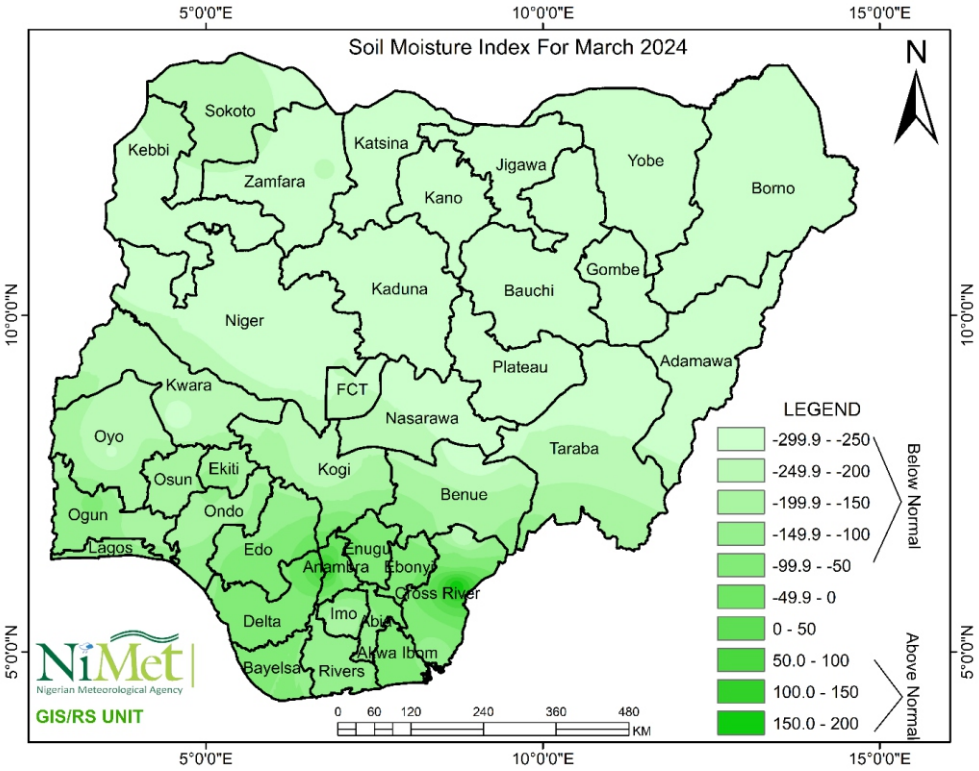

Figure 5: The Soil Moisture Index across Nigeria for March 2024 depicting areas of soil moisture saturation that may be predisposed to flood.

1.5.1 OBSERVED FEATURES:

The SMI analysis, illustrated in Figure 5, offers insights into the range of soil moisture conditions across the country in March 2024. This classification spans from normal (-12.7 to 0 to +83), below normal (-12.7 to -299.9), to above normal (83 to 178.7).

Deducing from the SMI Map, it can be seen that the available soil moisture over the northern, central and south western states of the country are below normal to normal conditions while the soil moisture over the south-south region is observed to be under normal to above normal condition especially over parts of Cross River and Anambra state. Integrating these information with the average rainfall received during the period, it is expected that regions with negative or low positive average rainfall are likely to experience drier conditions. The northern, central the southwestern parts of the country are expected to be dry. However, places over the south - east and south – south regions especially parts of Cross River,

Anambra, Enugu and Akwa Ibom state are seen to be above normal condition as such can be subject to flood if continuous rainfall persists.

1.5.2 RECOMMENDATIONS:

Regions under above normal conditions, particularly in the South-South and part of the South-East areas, may experience slight flood cases with persistent wetness. It is therefore important to take adequate precautions and implement measures to mitigate the impact of flooding in these regions.

1.6 RELATIVE HUMIDITY DISTRIBUTION

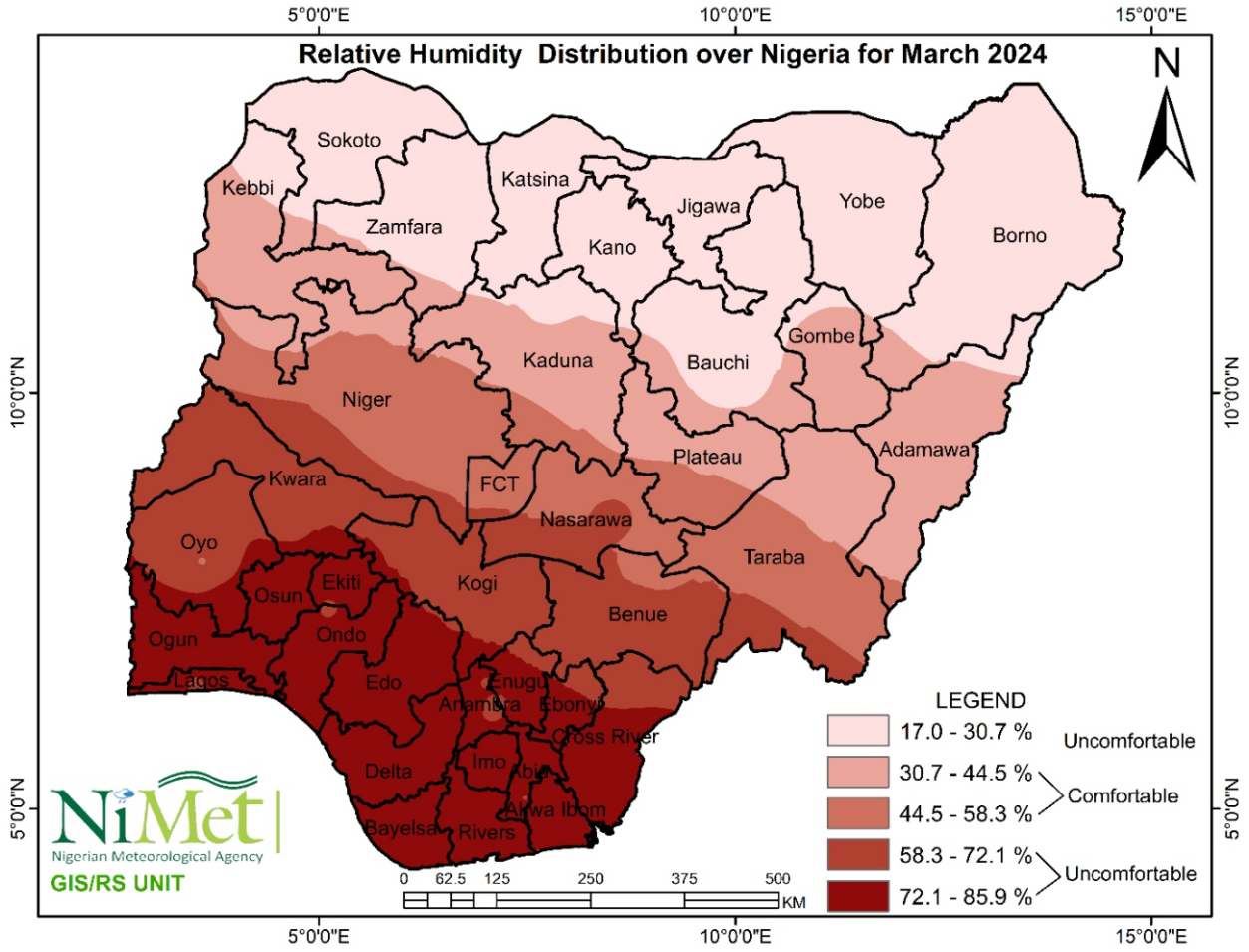

Figure 6: The Relative Humidity Distribution over Nigeria for March 2024 Showing Areas of Comfortable and Uncomfortable Levels Respectively.

1.6.1 OBSERVED FEATURES:

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

- The Relative Humidity (RH) over the extreme northern parts of the country, including of Gombe, Bauchi, Kaduna and Kebbi state is between 19.0% and 31.2%, which is at the uncomfortable level.
- Part of Kebbi, Zamfara, Kaduna, Bauchi, Plateau, Gombe, Adamawa, Taraba, Benue, Nasarawa, Federal Capital Territory and Niger state experienced good relative humidity ranging between 31.2% and 55.5%
- Relative humidity range of between 55.5% and 67.7% was observed mainly over Benue, parts of Kwara, Kogi, Oyo, Enugu, Cross River, Ebonyi, Anambra, Taraba, Niger, Nasarawa and the Federal Capital Territory.
- High Relative Humidity beyond comfortable humidity level in the range of 67.7% and 85.5% was observed mainly over the South-Western, South – Eastern region including Delta, Bayelsa, Rivers, Cross River and Akwa Ibom state.

However, these atmospheric conditions may be maintained in April 2024.

1.6.2 RECOMMENDATIONS:

The following tips may be followed to stay cold and dry, even if humidity levels are sky-high:

- Wear the right clothes
- Stay hydrated
- Limit strenuous outdoor activities
- Use anti-perspirant
- Use talcum powder (This is used to keep skin dry and helping prevent rashes)
- Use the dehumidifier

CHAPTER TWO
APRIL 2024

2.1 Rainfall Distribution

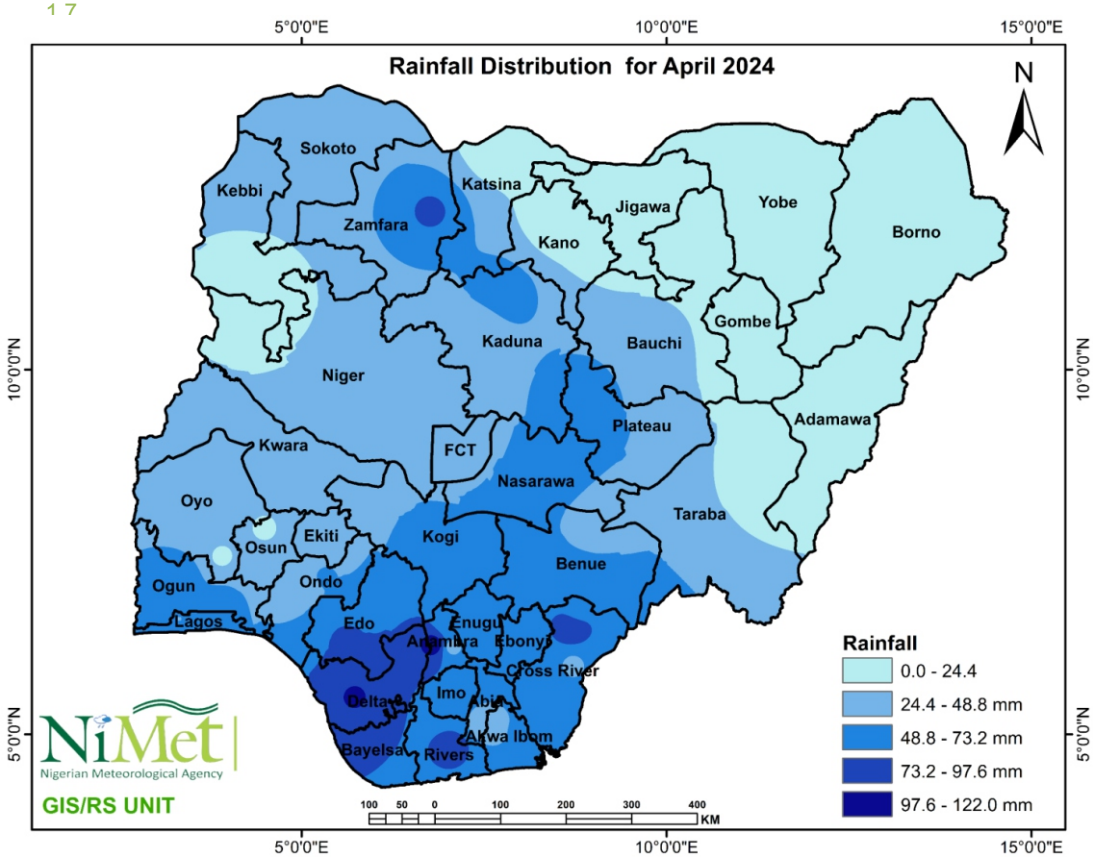

Figure 7: Rainfall Amount across Nigeria in April, 2024.

2.1.1 OBSERVED FEATURES: The rainfall distribution across Nigeria in April 2024 reveal that not much rainfall activities were experienced over most places across the country with rainfall amount of 122.0mm being the highest recorded value during the period. The northern and central states experienced rainfall ranging from 00mm to 24.4mm. However, Sokoto, Kebbi, Zamfara, Kwara, Oyo, Osun, Ekiti, Kaduna, Plateau, as well as some parts of Ondo and Akwa Ibom states states, recorded rainfall amounts between 24.4mm and 48.8mm on the other hand, the South-East and the South-South region recorded rainfall amounts ranging from 48.8mm to 73.2mm, while Kogi, Nassarawa, Ebonyi, Edo, some parts of Ondo, Cross- River, Enugu, Lagos and Ogun states experienced rainfall amounts ranging from 73.2mm to 97.6mm. Meanwhile

Delta, Anambra, Bayelsa, Rivers and some part of Cross River states experienced amounts of rainfall of ranging from 97.6 mm to 122.0mm

2.1.2 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.

2.2 DIGITAL ELEVATION MODEL (DEM)

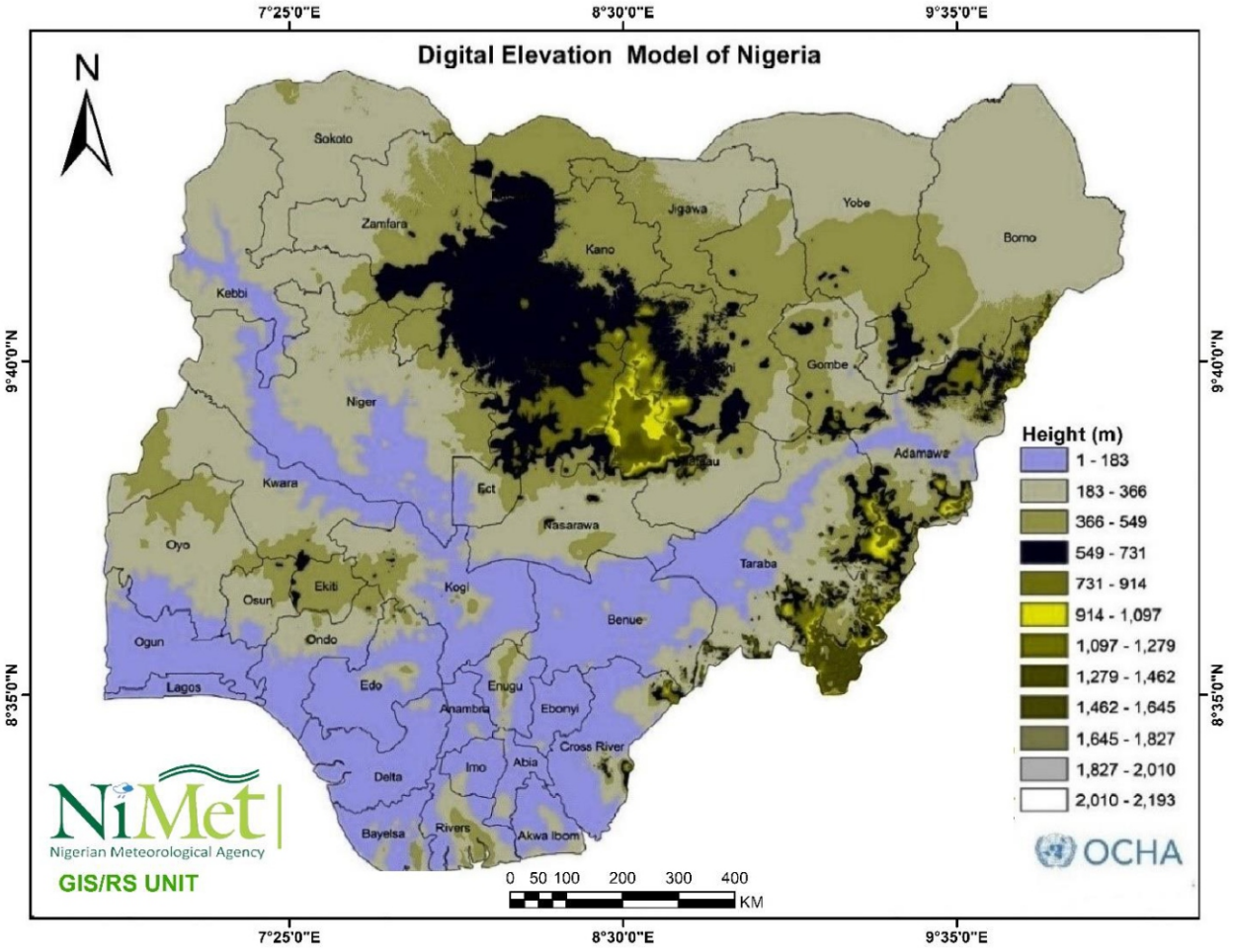

Figure 8: Digital Elevation Model for Nigeria, depicting the geographical positions of high and low areas

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2.2.2 RECOMMENDATIONS:

Elevated areas above sea level and areas with steep slopes are susceptible 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 important 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

2.3. LOCATION OF WET AREAS FOR April 2024

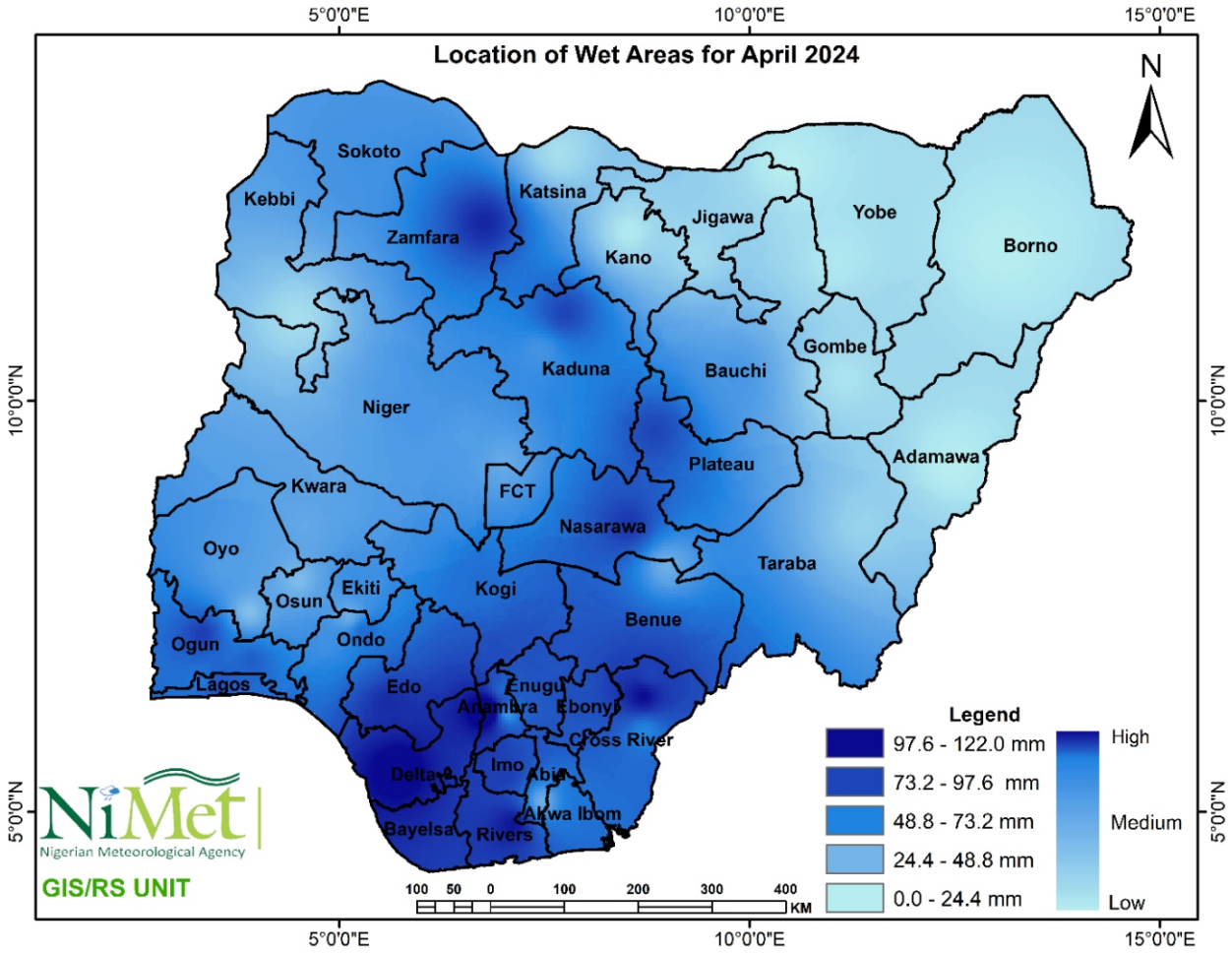


Figure 9: Map indicating Areas of high, medium and low wetness.

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

S/N	Geo-political Zones	States	Risk Level
South West			
1		Ogun	**Medium Risk**
2		Lagos	**Medium Risk**
3		Osun	**Medium Risk**
4		Ondo	**Medium Risk**
5		Oyo	**Medium Risk**
6		Ekiti	**Medium Risk**
South East			
		Imo	**Medium Risk**
1		Ebonyi	**Medium Risk**

2		Anambra	High Risk
3		Abia	Medium Risk
4		Enugu	Medium High Risk
South South			
		Delta	High Risk
1		Rivers	High Risk
2		Akwa Ibom	Low High Risk
3		Bayelsa	High Risk
4		Edo	Medium High Risk
5		Cross River	Medium High Risk
North Central			
1		Kwara	Medium Risk
2		Benue	Medium Risk
3		Kogi	Medium Risk
4		Kaduna	Medium Risk
5		Plateau	Medium Risk
6		Niger	Medium Risk
7		Abuja	Medium Risk
North East			
1		Taraba	Low Risk – Medium Risk
2		Borno	Low Risk
3		Yobe	
4		Kebbi	Low Risk
5		Bauchi	Low Risk
6		Gombe	Low Risk
			Low Risk
North West			
1		Jigawa	Low Risk
2		Kano	Low Risk
3		Kebbi	Low Risk
4		Katsina	Low Risk
5		Sokoto	Low Risk Medium Risk
6		Zamfara	Low Risk
7			

2..4 LOCATION OF HIGH RISK AREAS FOR APRIL 2024

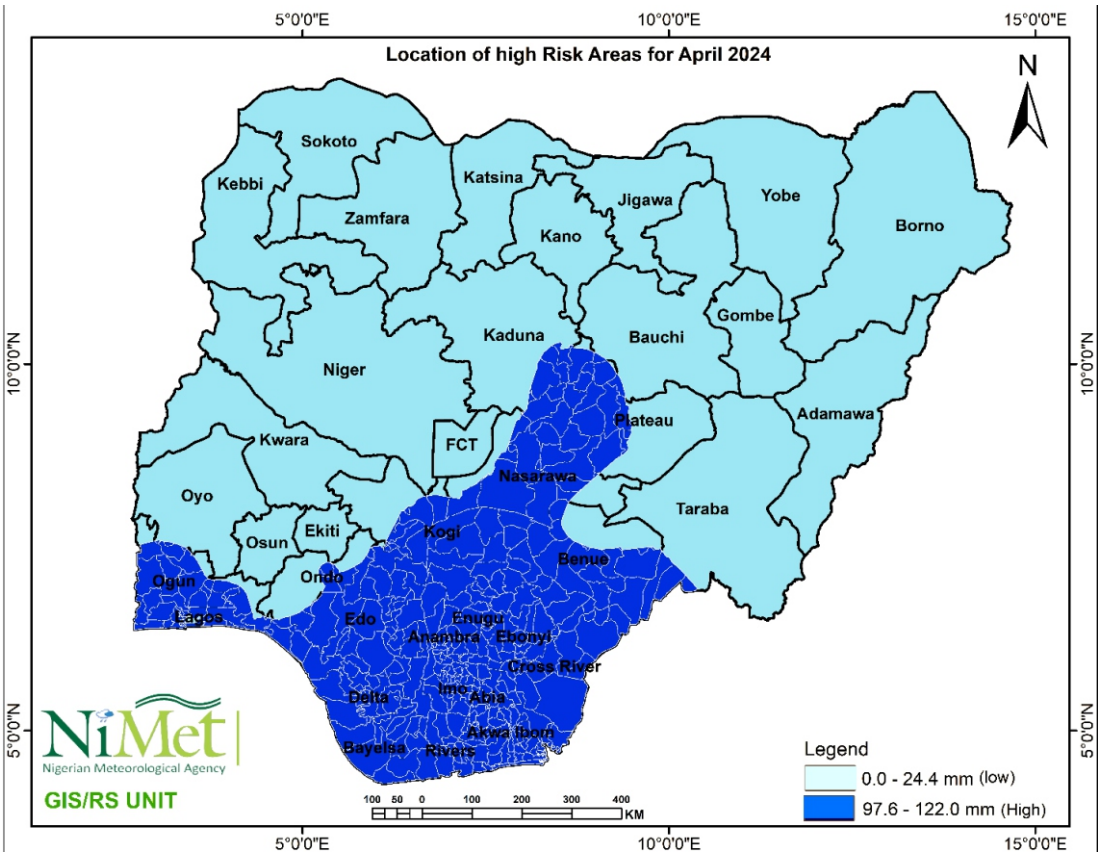


Figure 10: Map Depicting Location of High and Low Risk Areas in April 2024

2.4.1 OBSERVED FEATURES:

Certain local government areas have been identified with likelihood to potential flood incidents if precipitation is sustained over the area. Noteable amongst the states are Anambra, Rivers, Akwa Ibom, Cross River, Ebonyi,Lagos, Ogun, Imo, Delta, Kogi, Nassarawa,Bayelsa, Enugu,Edo,some part of Ondo and Plateau.

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.

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: Monitor local news and weather reports regularly, paying attention to guidance provided by emergency services and local authorities. It is important 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 April 2024

SN	LGA	STATES	AREA
1	Ukwa West	Abia	121.52
2	Anambra East	Anambra	189.39
3	Anambra West		499.17
4	Ayamelum		15.256
5	Ekwusigo		121.99
6	Idemili North		101.65
7	Idemili South		89.604
8	Ihiala		99.895
9	Dunukofia		8.2933
10	Nnewi North		45.831
11	Nnewi South		7.5055
12	Ogbaru		476.3
13	Onitsha North		37.644
14	Onitsha South		9.9265
15	Oyi		123.64
16	Brass	Bayelsa	0.1443
17	Ekeremor		1808.5
18	Kolokuma/Opokuma		351.04
19	Ogbia		133.01
20	Sagbama		805.01
21	Southern Ijaw		2429.4
22	Yenegoa		455.19
23	Boki	Cross River	652.21
24	Ikom		340.13
25	Ogoja		629.95
26	Yala		533.69
27	Aniocha North		404.92
28	Aniocha South		871.46

29	Bomadi	Delta	129
30	Burutu		1935.9
31`	Ethiope East		380.55
32	Ethiope West		538.41
33	Ika North East		468.37
34	Ika South		436.28
35	Isoko North		482.81
36	Isoko South		690.81
37	Ndokwa East		1461
38	Ndokwa West		823.05
39	Okpe		481.43
40	Oshimili North		510.66
41	Oshimili South		266.65
42	Patani		226.45
43	Sapele		430.2
44	Udu		166.2
45	Ughelli North		832.51
46	Ughelli South		771.61
47	Ukwuani		409.34
48	Uvwie		112.7
49	Warri North		1170.1
50	Warri South		587.31
51	Warri South West		1700.1
52	Izzi	Ebonyi	46.767
53	Egor	Edo	76.322
54	Esan South East		579.45
55	Igueben		68.52
56	Ikpoba-Okha		859.31
57	Oredo		251.12
58	Orhionmwon		2412.5
59	Ovia North East		869.11
60	Ovia South West		69.6
61	Uhunmwonde		609.94
62	Ibaji	Kogi	26.783
63	Abua/Odual	Rivers	13.586
64	Akuku Toru		99.215
65	Asari-Toru		115.09
66	Bonny		63.743
67	Degema		568.23
68	Eleme		136.63
69	Emohua		271.07
70	Etche		242.15
71	Gokana		30.482
72	Ikwerre		239.37

73	Obia/Akpor		257.75
74	Ogba/Egbema/Ndoni		4.1248
75	Ogu/Bolo		103.54
76	Okrika		285.46
77	Omumma		9.4443
78	Oyigbo		84.458
79	Port-Harcourt		108.24
80	Tai		130.41
81	Birnin Magaji	Zamfara	71.693
82	Bungudu		645.81
83	Gusau		669.86
84	Kaura Namoda		148.26
85	Tsafe		157.06

2.5 SOIL MOISTURE INDEX

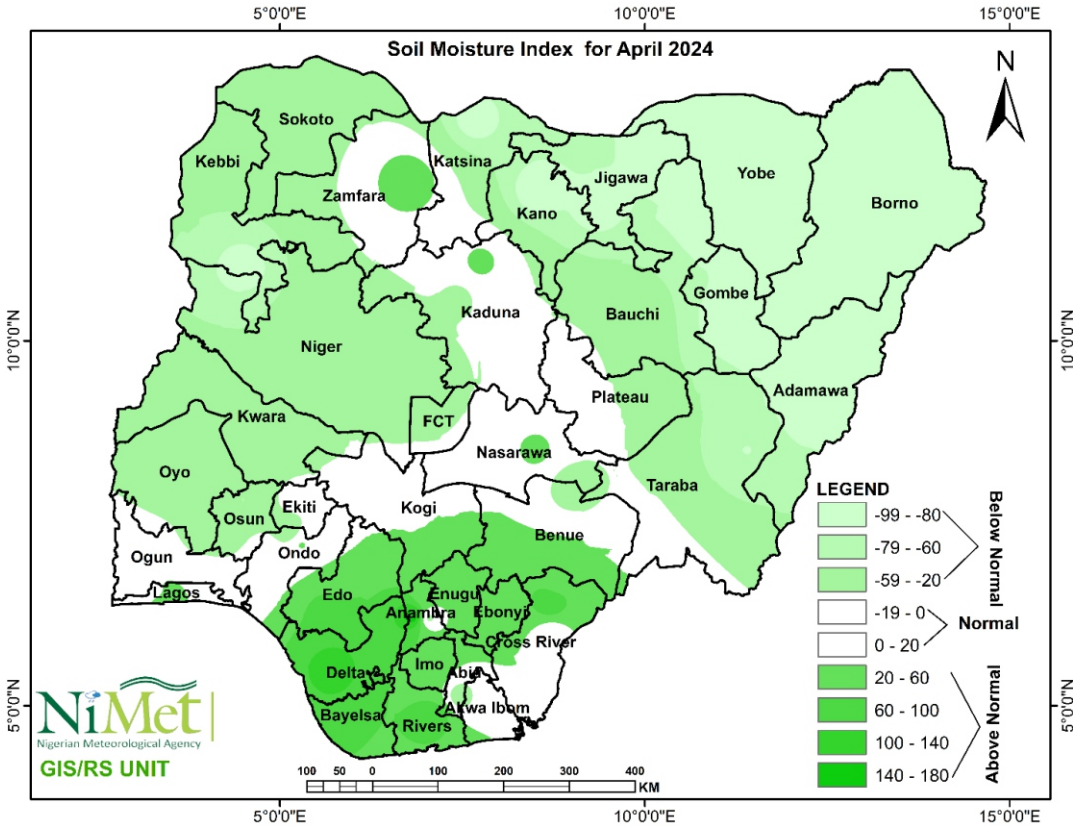


Figure 11: The Soil Moisture Index across Nigeria for April 2024 depicting areas of soil moisture saturation that may be predisposed to flood.

2.5.1 OBSERVED FEATURES:

The SMI analysis, illustrated in Figure 5, offers insights into the range of soil moisture conditions across the country in April 2024. This classification spans from below normal (-19 - 99), normal (-19 - 20), to above normal (20- 180).

Deducing from the SMI Map and integrating it with the average rainfall received during the period, it is expected that regions with negative or low positive average rainfall are likely to experience drier conditions. From the North down to the Central including the south western region are expected to be dry. However, places over the south - east and south – south region especially parts of Delta, Anambra, Bayelsa, and Rivers states recorded above normal condition, as such can be subject to flood and therefore may experience flooding if continuous rainfall persists.

2.5.2 RECOMMENDATIONS:

Places with high SMI values, particularly in the South-South and part of the South-East areas, may experience slight wetness in April 2024. It is important to take adequate precautions and implement measures to mitigate the impact of flooding in these regions.

2.6 RELATIVE HUMIDITY DISTRIBUTION

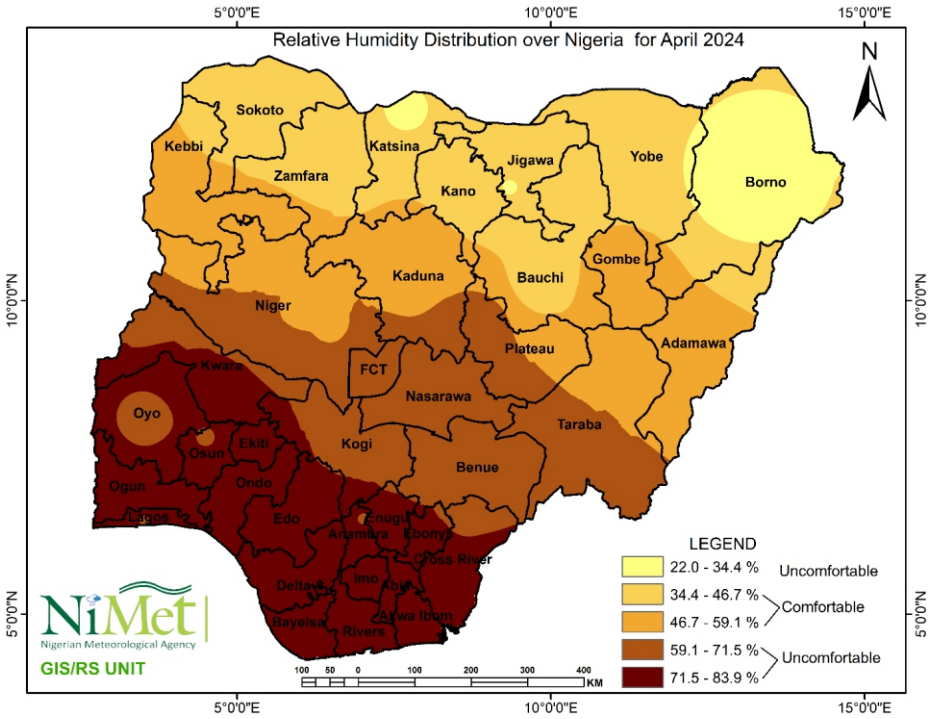


Figure 12: The Relative Humidity Distribution over Nigeria for April 2024 Showing Areas of Comfortable and Uncomfortable Levels Respectively.

2.6.1 OBSERVED FEATURES

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

- The Relative Humidity (RH) observed over the extreme northern region including parts of Borno, Jigawa and Katsina are all relatively dry.
- Part of Kebbi, Kaduna, Adamawa, Gombe, Plateau, Kogi, Taraba, Benue, Nasarawa, Federal Capital Territory and Niger state experienced good relative humidity ranging between 34.4% and 46.7%
- Relative humidity range of between 46.7% and 59.2% was observed mainly over Benue, parts of Kwara, Kogi, Oyo, Ebonyi, Anambra, Taraba, Niger, Nasarawa and the Federal Capital Territory.
- High Relative Humidity beyond comfortable humidity level in the range of 71.5% and 83.9% was observed mainly over the South-Western, South – Eastern states including Delta, Bayelsa, Rivers, Cross River and Akwa Ibom .

However, these atmospheric conditions may be maintained in May 2024.

2.6.2 RECOMMENDATIONS:

The following tips may be followed to stay cold and dry, even if humidity levels are sky-high:

- Wear the right clothes
- Stay hydrated
- Limit strenuous outdoor activities
- Use anti-perspirant
- Use talcum powder (This is used to keep skin dry and helping prevent rashes)
- Use a the dehumidifier

CHAPTER THREE
May 2024

3.1 Rainfall Distribution

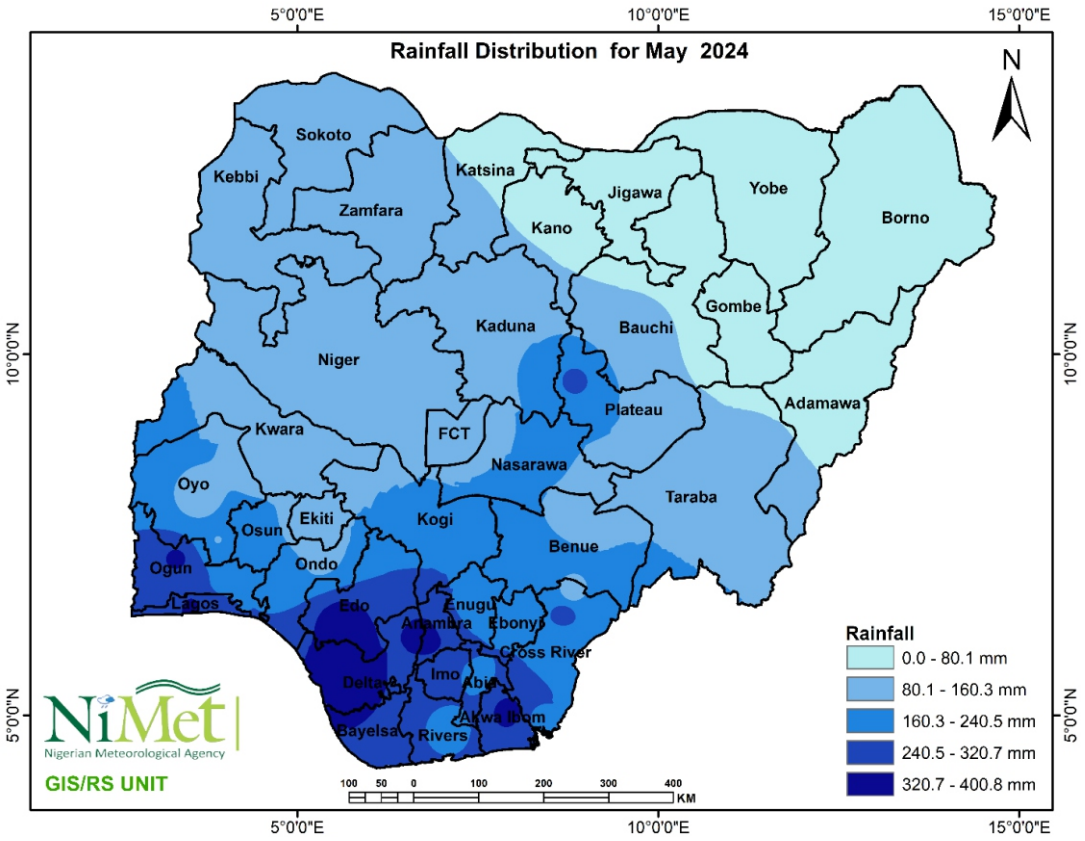


Figure 13: Map showing the rainfall distribution across Nigeria in May 2024

3.1.1 OBSERVED FEATURES:

The rainfall distribution in May 2024 reveals that there is increase in rainfall activities with distribution reaching most parts of the country with exception of some parts of the North East axis that had little or no rainfall activities. The highest amount of rainfall was recorded in (Warri) Delta state with a value of 400.9mm while the lowest value of 16.7mm was recorded in Gombe state.

3.1.2 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.

3.2 DIGITAL ELEVATION MODEL

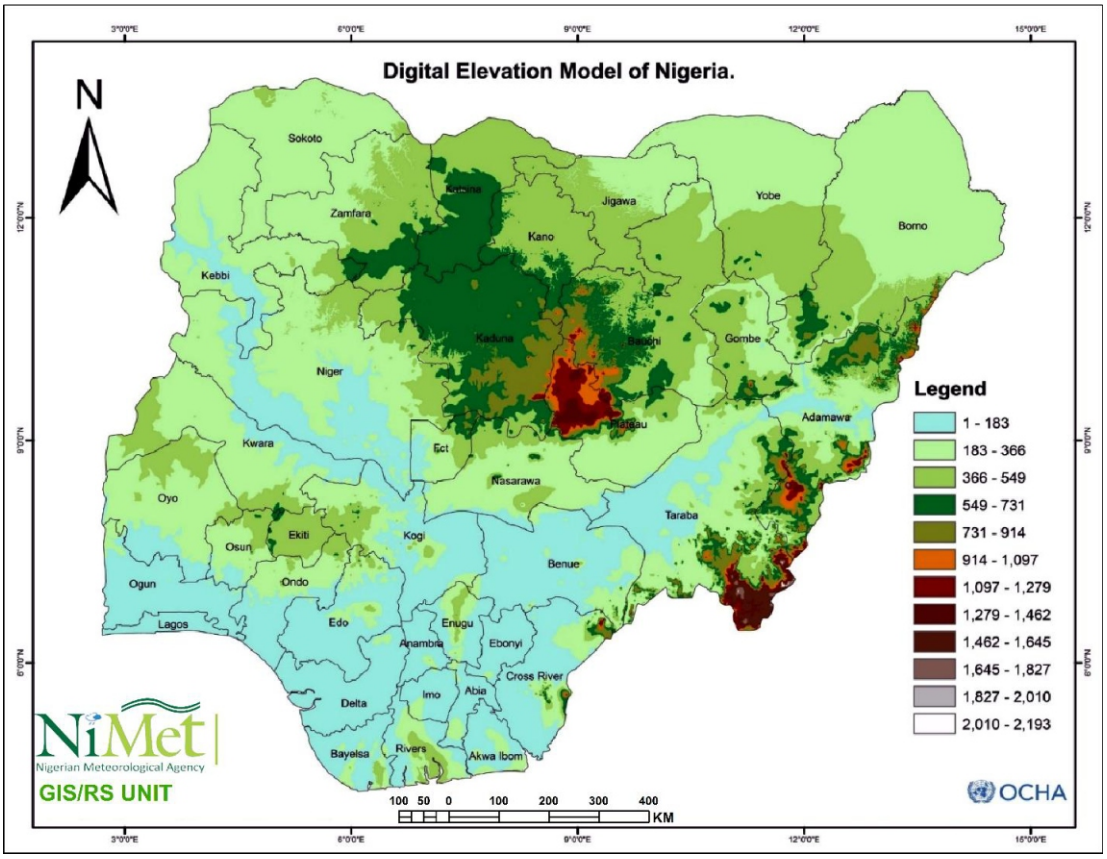


Figure 14: Digital Elevation Model for Nigeria, depicting the geographical positions of high and low areas

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 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 across the country range from 1 meter to 2193 meters. The highest elevations are observed over parts of 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 vulnerable

to erosion and landslides. In the event of heavy rainfall, it is important for local authorities and residents in these regions to be mindful of these potential risks.

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

Infrastructure Development: Thorough planning is important 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.

3.3 LOCATION OF WET AREAS FOR MAY 2024

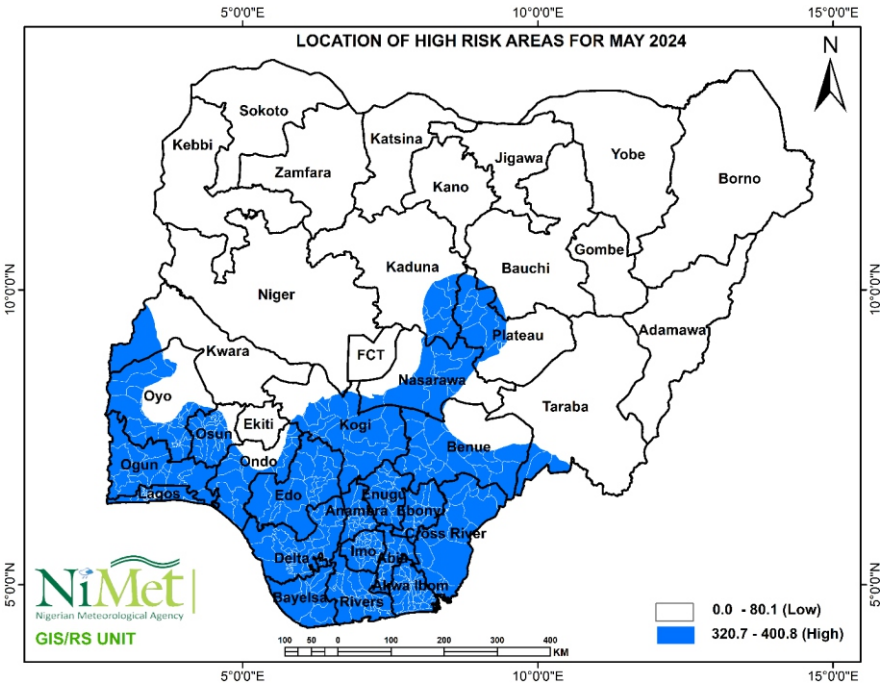


Figure 15: Map indicating Areas of High and Low Flood Risk in May 2024

3.3.1 OBSERVED FEATURES:

Certain local government areas in some states have been identified to be at higher risk of flooding if heavy rainfall continues over the areas. Noteable amongst the states are Anambra, Rivers, Akwa Ibom and Cross River.

3.3.2 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: People in flood-prone areas are advised to monitor local news and weather reports regularly, paying attention to guidance provided by emergency services and local authorities. It is important to stay updated on weather and flood information from NiMet and Nigeria Hydrological Service Agency (NIHSA). Local authorities are advised to initiate and communicate evacuation plans for vulnerable communities, identifying safe shelters and evacuation routes before flooding occurs.

Table 5: Location of High-Risk Local Government Areas for May 2024

S/N	LGA	STATE	AREA (SQ.KM)
1	Aba North		18.6855
2	Aba South		43.2994
3	Arochukwu		521.159
4	Bende		618.676
5	Isiala-Ngwa North		283.552
6	Isiala-Ngwa South		277.023
7	Obi Ngwa		403.884
8	Ohafia		439.953
9	Ugwunagbo		125.999

10	Ukwa East	Abia	282.855
11	Ukwa West		277.388
12	Umu-Nneochi		368.069
13	Umuahia North		227.469
14	Umuahia South		135.252
15	Abak	Akwa Ibom	178.106
16	Eastern Obolo		122.9
17	Eket		166.129
18	Esit - Eket		169.319
19	Essien Udim		289.118
20	Etim Ekpo		220.322
21	Etinan		172.796
22	Ibeno		242.743
23	Ibesikpo Asutan		175.04
24	Ibiono Ibom		336.026
25	Ika		114.651
26	Ikono		262.512
27	Ikot Abasi		335.601
28	Ikot Ekpene		115.859
29	Ini		382.779
30	Itu		180.171
31	Mbo		239.491
32	Mkpat Enin		350.137
33	Nsit Atai		130.663
34	Nsit Ibom		130.599
35	Nsit Ubium		200.844
36	Obot Akara		234.8
37	Okobo		300.885
38	Onna		163.851
39	Oron		52.1065
40	Oruk Anam		544.31
41	Udung Uko		58.6463
42	Ukanafun		218.251
43	Uruan		346.507
44	Urue-Offong/Oruko		115.724
45	Uyo		183.554
46	Abakaliki		463.089
47	Afikpo North		239.026
48	Afikpo South		376.908

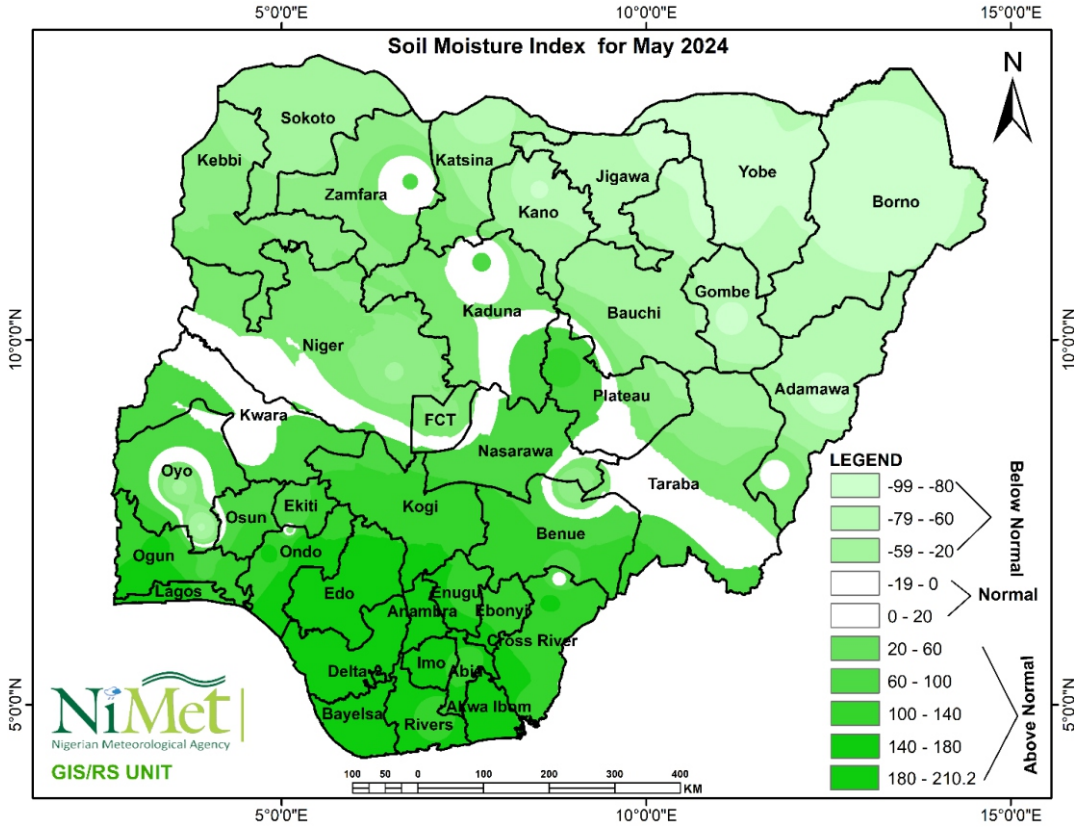
49	Ebonyi		438.357
50	Ezza North		413.274
51	Ezza South		263.975
52	Ishielu		694.885
53	Ivo		266.647
54	Izzi		929.018
55	Ohaozara		333.239
56	Ohaukwu		602.177
57	Onicha	Ebonyi	439.057
58	Abi		267.796
59	Akamkpa		5012.19
60	Akpabuyo		779.248
61	Biase		1291.98
62	Boki		2569.82
63	Calabar-Municipal		137.446
64	Calabar South		188.493
65	Etung		807.982
66	Ikom		1966.31
67	Obanliku		360.586
68	Obubra		1143.9
69	Obudu	Cross River	2.60642
70	Odukpani		1353.84
71	Ogoja		347.266
72	Yakurr		658.669
73	Yala		145.92
74	Bakassi		4.16484
75	Aniocha North		404.922
76	Aniocha South		871.457
77	Bomadi		128.996
78	Burutu		1923.37
79	Ethiope East		380.549
80	Ethiope West		538.407
81	Ika North East		468.366
82	Ika South		436.282
83	Isoko North		482.813
84	Isoko South		690.806
85	Ndokwa East		1610.95
86	Ndokwa West		823.047
87	Okpe		481.43

127	Njaba	Imo	78.4902
128	Nkwerre		35.0543
129	Nwangele		69.6638
130	Obowo		86.4259
131	Oguta		422.537
132	Ohaji/Egbema		896.423
133	Okigwe		306.901
134	Orlu		122.759
135	Orsu		75.0878
136	Oru East		131.475
137	Oru West		96.791
138	Owerri-Municipal		56.3177
139	Owerri North		194.006
140	Owerri West		286.433
141	Unuimo		107.676
142	Abua/Odual	Rivers	716.808
143	Ahoada East		318.438
144	Ahoada West		440.882
145	Akuku Toru		1231.56
146	Andoni		251.147
147	Asari-Toru		115.089
148	Bonny		526.07
149	Degema		979.069
150	Eleme		136.63
151	Emohua		833.588
152	Etche		816.079
153	Gokana		132.754
154	Ikwerre		658.512
155	Khana		558.863
156	Obia/Akpor		257.747
157	Ogba/Egbema/Ndoni		959.192
158	Ogu/Bolo		130.031
159	Okrika		286.498
160	Omumma		158.78
161	Opobo/Nkoro		114.824
162	Oyigbo		247.303
163	Port-Harcourt		108.239
164	Tai		160.589
165	Ado		547.351

166	Ado	Benue	547.351
167	Kwande		81.3807
168	Ogbadibo		363.373
169	Okpokwu		121.106
170	Aguata	Anambra	173.552
171	Anambra East		258.971
172	Anambra West		954.27
173	Anaocha		100.796
174	Awka North		345.52
175	Awka South		173.481
176	Ayamelum		590.574
177	Njikoka		97.4865
178	Ekwusigo		121.991
179	Idemili North		132.478
180	Idemili South		131.333
181	Ihiala		240.972
182	Dunukofia		53.3915
183	Nnewi North		68.6218
184	Nnewi South		154.296
185	Ogbaru		518.146
186	Onitsha North		37.6439
187	Onitsha South		9.92652
188	Orumba North		321.064
189	Orumba South		188.271
190	Oyi		135.147
191	Aninri		369.478
192	Awgu		441.555
193	Enugu East		391.933
194	Enugu North		93.3048
195	Enugu South		75.283
196	Ezeagu		638.321
197	Igbo-Etiti		333.973
198	Igbo-Eze North		267.815
199	Igbo-Eze South		170.143
200	Isi-Uzo		845.445
201	Nkanu East		759.97
202	Nkanu West		254.864
203	Nsukka		556.327
204	Oji-River		411.416

205	Udenu	Enugu	256.885
206	Udi		890.89
207	Uzo-Uwani		841.957
208	Ekeremor	Bayelsa	1777.12
209	Kolokuma/Opokuma		351.037
210	Nembe		1404.46
211	Ogbia		679.069
212	Sagbama		950.168
213	Southern Ijaw		2698.97
214	Yenegoa		683.186
215	Ese-Odo	Ondo	813.382
216	Ilaje		116.235
217	Irele		15.6254
218	Ibaji	Kogi	1335.93

3.4 SOIL MOISTURE INDEX



16: The Soil Moisture Index across Nigeria for May 2024 depicting areas of moisture saturation that may be predisposed to flood.

3.4.1 OBSERVED FEATURES:

The SMI analysis, illustrated in Figure 5, offers insights into the range of soil moisture conditions across the country in May 2024. This classification spans from normal (+24.1 to +86.1), below normal (-37.9.1 to -99.9), to above normal (+86.1 to +210.2).

Deducing from the SMI Map and integrating it with the average rainfall received during the period, it is expected that regions with negative or low positive average rainfall are likely to experience drier conditions. Some parts of the North-East region may likely be drier when compared to other parts of the country. However, places like Delta, Cross River, Anambra, Akwa-ibom, Bayelsa, Edo states are seen to be above normal condition as such can be subject to flood if continuous rainfall persist.

3.4.2 RECOMMENDATIONS:

Based on the Soil Moisture Index (SMI) data for May 2024, regions with high SMI values, particularly in the South-South and part of the South-East areas, may experience high wetness. It is important to take adequate precautions and implement measures to mitigate the impact of flooding in these regions.

3.5 RELATIVE HUMIDITY DISTRIBUTION

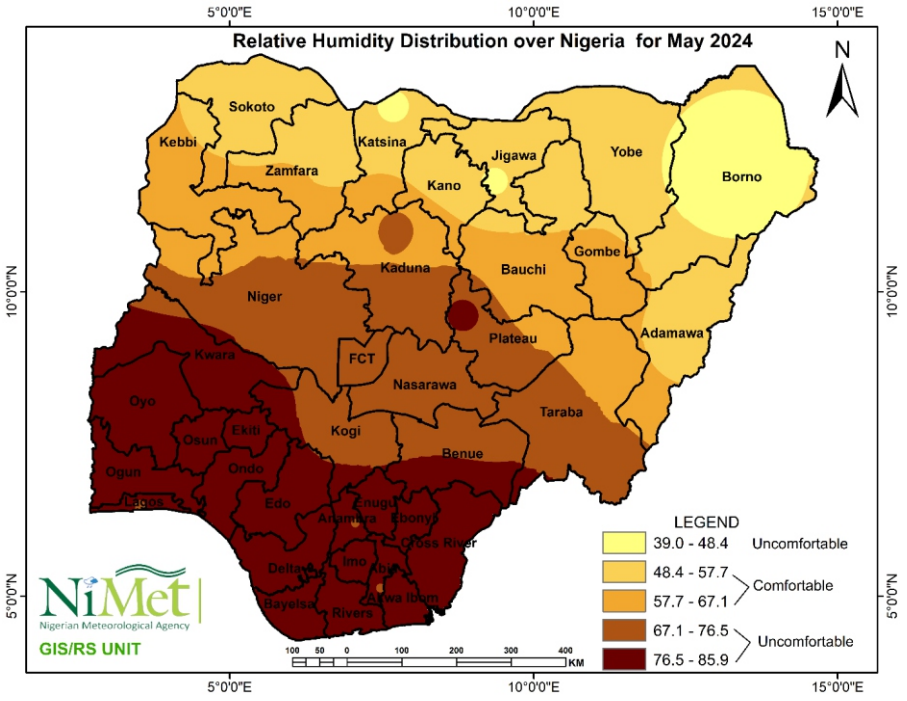


Figure 17: The Relative Humidity Distribution over Nigeria for May 2024 Showing Areas of Comfortable and Uncomfortable Levels Respectively.

3.5.1 OBSERVED FEATURES

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

- The Relative Humidity (RH) over the northern states, including parts of Sokoto, Kastina, Kano, Jigawa, Yobe and Borno states are between 39.0% and 57.7%, which is at the comfortable level.
- Parts of Bauchi, Gombe, Kebbi, Zamfara, and the central cities including parts of Kaduna, Nasarawa, Niger, Plateau, Benue, Taraba states and Federal Capital Territory experienced uncomfortable relative humidity ranging between 57.7% and 67.1%
- High Relative Humidity beyond comfortable humidity level in the range of 67.1% and 85.9% was observed mainly over the South-Western, South – Eastern region including Delta, Bayelsa, Rivers, Cross River and Akwa Ibom states.

However, these atmospheric conditions may be maintained in June 2024 if the rainfall trend persists.

3.5.2 RECOMMENDATIONS:

The following tips may be followed to stay cold and dry, even if humidity levels are sky-high:

- Wear the right clothes
- Stay hydrated
- Limit strenuous outdoor activities
- Use anti-perspirant
- Use talcum powder (This is used to keep skin dry and helping prevent rashes)
- Use a the dehumidifier

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