

Effects of Climate on Secondary Hospitals in Relation to Indoor Environmental Quality in Kwara State

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Abstract: *This study examines the influence of external climatic conditions on Indoor Environmental Quality (IEQ) in selected secondary healthcare facilities across Kwara State, Nigeria. IEQ—comprising thermal comfort, air quality, lighting, acoustics, and humidity—is a critical determinant of patient recovery, staff productivity, and overall healthcare performance. Using a quantitative, climate-responsive analytical approach, ten-year meteorological datasets (2014–2024) obtained from NiMet and other global databases were analysed alongside spatial characteristics of hospital locations across the three senatorial districts. Findings reveal significant microclimatic variations within the state, with northern zones experiencing higher temperatures and humidity influenced by riverine systems, while southern zones exhibit relatively cooler but highly humid wet-season conditions. Seasonal monsoon–Harmattan transitions strongly affect indoor thermal balance, ventilation potential, and moisture levels, thereby shaping health risks such as respiratory discomfort, microbial growth, and thermal stress. The study establishes that hospital buildings function as climatic filters whose effectiveness depends largely on orientation, material selection, ventilation design, and solar control strategies. It concludes that climate-responsive architectural design is essential for improving IEQ in tropical healthcare environments and recommends integrating passive cooling, controlled daylighting, and moisture management into hospital planning to enhance resilience, sustainability, and patient-centred healing outcomes.*

Keywords: climate, secondary hospitals, indoor environmental quality, Kwara State, Nigeria

INTRODUCTION

Indoor Environmental Quality (IEQ) is the condition within a building. It encompasses air quality, natural light and vistas, acoustic conditions, and occupant autonomy over lighting and thermal comfort (Doshu, Prucnal-Ogunsote, Obianuju, and Qurix, 2025). It also encompasses the

functional dimensions of space, including the accessibility of tools and individuals when required, as well as the adequacy of space for occupants. Building managers and operators can enhance occupant happiness by addressing all facets of indoor environmental quality rather than concentrating solely on temperature or air quality, (Felgueiras, Mourão, Moreira, and Gabriel 2023).

In modern conversations about architectural design and public health, the importance of indoor environment quality (IEQ) is significant. With rapid urbanisation, individuals increasingly occupy indoor environments such as offices, educational institutions, or residences. As a result, the importance of air quality, thermal comfort, lighting, and acoustics elements to occupant's health and productivity in an indoor environment cannot be over-emphasised. Furthermore, (Felgueira, Mourão, Moreira, and Gabriel; 2023) posit that low IEQ is connected with several health issues, including respiratory infections, stress, and poor cognitive performance. Hence, understanding the elements of Indoor Environmental Quality and its effects is crucial for architects and decision-makers so as to enhance overall quality of life.

Over the years, healthcare facility structures have focused on the patients' primary needs and neglected one of the most significant aspects of dwelling, that is, the quality of the indoor environment (Zborowsky and Kreitzer, 2018). Additionally, it is the primary responsibility of hospital workers to ensure the comfort and quality of recovery of ailing patients, which includes but is not limited to the quality of food and water consumed and used and environmental conditions like air, light, and sound. Therefore, healthcare facilities should be designed in the best interests of the patients, the patient's family, and the hospital staff, because the primary function is to offer and maintain high-quality medical care (Verma Gupta, Nihar, Jana, and Jain; 2023). The external Climate is biased towards the geographical location of the entire building (Ackley, Olanrewaju, Oyefusi, Enegbuma, Olaoye, Ehimatie, Akpan-Idiok; 2024). A community that is inclusive, safe, resilient, and sustainable (SDG 11) is one of 17 goals established by the United Nations General Assembly in 2015. Tropical regions have been seen to have more of a role to play in achieving this goal (SDG 11), especially with the projection of an increase in population by 60% in Urban areas (United Nations; 2015).

Statement of the Research Problem

The outdoor climate has direct effects on the indoor environment due to heat and mass transfers between indoor and outdoor environments (Ackley *et al.*, 2024). To mitigate climate change impacts and adapt buildings to the changing environment (i.e. good IEQ), changes in building characteristics and occupants' behaviour occur (Mansouri, Wei, Alessandrini, Mandin, and Blondeau; 2022). Hence, taking into consideration that the climate of hospitals in Kwara State differs, there is a need to evaluate the effect of climate on selected hospital male and female wards in Kwara State.

Aim and Objective

This study aim to propose architectural design parameters in other to optimize the climate to the experience the good indoor environmental conditions.This will be achieved through analysing the climatic data of the area in relation to indoor environmental condition.

Scope of the study

The assessment is a study of selected Kwara State Government owned secondary hospitals across the 3 senatorial districts. the study is expected to capture the ambient indoor climate in the hospital wards various hospital designs and their effects on IEQ, in terms of relative humidity, ventilation, acoustics, micro-organism, air quality.

Study Area

Kwara state is situated in the geopolitical zone of North Central Nigeria. It borders the states of Niger to the North, Kogi to the East, Oyo, Ekiti, and Osun to the South, and the Republic of Benin to the West through an international boundary (Kwara GIS, 2020). The five main diverse tribes are the Yoruba (Kwara Central and Kwara South), Fulani (Kwara Central, North and South), Nupe, Baruba, and Hausa (predominantly in the North senatorial zones).

Concepts of IEQ and Climate

Indoor Environmental Quality (IEQ) refers to the overall condition of the indoor environment in relation to occupants' health, comfort, productivity, and well-being. When viewed in relation to the external climate, IEQ focuses on how outdoor environmental conditions—such as temperature, humidity, solar radiation, wind, and air quality—affect indoor spaces and how buildings respond to them.

Relationship Between External Climate and IEQ

External climate is a primary determinant of indoor comfort (Wodu, Nwagbara, and Weli, 2020). Buildings act as a “filter” between outdoor conditions and indoor environments(Morales, Audenaert, and Verbeke, 2025). Good IEQ depends on how well a structure moderates harsh climatic conditions while allowing beneficial natural elements (like daylight and fresh air) (Abdou, Ki Kim, and Bande, 2020; Awolesi, Ghafari, and Reams, 2025),.

Thermal Comfort and Outdoor Temperature

External temperature influences indoor heat gain or loss.

In hot climates (such as much of Nigeria), excessive solar heat can cause indoor overheating (Ishola, Adeyemi, Ozigis, and Zarmai, 2025).Buildings must use shading devices, insulation, and natural ventilation to regulate indoor temperature (Xu, Bo, Chang, Guo, and Shao, 2022).Proper climate-responsive design reduces reliance on mechanical cooling systems (Osman and Sevinc,

2019). Thermal comfort indoors should be achieved by adapting building materials and design to external climatic realities (Prozuments et al., 2025).

Natural Ventilation and Wind Patterns

Wind movement outdoors determines indoor air circulation (Konbr, 2015).

Proper orientation of buildings allows cross-ventilation, improving indoor air freshness (Niza, Bueno, Gameiro Da Silva, and Broday, 2024). Poorly designed structures trap heat and pollutants, lowering IEQ (Al Horr et al., 2016). External airflow should be harnessed to improve indoor air quality and reduce humidity (Yetiş and Tuna Kayılı, 2024).

Daylighting and Solar Radiation

Sunlight is a major external climatic factor affecting IEQ (Toyinbo et al., 2025). Controlled daylight improves visual comfort, mood, and productivity (Cajochen et al., 2019). Excess glare or radiation can increase indoor temperatures and discomfort (Song, Bai, and Yang, 2022). Window placement, glazing, and shading help regulate solar penetration (Lu, 2024). Balance is required—maximize useful daylight while minimizing heat gain and glare (Yu, Wennersten, and Leng, 2020).

Humidity and Moisture Control

In humid climates, external moisture levels influence:

- Mold growth
- Indoor air quality
- Structural durability

Buildings must incorporate:

- Breathable materials
- Ventilation systems
- Moisture barriers

Managing external humidity is essential for maintaining healthy indoor environments.

Outdoor Air Quality and Indoor Health

External pollution (dust, emissions, or allergens) directly affects IEQ when infiltrated indoors.

- Filtration, landscaping, and controlled air entry improve indoor conditions.
- Poor external air quality can lead to respiratory discomfort and reduced productivity.

Indoor environments must protect occupants from harmful outdoor pollutants while ensuring adequate fresh air exchange.

Indoor Environment Quality in Hospitals.

The environment that heals its occupants is the most challenging responsibility of any hospital design. Thermal quality, indoor air quality, and lighting quality are the IEQ elements that have the most effects on patients' overall satisfaction with IEQ in hospital wards, Nimlyat; (2021). Findings

indicated that the factors affecting patients' overall satisfaction and health outcomes differ according to hospital ward orientation and architectural design configuration Nimlyat, Salihu, and Wang (2024), (Offor, Isiofia and Uzuegbunam ;2024). Nimlyat (2021) opined that overall patient satisfaction with hospital ward performance is influenced by IEQ parameters (thermal, acoustic, lighting, and Indoor Air Quality (IAQ)). Patients were asked to complete questionnaires as the primary people who live in hospital ward facilities. Structural equation modeling (SEM) was used to examine a suggested weighted structural model for IEQ that established the association between IEQ parameters, patients' overall happiness, and patients' health results.

METHODOLOGY

This study used objective method, utilising technical data obtained from secondary sources from Nigerian Meteorological Agency (Ni-met), Copernicus Data store, and weather spark websites.

Sampling Frame

The study is expected to cover the three senatorial zones in Kwara state which are Kwara North, Kwara South and Kwara Central. According to the available data from the Kwara State Hospital Management Bureau, there are total of 44 (forty-four) state owned hospitals out of which 18 (eighteen) are secondary hospitals thus shall constitute the sampling frame for the study. The study purposively focuses on secondary hospitals because of the distribution across the study area, (unlike Tertiary that is located in Kwara Central), and also because of the high degree of operations (unlike the primary hospitals).

Table 1: Kwara State Government Hospitals

S/N	Hospital	Location	LGA		Senatorial Zone
1	Cottage Hospital, Alapa.	Alapa Village.	Asa	Primary	Kwara Central
2	Cottage Hospital, Ballah.	Alapa Road.	Asa	Primary	Kwara Central
3	General Hospital, Afon.	Opposite Asa LGA Sec, Afon.	Asa	Secondary	Kwara Central
4	General Hospital, Okuta	Along Ilesh-Baruba-chikanda Road, Okuta,	Baruten	Secondary	Kwara North
5	Cottage Hospital, Yashikira	Yasikira Village	Baruten	Primary	Kwara North
6	Cottage Hospital, Ilesha-Baruba	Along Okuta road Ilesha-Baruba.	Baruten	Primary	Kwara North
7	General Hospital, Lafiagi.	Beside Local Govt Secretariat, Lafiagi.	Baruten	Secondary	Kwara North
8	Cottage Hospital, Tsaragi.	KM 4 Share/Pategi Road.	Baruten	Primary	Kwara North
9	Cottage Hospital, Obbo-Aiyegunle	Behind ECWA Church Obo Aiyegunle.	Ekiti	Primary	Kwara South

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10	Cottage Hospital, Eruku	Adjacent Eruku Central Market Egbe Road.	Ekiti	Primary	Kwara South
12	Cottage Hospital, Obbo-Ile	Behind Obbo-ile main market, Offa Ilorin-Egbe Road, Obbo-ile.	Ekiti	Primary	Kwara South
13	General Hospital Oke-Ode	Along Labaka Road Oke-Ode.	Ifelodun	Secondary	Kwara South
14	General Hospital, Oro-Ago.	Oro-Ago.	Ifelodun	Secondary	Kwara South
15	General Hospital, Share	Hospital Road, Share	Ifelodun	Secondary	Kwara South
16	Cottage Hospital, Omupo.	Omupo Road, Omupo.	Ifelodun	Primary	Kwara South
17	Cottage Hospital, Igbaja	Along Oke-ode Igbaja	Ifelodun	Primary	Kwara South
18	Specialist Hospital, Sobi	Alagbado Area, Ilorin.	Ilorin east	Secondary	Kwara Central
19	Cottage Hospital, Iponrin	Along Ayekale Road Iponrin	Ilorin east	Primary	Kwara Central
20	Civil Service Hospital.	Ilofa Road, GRA, Ilorin	Ilorin south	Primary	Kwara Central
21	Cottage Hospital, Ogidi	Along FGC road, Ogidi,	Ilorin south	Primary	Kwara Central
22	General Hospital, Ilorin	AbdulAzeez Attah Road,Ilorin.	Ilorin west	Secondary	Kwara Central
23	Children Hospital, Centre Igboro Princess Road, Centre Igboro, Ilorin.		Ilorin west	Secondary	Kwara Central
S/N	Hospital	Location	LGA		Senatorial Zone
24	Cottage Hospital, Adewole	Along Yebumot Hotel Road, Olorunsogo.	Ilorin west	Primary	Kwara Central
25	Cottage Hospital, Ajikobi	Omada Area, Okekere, Ilorin.	Ilorin west	Primary	Kwara Central
S/N	Hospital	Location	LGA		Senatorial Zone
26	Cottage Hospital, Agbamu	Agbamu Town.	Irepodun	Secondary	Kwara South
27	General Hospital, Omu-Aran	65, Danel Bamigboye Rd Omu-Aran	Irepodun	Secondary	Kwara South
28	General Hospital, Oro	Adjacent Luke Mansion along Ilorin-Omu-Aran Express Way, Oro.	Irepodun	Secondary	Kwara South
29	Cottage Hospital, Edidi	Along Oro-Omo Aran Road.	Irepodun	Primary	Kwara South
30	Cottage Hospital, Arandun	Opposite 7th Day Adventist Arandun	Irepodun	Primary	Kwara South

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31	Cottage Hospital, Ajase-Ipo	Along Ilorin Ajase ipo Road.	Irepodun	Primary	Kwara South
32	Cottage Hospital, Iludun -Oro	Ijomu Oro town	Irepodun	Primary	Kwara South
33	Cottage Hospital Ijomu-Oro	Near CCHS, Aiyegbami Street Ijomu Road.	Irepodun	Primary	Kwara South
34	General Hospital, Isanlu-Isin	Oke-Ayegun Along Omu-Aran	Isin	Secondary	Kwara South
35	General Hospital, Kaiama	Kanikoko Road GRA.	Kaiama	Secondary	Kwara North
36	Specialist Hospital, Jebba	Opposite Junction to college of Arabic Jebba	Moro	Secondary	Kwara North
37	General Hospital, Offa	No 1 Atan-Oba off Ibrahim Taiwo Road Offa	Offa	Secondary	Kwara South
38	Cottage Hospital, Iloffa	Beside Oke Ero Local Govt Sec. Iloffa.	Oke Ero	Primary	Kwara South
39	Cottage Hospital, Idofin-Odo-Ase	Idofin Odo- Ase.	Oke Ero	Primary	Kwara South
40	General Hospital, Erin-Ile	Elerin way, Erin-Ile.	Oyun	Secondary	Kwara South
S/N	Hospital	Location	LGA		Senatorial Zone
41	Cottage Hospital, Ira	Ira.	Oyun	Primary	Kwara South
42	Cottage Hospital, Ilemona	Along Ira Road Ilemona.	Oyun	Primary	Kwara South
43	General Hospital, Pategi	Rifun road, Pategi.	Pategi	Secondary	Kwara North
44	Cottage Hospital, Lade	Ekati road, Lade.	Pategi	Primary	Kwara North

Source: Kwara State Hospital Management Board; 2025

Method of Data Collection

The research setting is Kwara State, Nigeria. Multistage sampling shall be used for the study. According to Oladimeji, Odunjo, Ayinla, & Amao, 2024 the technique of multistage sampling involves the division of the population of a study into groups and sub-groups, while the selection of the samples is based on their location characteristics and not necessarily on social characteristics.

Thus, the first stage shall involve stratifying Kwara state into senatorial zones. Reconnaissance survey carried out shows that these are Kwara North, Kwara South and Kwara Central. However, the second stage will be the identification of Kwara state owned hospitals in each senatorial zone and a total of 44 (forty-four hospitals were inventorised (Table 1).

In the third stage, the state-owned hospitals shall be stratified on the basis of operations which are primary, secondary and tertiary Hospitals. However, a total of 18 (eighteen) secondary hospitals were identified: 4 (four secondary hospitals in Kwara central); 5 (five in Kwara north and 9 (nine in Kwara south) (Table 3) and this shall constitute the basis for the study.

In the fourth stage, the study shall select the hospitals to use for the study and Slovin formula shall be employed:

$$i.e n = N/1 + Ne^2.$$

N= population of the size, n = sample size, e =margin of error which is a constant 0.05

$$i.e sample size(n) = 18/ (1+18 \times 0.05^2)$$

$$n = 18/1+18 \times 0.0025$$

$$18/1+1.01$$

$n= 9$; thus, a sample size of 9 hospitals (comprising 2 in Kwara Central; 3 in Kwara North and 4 in Kwara South) shall be randomly selected and used for the study. This therefore, makes a total of nine secondary hospitals that shall be used for the study as shown in Table 4.

Analysis

Indoor Environmental Quality (IEQ) is a key factor that determines hospital performance, with implications for patient recovery, staff productivity, clinical procedures, and the safety of healthcare environments(Frontczak and Wargocki, 2011), (Branco et al., 2024). In areas with significant climatic variation, like Kwara State where hospital building design is highly effective, the alignment of hospital buildings to local atmospheric conditions is crucial. It is therefore pertinent to have a good understanding of the climate of the study area and its implications for quality of the indoor environment within the internal spaces.

Climatic Zone and Spatial Analysis of Selected Towns in Kwara State Based on Latitude and Longitude

The latitude, longitude, elevation, and proximity to major hydrological bodies have a significant impact on climate, resulting in spatial variations even within small geographic areas. West Africa's recognizable north-south climatic gradient is primarily caused by latitudinal differences that affect solar radiation, temperature, moisture levels, and wind patterns.

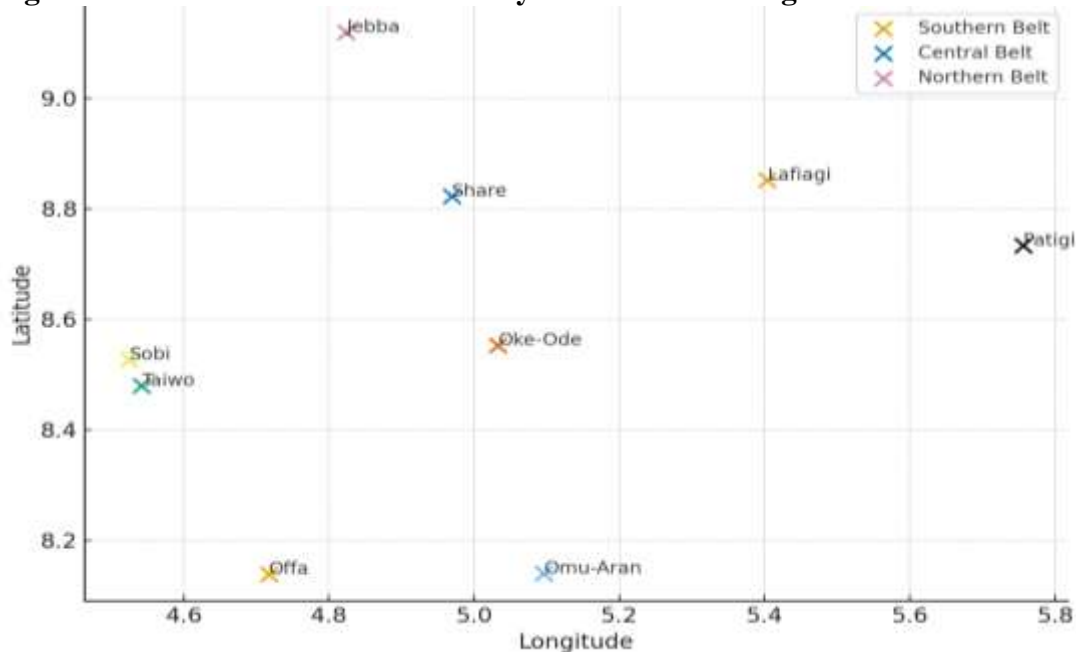
Table 2.0 Climatic Variables of Selected Study Area

S/N	Category	Towns	Latitude Range	Longitude Range	Key Features
1	Southern Area Zone	Offa, Omu-Aran, Taiwo, Sobi	8.13–8.53	4.52–5.09	Cooler, moderate elevation, stable temps
2	Central Area Zone	Share, Oke-Ode	8.55–8.82	4.96–5.03	Transitional climate, moderately warm
3	Northern Area Zone	Jebba, Pategi, Lafiagi	8.73–9.12	4.82–5.76	Hottest, lowest elevation, influenced by north

Source: Author’s compilation from field data, 2025.

Despite being located in the transition zone between the southern forested area and the northern savannah region, Kwara State experiences significant microclimatic changes among its towns. The study examines the climatic variables the grouped areas based on Latitude and Longitude, Table 1.0 of Offa, Omu-Aran, Share, Oke-Ode, Taiwo and Sobi, as well as their latitude and longitude, and compare them spatially with those of Pategi and Lafiagi. These nine towns are selected for research purposes. Its objective is to identify climatic zones, interpret spatial trends, and establish the environmental implications of these patterns for settlement, agriculture, and sustainability.

Figure 1.0 Clustered Climatic Zones by Latitude and Longitude



Source: Author’s compilation from field data, 2025.

Three natural clusters are discernible in the spatial pattern:

1. Southern Climatic Area (Lat 8.13–8.50°N): Offa, Omu-Aran, Taiwo, Sobi, these areas are characterized with high altitude causes cooler temperatures and moderate precipitation.
2. Central Transition Area (Lat 8.50–8.80°N): Share, Oke-Ode, these areas are characterized by Intermittent weather conditions caused by the influence of southern and northern air masses.
3. Northern Area (Lat 8.80–9.12°N): Jebba, Pategi, Lafiagi, influenced with higher precipitation and increased humidity are the outcomes of the Niger River Basin's influence on the environment.

These latitudinal and longitudinal differences are fundamental to the subsequent climatic variations discussed below.

Latitude Influence on Temperature

Temperature is primarily affected by latitude, which has an indirect effect on the angle and intensity of solar radiation. Pategi (36.98°C), Lafiagi (35.7°C) and Jebba (34.92° C) are the northernmost towns where annual maximum temperatures can reach up to 35° Celsius. Southern towns, including Omu-Aran and Sobi, have cooler temperatures. Regional microclimatic factors are responsible for the inverse relationship between temperature and proximity to the sun and distance from the earth, which contradicts global latitude patterns. Elevation and river-basin effects alter the anticipated pattern. The elevation in the southern region (Omu -Aran, Offa) results in a decrease in temperature.

A higher heat sink is observed in the north when living in low-lying riverine plains. The Sudan Savannah creates a warmer climate, while in the south, it mirrors the Guinea Savannah, which is more temperate.

Longitude Influence on Rainfall.

The study indicates a robust connection between rainfall distribution and longitude (west-east direction). The eastward increase is observed in towns like Pategi and Lafiagi, where the highest amount of annual precipitation (108.8 mm) falls. Lower rainfall levels are observed in western towns like Sobi and Taiwo, where the total amount drops to 97.89 mm. it was realized that floodplain microclimates that enhance precipitation. In this area, rainfall distribution is influenced more by longitude than latitude. The hydroclimatic impact of the Niger River is accentuated by the rise in annual precipitation towards the east, leading to wetter microclimates that serve as ideal conditions for aquaculture, floodplain agriculture, and hydrological recharge.

Latitude Influence on Humidity.

Humidity levels display a non-linear pattern that can be understood along the latitudinal gradient:

1. In the northern area towns Pategi, (66.13%), Lafiagi (63.85%), humidity is high.
2. The central region (Share and Oke- Ode) measures intermediate relative humidity.
3. The southern towns have a low level of humidity (60–62%), but Sobi is an exception due to local vegetation and topographic factors.

the availability of open water in the north results in atmospheric moisture being altered, leading to localized humidification, despite their typically drier climate. The intricate interplay between latitude and physiographic characteristics is reflected in humidity gradients. High humidity is a result of both evapotranspiration and moisture recycling from river systems in the north, which continue to maintain higher temperatures. In summary, the temperature of the study area can be influenced by altitude, with northern towns being hotter. Precipitation is heavily influenced by longitude, especially in eastern towns, Northern riverine areas are known to have the highest levels of humidity, which is contrary to what was expected from savannahs due to their hydrological influence. Three distinct climatic zones are identified within the study area, each with its own set of environmental features. Spatial climatic variation in Kwara State has an impact on settlement patterns, and environmental sustainability.

Climatic Conditions and Patterns in the Study Area

Relevant climatic data were gotten from Nigerian Meteorological Agency (Ni-met) , Department of Geography, University of Ilorin, Copernicus Data store, and weather spark website for a period of ten (10) years in line with recommendation of Ayinla and Odetoye, 2015, that averages of climatic data for five (5) to ten (10) years are sufficient for building design and specifications purposes. The data obtained included values of the following climatic elements on a monthly basis from January to December for the years of 2014,2015, 2016, 2017,2018,2019, 2020, 2021, 2022, 2023, and 2024. Diurnal temperature readings, diurnal relative humidity, solar radiation, rainfall and wind speed. The mean values for the years are presented in Tables 3, 4, 5, 6,7, and 8.

Table 3 Average Climatic data for Omu-Aran, Southern Zone (2014 -2024)

Months	Temp. °C (Max.)	Temp. °C (Min.)	Temp. °C Mean monthly	RH(AM) %	RH(PM) %	Rainfall (mm)	Wind Speed (m/s)
Jan	31.11	17.22	24.17	67.83	25.12	2.54	5.4
Feb	32.77	19.44	26.11	77.48	26.06	7.62	6.2
Mar	32.77	21.67	27.22	89.06	49.37	25.40	7.3
April	31.67	22.22	26.95	89.56	49.37	63.50	7.7
May	29.44	21.67	25.56	91.31	61.61	101.6	6.9
June	27.78	21.11	24.45	92.81	68.20	129.54	6.7
July	26.67	20.00	23.34	92.92	70.57	149.86	7.4
August	26.67	20.00	23.34	93.39	71.78	160.02	7.3
September	27.22	20.00	23.61	93.83	72.58	185.42	5.6
October	27.78	20.00	23.89	93.15	65.89	81.28	4.8
November	29.44	18.89	24.17	92.06	42.66	10.16	4.6
December	30.00	17.22	23.61	73.97	27.89	2.54	4.9

Source: Author's compilation from field data, 2025.

The temperature data of Omu-Aran follows the normal pattern of tropical climates, with high yearly temperatures and a small temperature range (Figure 4.1). The Hottest months, February and March are 32.77°C and coolest months of July and August at 26.67°C. Mean monthly temperatures range between 23°C–27°C, indicating thermal stability. The dry season (November-March) has the highest temperatures due to clear skies and intense sun radiation. The rainy season (April-October) brings more cloud cover, which reduces solar heating and causes temperatures to decline. The lowest temperatures occur in July and August, during the peak rainfall season, when persistent cloudiness and saturation greatly reduce daytime heat. Rainfall in Omu-Aran is strongly seasonal, reflecting the migration of the Inter-Tropical Discontinuity (ITD) and the influence of the monsoon. Rains begin in Omu -Aran early April with peak rainfall in September at reading of 185.42 mm, figure 4.2. Cessation of rain usually occurs in late October. The dry months starts in November to March, with hardly no rainfall.

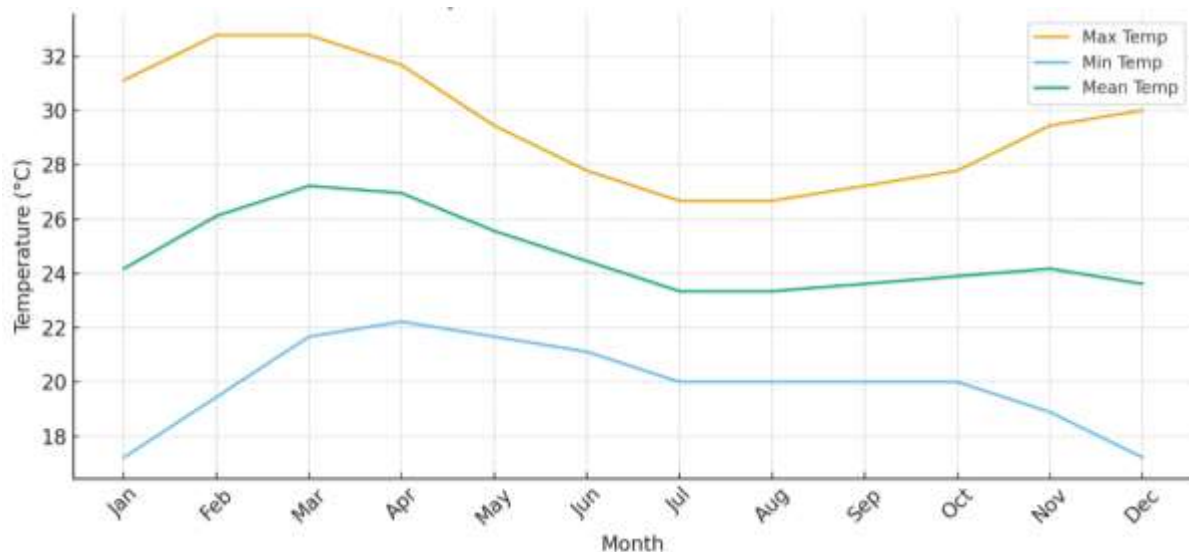


Figure 4.1: Temperature Variation in Omu-Aran

Source: Author's compilation from field data, 2025.

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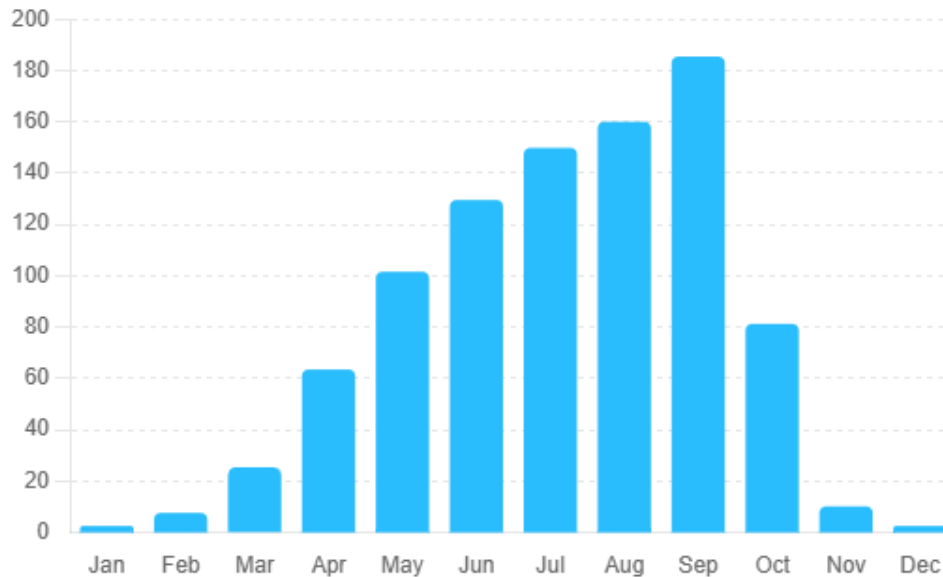


Figure 2 Rainfall Pattern in Omu-Aran

Source: Author's compilation from field data, 2025.

The rainfall pattern clearly defines two separate seasons, The rain season starting from April to October characterized with heavy, consistent rainfall due to the presence of moist southwesterly monsoon winds. The dry season starts November through March sees almost little rainfall due to the arrival of the dry, dusty Harmattan wind. The Rainfall gradually increases from April, reaches a broad peak between July and September, and then drops sharply as seen in figure 2. The months September is the wettest month with an average rainfall of over 182mm, indicating the peak of monsoon moisture infiltration.

Humidity levels in Omu-Aran exhibit significant seasonal changes due to rainfall and air mass dominance the key Observations are that the highest morning humidity is in September at 93.83% and lowest morning humidity is in January at 67.83% figure 3. The evening relative humidity levels are lowest during the dry season. The Interpretation of this is that the dry season humidity (November–March) has low humidity in the morning and afternoon due to the effect of dry Harmattan air, causing skin dryness, dehydration, and dustiness. The Wet season humidity (April–October) High humidity (>90%) due to ample moisture in the atmosphere and constant cloud cover. High humidity promotes thermal discomfort, fungal growth, and poor indoor air quality.

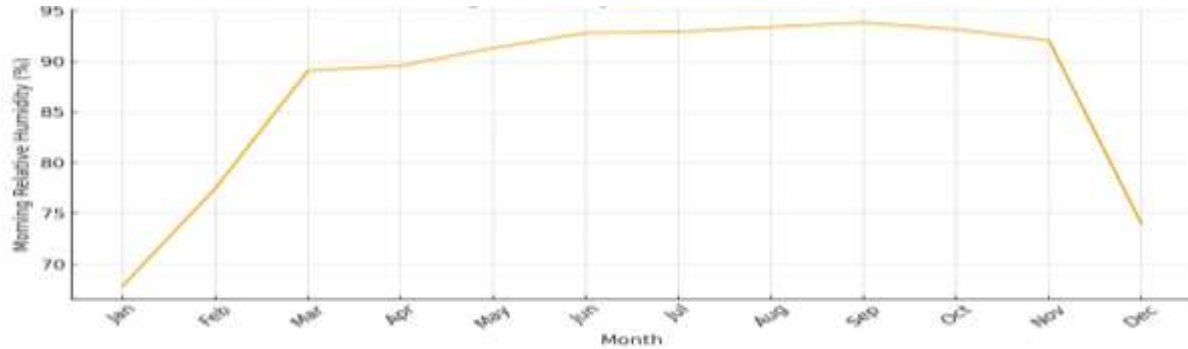


Figure 4 Morning Relative Humidity in Omu-Aran

Source: Author's compilation from field data, 2025.

Wind patterns display moderate seasonal variations due to changes in atmospheric pressure and rainfall cycles. The highest wind speeds reading was in April (7.7 m/s) and July (7.4 m/s) while lowest wind speeds are in November (4.6 m/s). this translate that stronger winds occur between March and July figure 4, coinciding with the transition into the rainy season, which frequently brings thunderstorms and dusty weather. During steady Harmattan periods from November to January, winds are weaker, but rare dust-laden bursts may occur. The increased wind speeds in April herald the arrival of the monsoon. High wind speeds from April to July could enhance the risk of roof uplift, tree fall, and structural stress, particularly during thunderstorms. Outdoor ventilation is often excellent during the rainy season but limited during the dry season.

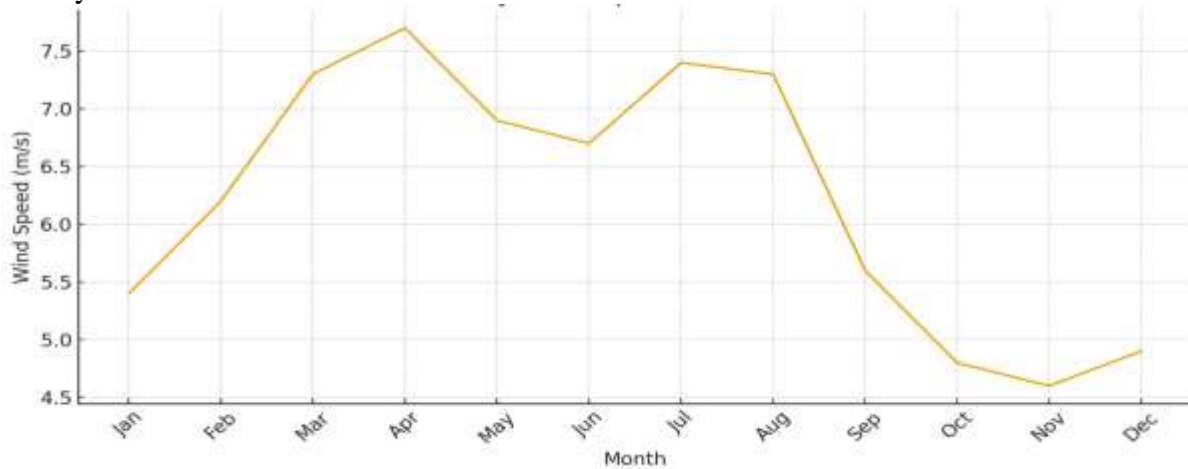


Figure 4.4: Wind Speed in Omu-Aran

Source: Author's compilation from field data, 2025.

Omu-Aran's climate is summarised as a tropical wet-dry climate with hot temperatures, extremely high wet-season humidity, sharply seasonal rainfall, and moderate winds influenced by the

monsoon and Harmattan regimes. This climatic location influences the town's agriculture, architecture, health care, and general environmental management needs.

Table 4 Average Climatic data for Offa, Southern Zone (2014 -2024)

Months	Temp. °C (Max.)	Temp. °C (Min.)	Temp. °C Mean monthly	RH(AM) %	RH(PM) %	Rainfall (mm)	Wind Speed (m/s)
Jan	31.70	18.30	25.00	54.19	32.23	2.54	5.4
Feb	33.33	20.65	26.99	63.02	34.90	10.16	6.1
Mar	32.8	22.23	27.52	79.30	55.42	27.94	7.2
April	31.7	22.87	27.29	81.23	64.19	68.58	7.7
May	30.0	22.26	26.28	85.53	79.30	137.16	6.9
June	28.37	21.72	25.05	87.87	78.31	152.40	6.7
July	27.21	20.64	23.93	87.87	79.08	162.56	7.5
August	27.21	20.64	23.93	88.55	79.56	195.58	7.4
September	27.28	20.64	23.96	88.62	80.99	195.58	5.7
October	28.93	21.12	25.03	86.57	76.43	104.14	4.7
November	30.06	20.04	25.05	80.93	57.24	12.70	4.5
December	30.06	17.86	23.96	60.15	37.01	2.54	4.9

Source: Author's compilation from field data, 2025.

The hottest month in Offa is February (33.33°C), other high-temperature months are January with 31.70°C and March 32.8°C. Coolest months are July and August (27.21°C). Warmest in nights in Offa are in March through April (22.23–22.87°C). Coolest nights are December (17.86°C) and January (18.30°C). Mean temperature pattern March has the highest average temperature(27.52°C). The Lowest mean temperature is in July-August (23.93°C) This translate to the dry season to be between November and March with greater temperatures due to clearer skies and intense sun heating. The wet season (April–October) delivers more cloud cover, resulting in cooler days and nights. Maximum temperatures fall during peak rains (June-September), indicating monsoonal cooling. Overall, Offa has a warm thermal area, with average monthly temperatures ranging from 23.9°C to 27.5°C, which is typical of a tropical environment.

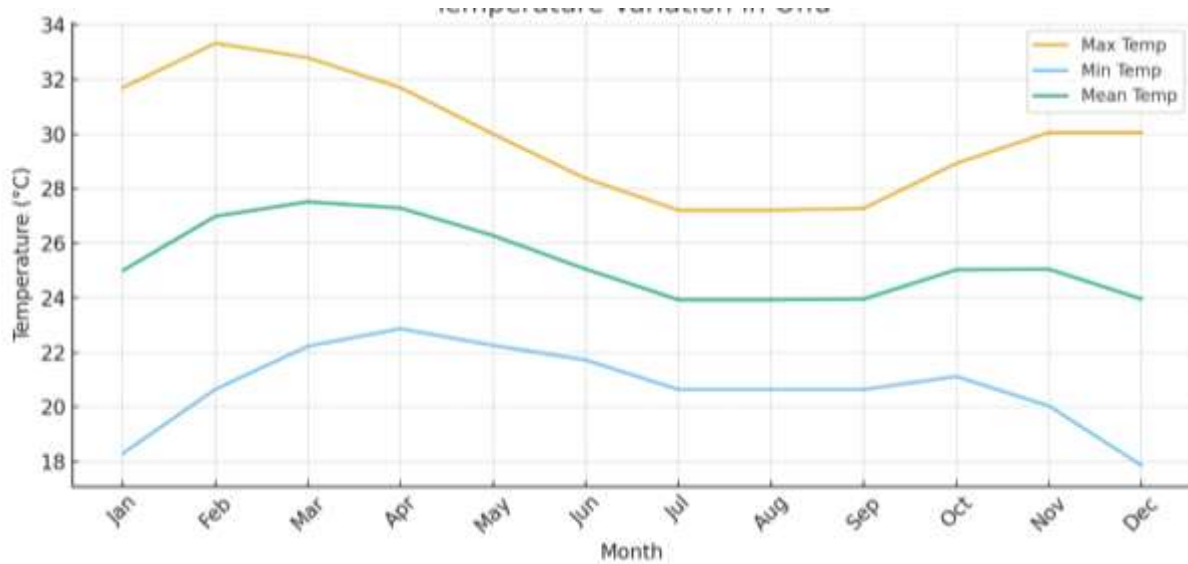


Figure 5 Temperature Variation in Offa
Source: Author’s compilation from field data, 2025.

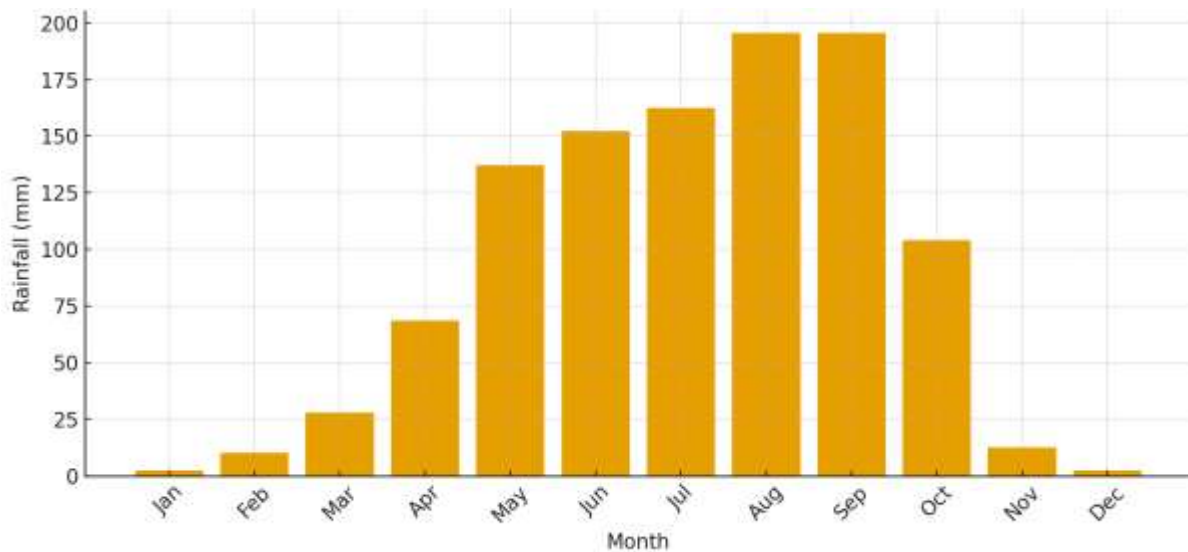


Figure 6 Rainfall Pattern in Offa
Source: Author’s compilation from field data, 2025.

Rainfall begins in April with 68.58 mm Peaking in August and September with 195.58 mm each. Heavy rainy season occur between May-October (79-195 mm). The Dry season is in November through March (2.54–27.94 mm). Offa has a single rainfall maximum. Rainfall increases

dramatically beginning in April, peaks in the late rainy season (August-September), and then swiftly decreases by November. The wettest months (July-September) are characterised by high relative humidity and cool temperatures. The Harmattan region experiences little or no rainfall throughout the dry season (November to March). This heavy seasonal rainfall governs Offa's agriculture, vegetation growth, and water supply.

The data from Offa reveals pronounced intra-annual variability in both morning (RH AM) and afternoon (RH PM) humidity values, reflecting these broader atmospheric dynamics.

Morning Humidity (RH AM) Dynamics shows the lowest value of 54.19% for January and 60.15% for December while the highest value is at 88.55% for August and 88.62% for September. This translates that morning humidity in Offa exhibits a sharp seasonal contrast, with significantly suppressed RH during the dry season and elevated RH during the wet season. This pattern is climatically coherent with the interaction between surface temperature, nocturnal radiative cooling, and the moisture content of the prevailing air mass.

During the dry season (December–February), the Harmattan, a dust-laden northeasterly trade wind originating from the Sahara Desert, produces an atmosphere characterized by exceptionally low moisture content. The dry air supports higher evaporative demand, and despite nighttime cooling (which normally raises morning RH) the atmosphere remains unsaturated due to low dew points. This explains the anomalously low morning humidity values in January (54.19%) and December (60.15%), which depart significantly from typical tropical morning humidity levels.

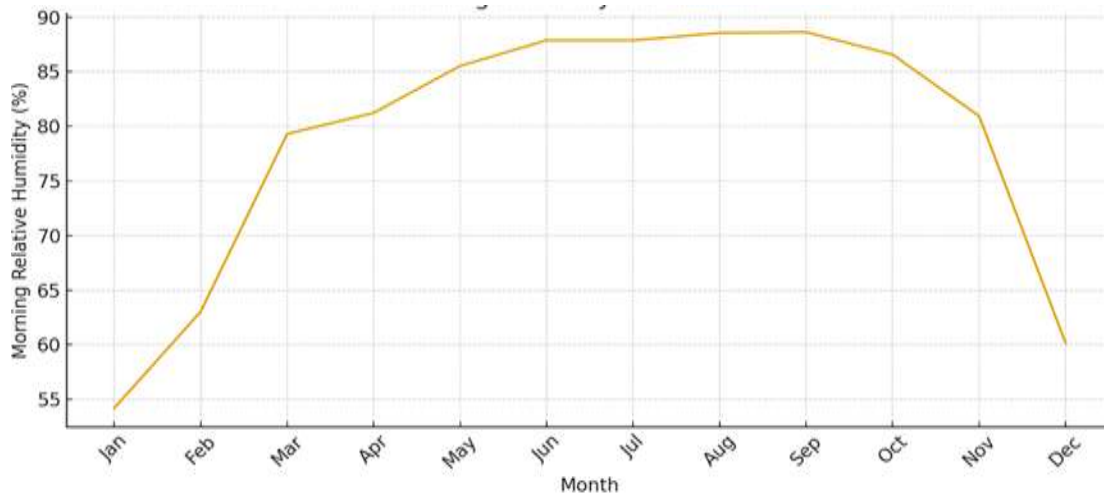


Figure 7 Morning Relative Humidity in Offa

Source: Author's compilation from field data, 2025.

In contrast, during the wet season (May–October), the dominance of the southwesterly monsoonal flow transports substantial moisture from the Atlantic Ocean. Combined with cooler nocturnal temperatures, the air mass approaches near-saturation conditions by early morning, yielding values consistently above 85%. The peak values in August and September (both approximately 88.6%) Figure 7, coincide with the seasonal rainfall maximum, confirming the strong coupling between atmospheric moisture availability, cloud cover, and rainfall generation mechanisms.

Highest Wind Speeds in Offa are in the months of April, July and August with speed reaching 7.7m/s, 7.5m/s, 7.4m/s respectively. The lowest speeds are experienced in the months of October and November with readings of 4.7m/s and 4.5m/s respectively. This pattern reflects a coherent structure wherein wind speeds increase during the transitional and peak monsoon periods and decrease during the dry season when atmospheric conditions become more stable.

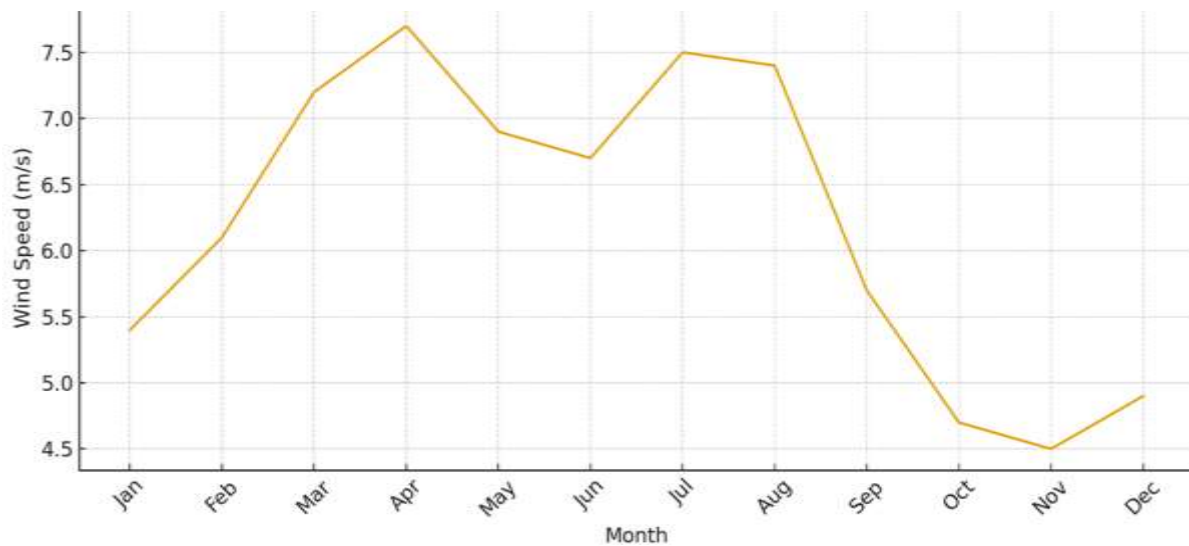


Figure 8 Wind Speed readings in Offa

Source: Author's compilation from field data, 2025.

Table 5 Average Climatic data for Ilorin, Southern Zone (2014 -2024)

Months	Temp. °C (Max.)	Temp. °C (Min.)	Temp. °C Mean monthly	RH(AM) %	RH(PM) %	Rainfall (mm)	Wind Speed (m/s)
Jan	33.31	18.33	25.86	57.95	29.94	2.54	5.9
Feb	34.42	21.12	28.80	65.20	33.57	7.62	6.7
Mar	34.47	22.85	28.66	74.85	47.55	25.40	7.9
April	33.32	23.32	28.32	79.06	60.84	63.50	8.4
May	31.12	23.32	26.13	82.17	69.11	101.6	7.5
June	30.02	22.23	26.13	85.26	74.65	129.54	7.2
July	28.35	21.74	25.05	86.97	76.83	149.86	7.8
August	28.35	21.11	24.73	87.96	77.78	160.02	7.6
September	28.91	21.72	25.32	89.03	80.23	185.42	5.8
October	30.00	21.72	25.86	87.44	76.32	81.28	5.0
November	31.72	20.64	26.18	79.88	53.72	10.16	4.8
December	32.23	18.32	25.28	63.98	35.07	2.54	5.3

Source: Author's compilation from field data, 2025.

Ilorin has consistently high temperatures throughout the year, with noticeable contrasts between dry-season heat and wet-season. The hottest months are February (34.42°C) and March (34.47°C) while the coolest months are July and August (28.35°C). Minimum Temperature Pattern in Ilorin suggest that warmest nights are in April and May (23.32°C) and coolest nights are in December and January (18.32-18.33°C). Mean Monthly Temperature reflects that the highest mean temperature was 28.80°C in February. August's lowest mean temperature is 24.73°C. Temperatures peak between November and March because the skies are clear, humidity is minimal, and sun radiation is powerful. The rainy season (April-October) delivers more cloudiness, which reduces solar heating and lowers daytime temperatures. The modest diurnal temperature range characterises the transition between savanna and Guinea woodland climates.

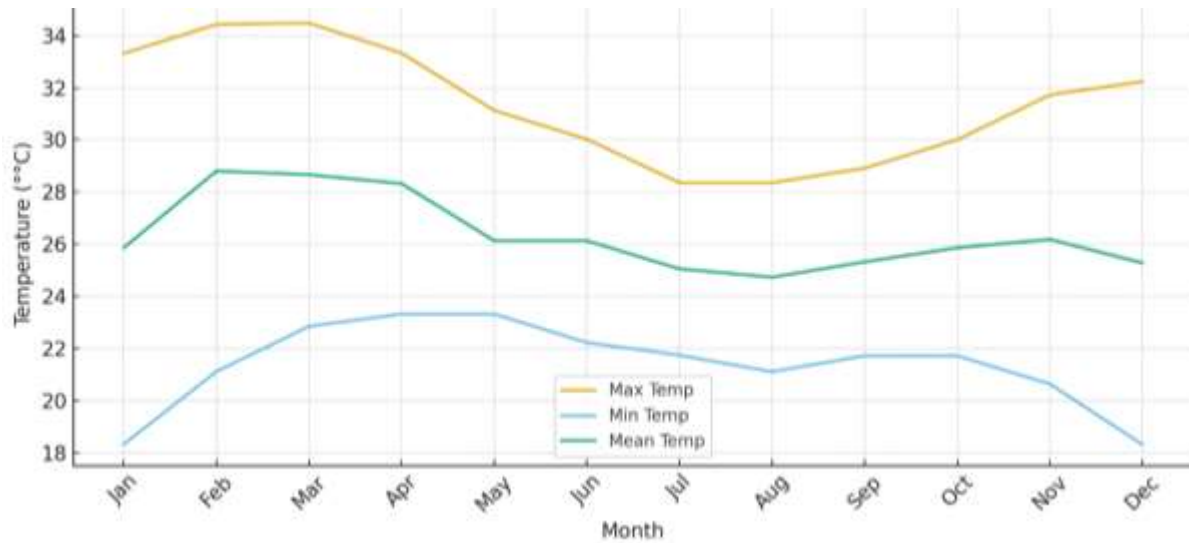


Figure 9 Temperature Variation in Ilorin
Source: Author's compilation from field data, 2025.



Figure 10 Rainfall Pattern in Ilorin
Source: Author's compilation from field data, 2025.

Rainfall has a significant seasonal pattern, effective from April with 63.50 mm. Rapid increase in rainfall from May to June (101.6-129.54 mm) the peak rainfall is in September (185.42 mm), with extremely rainy circumstances in July (149.86 mm) and August (160.02 mm). Cessation usually occurs in October at 81.28 mm, followed by a sharp decline to 10.16 mm in November and 2.54 mm in December and January. This monomodal rainfall peak in the late rainy season (Aug-Sep) is unique to the central belt zone, as opposed to the double peak seen in some coastal areas. Peak rainfall months (July to September) coincide with flood and erosion risk in poorly drained areas. Long dry spells in November through March create a strong soil moisture deficit, constraining dry-season agriculture and stressing surface water resources.

Morning Relative Humidity (RH AM) Lowest values of January (57.95%) and December (63.98%) unusually low for tropical mornings. Highest values: September (89.03%), with August (87.96%) and July (86.97%) also very high. These values show a clear transition from dry Harmattan air to deep monsoon moisture. Afternoon Relative Humidity (RH PM) Dry season minima: January (29.94%), December (35.07%) more typical of semi-arid environments and wet season maxima: September (80.23%) and August (77.78%).

Afternoon RH illustrates stronger thermal control translating to intense daytime heating in the dry season depresses RH, while wet-season cloud cover and evaporation keep it high. November through March (Harmattan period) shows air mass is dry and often dust-laden, dew points are low, so even nighttime cooling cannot bring the atmosphere close to saturation. April through October (Monsoon period). High specific humidity and lower temperatures lead to near-saturation mornings and persistently high RH all

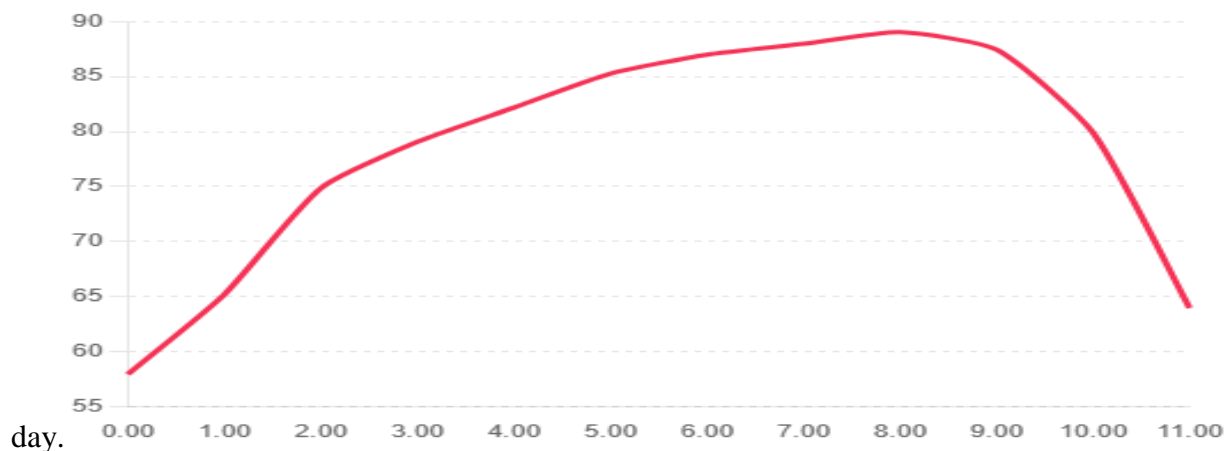


Figure 4.11: Morning Relative Humidity in Ilorin
Source: Author's compilation from field data, 2025.

During the wet season, high RH severely restricts evaporative cooling, raising the heat index and exacerbating thermal discomfort. It also; fosters mould, mildew, and fungal growth in buildings, slows evaporation of surface moisture, promotes decay of materials (timber, fabrics, paper). During the dry season, very low RH leads to; desiccation of mucous membranes, increasing susceptibility to respiratory infections and asthma, skin dryness and eye irritation, dust resuspension, worsening air quality.

Strongest winds occur between April (8.4 m/s) and, March (7.9 m/s), July (7.8 m/s), August (7.6 m/s). Weakest winds occur in November (4.8 m/s) and October (5.0 m/s). Wind behaviour closely tracks the strength and position of the monsoon circulation. In March through April, the strong pressure gradient between the still-hot interior and cooler, moist air from the Gulf intensifies winds. This is a classic pre-monsoon acceleration of low-level flow, often associated with squall lines and gust fronts. In July–August, high winds are maintained by deep monsoon flow and frequent convective storms. In October–November, as the ITD retreats southward and the pressure gradient weakens, wind speeds diminish, reflecting more stable and less convective conditions under emerging Harmattan influence.

Environmental and Design Implications High wind speeds in March through August: enhance natural ventilation, beneficial in hot-humid conditions. Increase risk of roof uplift, tree fall, and storm damage, especially in poorly engineered structures. Lower winds in October through January this reduce outdoor ventilation and may worsen urban heat retention and dust accumulation in stagnant conditions.

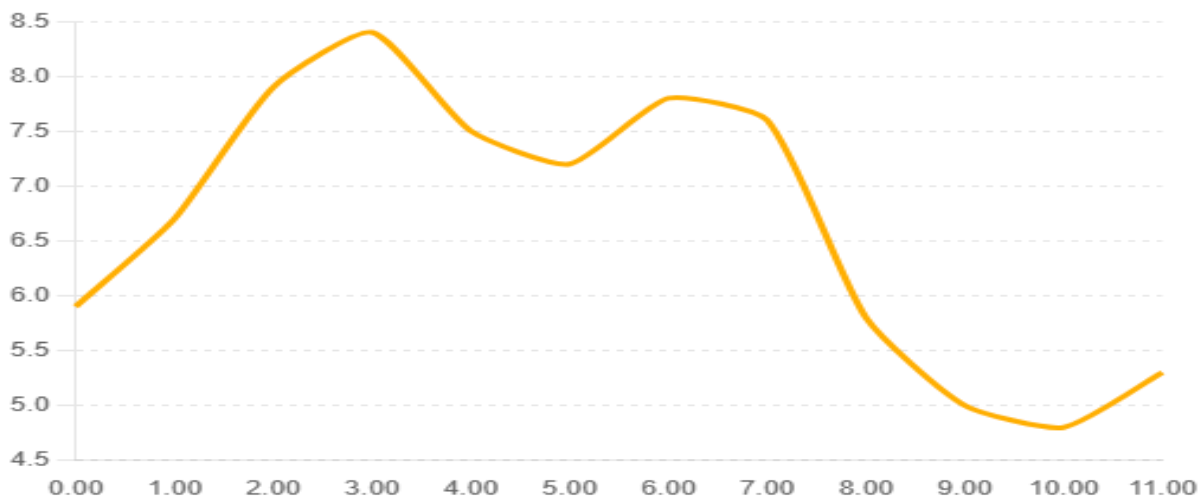


Figure 11 Wind Speed readings in Ilorin

Source: Author's compilation from field data, 2025.

Ilorin's dataset offers a meso-scale window into West African monsoon behaviour. The tight coupling between temperature, humidity, rainfall, and wind provides an excellent case study for Monsoon onset/retreat diagnostics, and Land–atmosphere feedbacks in a savanna transition zone.

Table 6 Average Climatic data for Pategi, Northern Zone (2014 -2024)

Months	Temp. °C (Max.)	Temp. °C (Min.)	Temp. °C Mean monthly	RH(AM) %	RH(PM) %	Rainfall (mm)	Wind Speed (m/s)
Jan	31.11	17.22	24.17	54.19	32.23	2.54	5.4
Feb	32.77	19.44	26.11	63.02	34.90	7.62	6.2
Mar	32.77	21.67	27.22	79.30	55.42	25.40	7.3
April	31.67	22.22	26.95	81.23	64.19	63.50	7.7
May	29.44	21.67	25.56	85.53	79.30	101.6	6.9
June	27.78	21.11	24.45	87.87	78.31	129.54	6.7
July	26.67	20.00	23.34	87.87	79.08	149.86	7.4
August	26.67	20.00	23.34	88.55	79.56	160.02	7.3
September	27.22	20.00	23.61	88.62	80.99	185.42	5.6
October	27.78	20.00	23.89	86.57	76.43	81.28	4.8
November	29.44	18.89	24.17	80.93	57.24	10.16	4.6
December	30.00	17.22	23.61	60.15	37.01	2.54	4.9

Source: Author's compilation from field data, 2025.

From the above data Table 6, Pategi maximum temperature (Tmax) peaks at 32.77°C in February and March, then declines to 26.67°C in July–August, before rising again to about 30.00°C in December. Minimum temperature (Tmin) increases from 17.22°C January to 22°C April through May, then stabilises around 20°C from June to October and falls back to 17.22°C in December. Mean monthly temperature ranges between 23.34°C July through August and 27.22°C (March). This indicates a warm but not extreme tropical thermal environment, with a modest annual range but a marked seasonal shift linked to cloud cover and moisture. The pre-monsoon months (February to March) exhibit the highest mean and maximum temperatures. Clear skies, low humidity and intense solar radiation enhance daytime heating. Night-time radiative cooling is effective in January and December, explaining the low Tmin values around 17°C and generating a relatively large diurnal temperature range, characteristic of dry-season continental conditions.

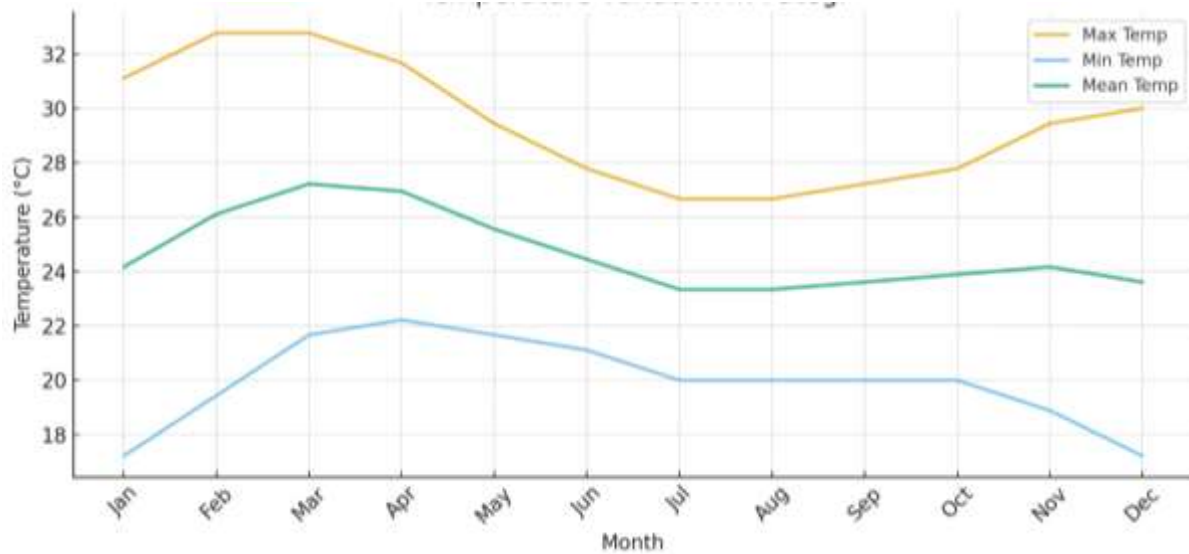


Figure 12 Temperature Variation in Pategi

Source: Author's compilation from field data, 2025.

Beginning in April, a rise in cloud cover and humidity leads to a decrease in daytime temperatures indicates Tmax consistently drops from 31.67°C (April) to 26.67°C (July–August). The average temperature low in July–August (around 23.3°C) aligns with the highest levels of rainfall and humidity. Therefore, the wet season experiences lower temperatures due to cloud albedo, convective cooling, and the absorption of latent heat during evaporation and rainfall.

The bar chart Figure 13, depicting rainfall illustrates a pronounced seasonal trend, significant rainfall begins in April (63.50 mm), following very low amounts from January to March (2.54–25.40 mm). A rapid increase occurs in May (101.6 mm) and June (129.54 mm). The highest rainfall levels are recorded in September (185.42 mm), with substantial totals also noted in July (149.86 mm) and August (160.02 mm). Rainfall significantly declines in October (81.28 mm) and becomes quite minimal in November and December (10.16–2.54 mm).

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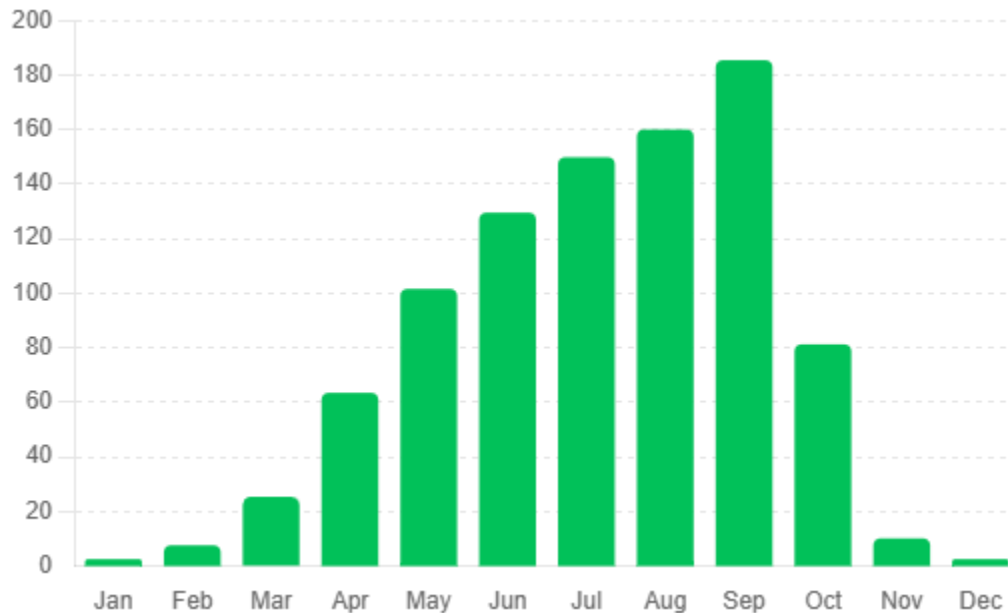


Figure 13 Rainfall Pattern in Pategi

Source: Author's compilation from field data, 2025.

This single peak pattern corresponds with the time when the Intertropical Discontinuity (ITD) is situated north of Pategi, facilitating strong southwesterly monsoon winds and considerable low-level convergence. Much of the rainfall from June to September can be attributed to convective systems such as thunderstorms, squall lines, and mesoscale convective complexes. The months with peak rainfall present risks of flooding and erosion, particularly on slopes or poorly draining land. The extended dry period from November to March leads to a soil moisture shortage, limiting the possibility of dry-season cropping without irrigation.

The morning humidity graph Figure 14, shows that January has the lowest RH AM (54.19%), followed by December (60.15%). The highest RH AM was recorded in September (88.62%), with values exceeding 85% from May to October. This spike coincides with the commencement and intensification of the monsoon. During the wet season, overnight cooling in damp conditions brings the air mass to saturation by early morning. The evening n relative humidity (RH PM) is more sensitive to temperature. The dry-season minimums are 32.23% in January and 34.90% in February, which is exceptionally low for the tropics and indicates very dry continental air. Wet-season maximum: 80.99% in September, with persistent values of 78-81% from May to October. In the Harmattan months (Nov–Mar), low dew-points, clear skies and strong heating depress RH, especially in the afternoon, producing a hot–dry environment.

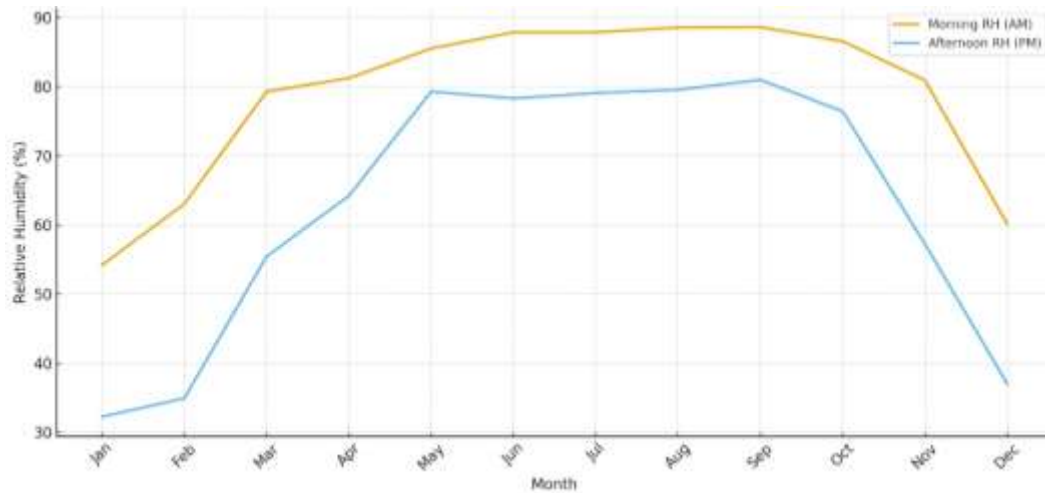


Figure 14 Morning and Evening Relative Humidity in Pategi

Source: Author’s compilation from field data, 2025.

During the monsoon season (April-October), high specific humidity, frequent rainfall, and cloudiness raise both morning and afternoon RH to extremely high levels, resulting in a hot-humid climate with minimal evaporative cooling. The wind speed graph Figure 15 shows the highest winds to be in April (7.7 m/s), followed by July (7.4 m/s) and March and August (7.3 m/s). Lowest winds are indicated in November (4.6 m/s) and October (4.8 m/s). 5.2 Atmospheric Controls The pre-monsoon period (Mar-Apr) coincides with strengthening pressure gradients between hot inland regions and the cooler, moist Gulf of Guinea, explaining the April wind maximum. Elevated winds in July-August are linked to deep monsoon flow and frequent thunder.

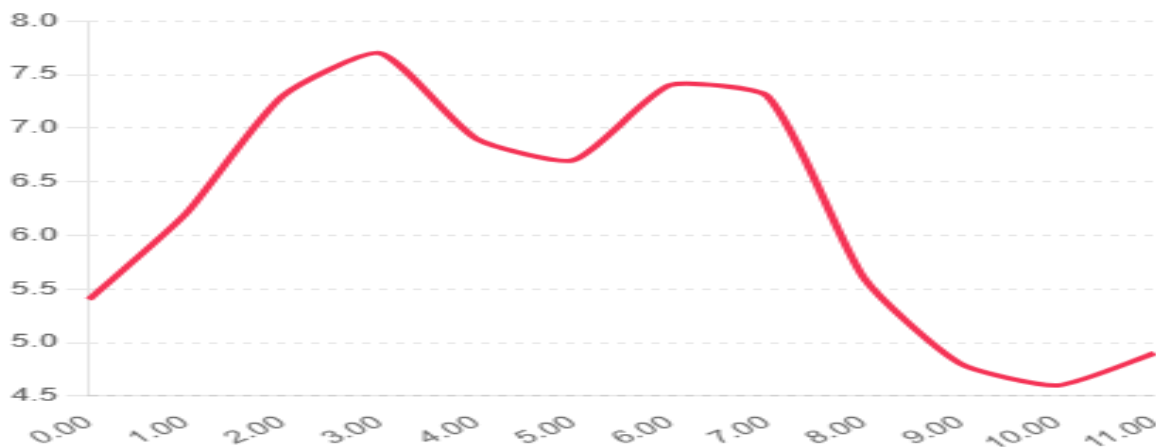


Figure 15 Wind Speed readings in Pategi

Source: Author’s compilation from field data, 2025.

Table 7 Average Climatic data for Jebba, Northern Zone (2014 -2024)

Months	Temp. °C (Max.)	Temp. °C (Min.)	Temp. °C Mean monthly	RH(AM) %	RH(PM) %	Rainfall (mm)	Wind Speed (m/s)
Jan	35.00	18.89	26.11	61.55	21.84	0.00	6.1
Feb	36.67	21.67	28.89	66.61	20.97	5.08	6.5
Mar	37.22	24.44	30.00	82.02	28.25	17.78	7.2
April	36.11	25.00	30.00	81.82	36.77	45.72	7.9
May	33.89	23.89	28.89	84.39	49.16	73.66	7.1
June	32.22	23.33	27.78	87.77	58.02	88.90	6.7
July	30.56	22.78	26.67	89.39	64.10	114.30	6.8
August	30.00	22.78	26.11	90.46	68.81	139.70	6.5
September	30.56	22.78	26.11	91.43	67.75	149.86	5.2
October	31.67	22.78	27.22	90.53	58.17	68.58	4.8
November	33.89	21.11	27.22	86.50	35.98	7.62	5.0
December	34.44	18.89	26.11	68.33	25.02	0.00	5.7

Source: Author's compilation from field data, 2025.

From the climatic data of Jebba Table 7, the maximum temperature (Tmax) ranged from 30.00 to 37.22°C, with the highest recorded in March (37.22°C) and a secondary maximum in February (36.67°C). Minimum temperature (Tmin) climbs from 18.89°C (January, December) to 25.00°C (April), then settles at 22.78°C from July to October. Mean monthly temperatures are continuously high, ranging from 26.11°C to 30.00°C, with peaks in March and April. Night-time minima are coolest in December–January (18.9°C) due to strong long-wave radiative cooling under dry, cloud-free conditions. This produces a large diurnal temperature range, typical of continental, dry-season conditions. Cloud cover and humidity increase when the monsoon season begins in April. Tmax decreases from 36.11°C (April) to 30-30.56°C (July-September). During the core wet season, average temperatures fall to 26-27°C. This cooling is caused by cloud albedo, convective overturning, and latent heat exchange during rainfall, which all lower surface heating despite the high sun angle.

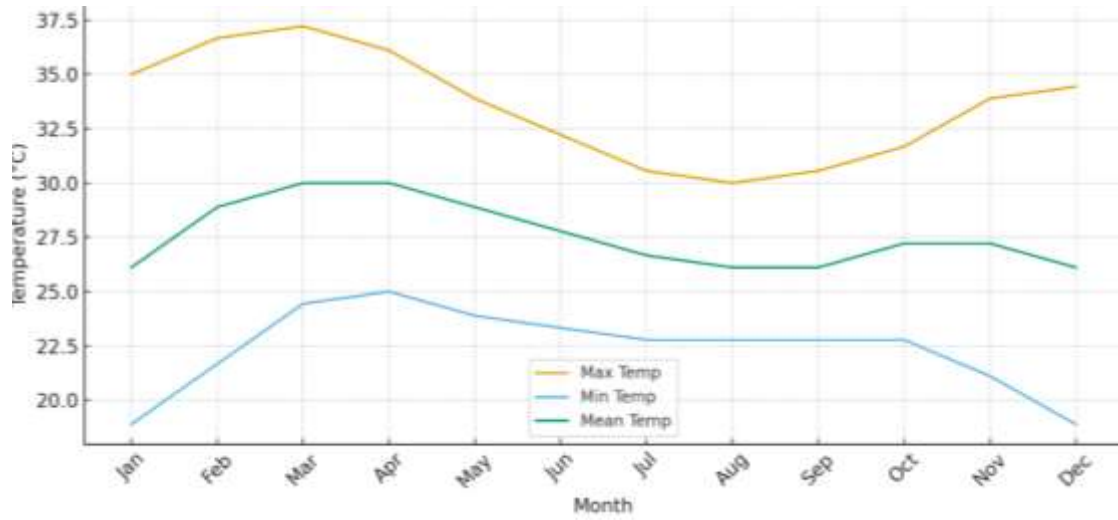


Figure 16 Temperature Variation in Jebba
Source: Author's compilation from field data, 2025.

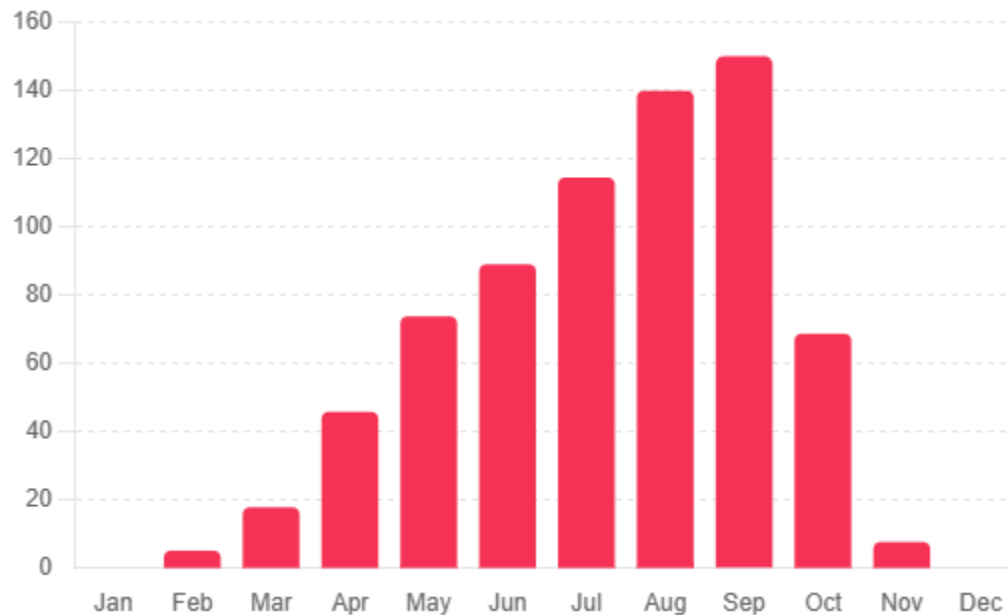


Figure 17 Rainfall Pattern in Jebba
Source: Author's compilation from field data, 2025.

The rainfall bar chart shows a notable unimodal pattern; there was virtually no rain in January or December (0.0 mm). The first meaningful rainfall occurs in February (5.08 mm) and March (17.78

mm). Rapid intensification from April to June (45.72-88.90 mm). The peak rainfall occurs in August (139.70 mm) and September (149.86 mm), with high totals also recorded in July (114.30 mm). Rainfall declines substantially by October (68.58 mm) and practically completely in November (7.62 mm). Peak rainfall months (July-September) are crucial for soil moisture recharging, but they are also associated with flooding and erosion risks. The extended dry season (November to March) causes a severe soil moisture deficit, limiting dry-season cultivation without irrigation and increasing demand on surface and groundwater resources.

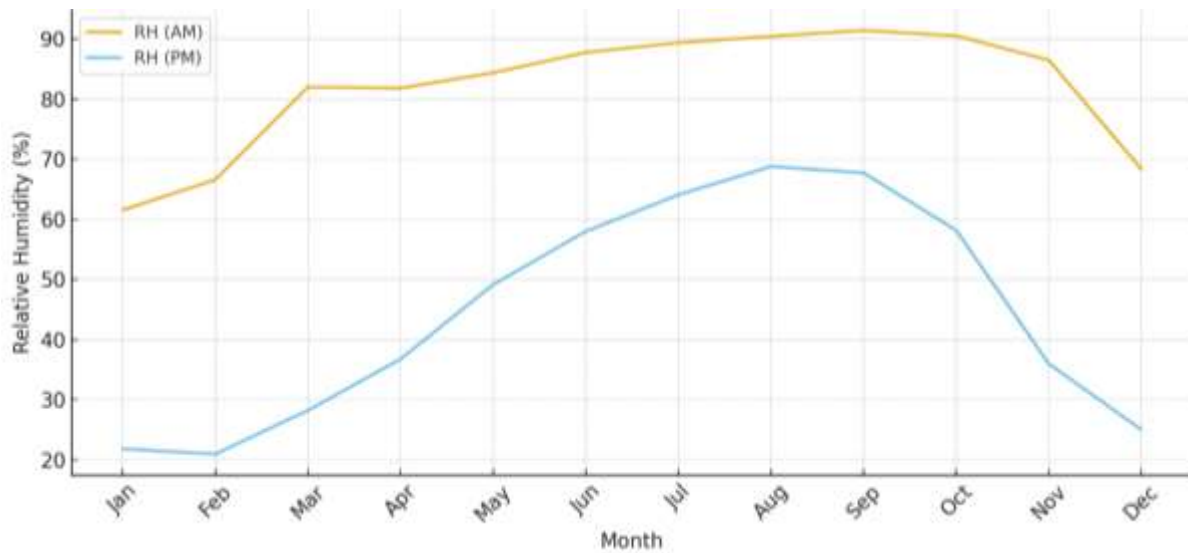


Figure 18 Morning and Evening Relative Humidity in Jebba

Source: Author's compilation from field data, 2025.

From the plot of combined humidity, Figure 18, RH (AM) increases from 61.55% in January and 66.61% in February to more than 80% starting in March and reaching a peak of 91.43% in September. Between May and November, values stay above 84%, indicating nearly saturated morning conditions during the rainy season. Relative Humidity in the Afternoon (RH PM) During the dry season, RH (PM) is very low, ranging from $\approx 21-22\%$ in January–February to $\sim 28\%$ in March. The rains then cause it to climb quickly to 49–58% in May and June, peak at 68–69% in July and August, and then start to decline once more after September. November through March is the dry season. High temperatures and dry Harmattan air are the main causes of the extremely low RH PM. Strong daytime temperatures and low air moisture content are indicated by a large AM–PM humidity contrast.

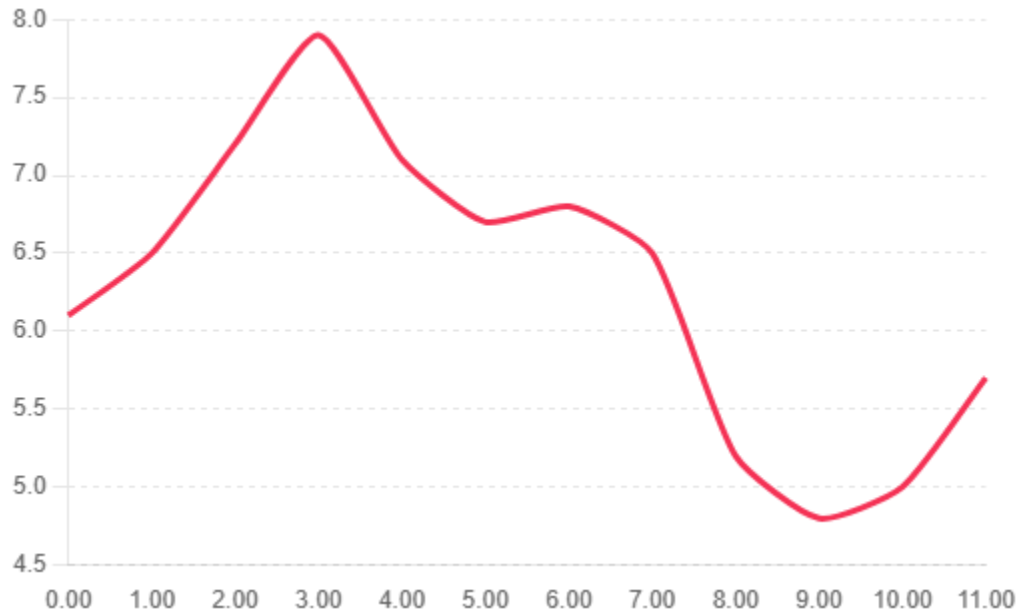


Figure 19 Wind Speed readings in Pategi

Source: Author's compilation from field data, 2025.

From the graph of wind speed Figure 19, April has the strongest winds (7.9 m/s), followed by March (7.2 m/s) and May (7.1 m/s). June through August see comparatively high winds (6.7–6.8 m/s). October (4.8 m/s) and November (5.0 m/s) have the weakest winds, with a slight rebound in December (5.7 m/s). Strengthened pressure gradients between the hot continental interior and the cooler, wet Gulf of Guinea, as well as the frequent passage of squall lines and thunderstorms, cause increased winds during the pre-monsoon and early monsoon months (March–May). These gradients lessen and the atmosphere stabilises when the monsoon retreats (September–November), which lowers wind speeds.

Natural ventilation is greatly improved by stronger winds from March to August, which is beneficial for thermal comfort during hot, muggy months. But they also raise the possibility of tree fall, roof uplift, and structural damage, especially during thunderstorm gust fronts. Particularly in heavily populated areas, weaker breezes in October and November may exacerbate heat stress, dust buildup, and stagnant air.

Table 8 Average Climatic data for Lafiaji, Northern Zone (2014 -2024)

Months	Temp. °C (Max.)	Temp. °C (Min.)	Temp. °C Mean monthly	RH(AM) %	RH(PM) %	Rainfall (mm)	Wind Speed (m/s)
Jan	34.44	18.89	26.11	59.68	21.51	0.00	5.4
Feb	36.11	21.67	28.33	66.46	21.40	5.08	5.8
Mar	36.67	24.44	30.00	82.25	29.88	17.78	6.6
April	36.11	25.00	30.00	82.68	38.81	48.26	7.0
May	33.89	25.00	28.89	85.22	50.91	83.82	6.3
June	31.67	23.89	27.78	88.22	59.90	104.14	6.1
July	30.56	23.33	26.11	89.28	65.07	134.62	6.5
August	30.00	22.78	26.11	90.13	68.39	154.94	6.3
September	30.00	22.78	26.67	91.19	67.18	167.64	5.0
October	31.67	22.78	27.22	90.22	58.34	81.28	4.5
November	33.33	21.11	26.67	86.43	36.03	7.62	4.4
December	33.89	18.89	25.56	66.45	24.42	0.00	4.9

Source: Author's compilation from field data, 2025.

This graph Figure 20, shows extremely high temperatures throughout the dry season (January to April) March (36.67°C) and April (36.11°C) are the months with the highest temperatures. From January (18.89°C) until April (25°C), minimum temperatures increase gradually. March and April are the hottest months, with mean temperatures reaching 30°C. Wet season (June–October), Moderate temperatures Heating is reduced by peak rainfall and cloud cover. The lowest temperatures (around 26–27°C) occur in July and September. The graph confirms a classic tropical wet–dry climate, where the dry season is hot and intensely sunny. The wet season is cooler due to cloud cover and rainfall.

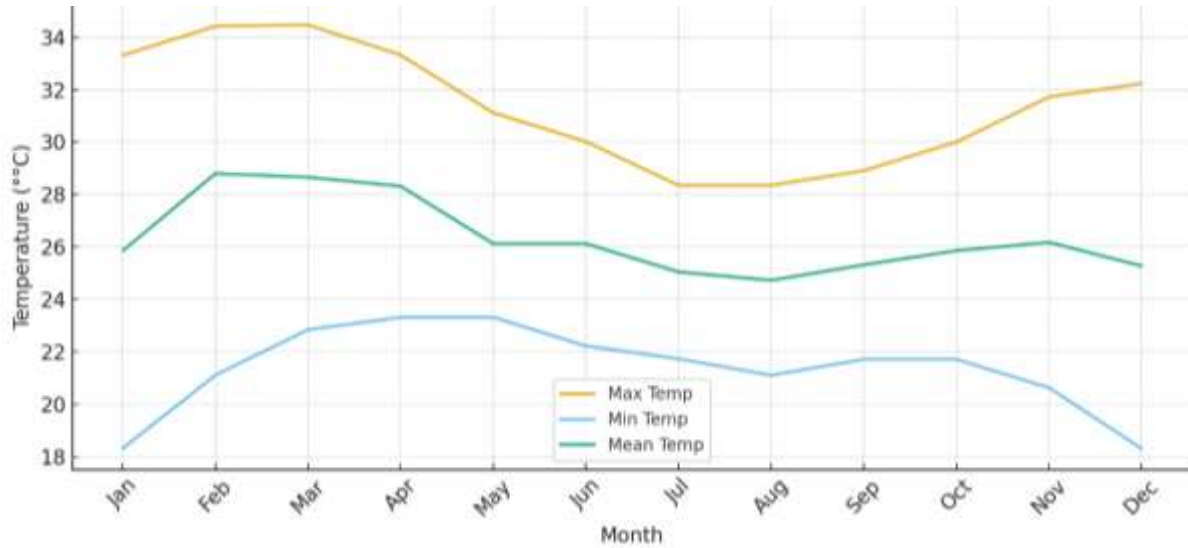


Figure 20 Temperature Variation in Lafiaji
Source: Author’s compilation from field data, 2025.

The bar graph of rainfall Figure 4.22, shows January and December had no precipitation. Harmattan season is predominated throughout the absolute dry season. March marks the start of the rainy season (17.78 mm) and starts to rise quickly in April. August (154.94 mm) and September (167.64 mm) had the highest rainfall. The wettest months are these ones. The retreat of rainfall begins in October (81.28 mm). It sharply decreases to 7.62 mm by November.



Figure 21 Rainfall Pattern in Lafiaji
Source: Author’s compilation from field data, 2025

This graph Figure 4.19 clearly shows the contrast between AM humidity (RH AM) and PM humidity (RH PM). Morning Humidity (RH_AM), rises sharply from 59% (January) to a peak of 91% (September) and stays above 85% from May to November. The Afternoon Humidity (RH_PM) is extremely low in dry months (21–22% in Jan–Feb) due to intense heating. The Relative Humidity Peaks around 68% in August and 67% in September. Dry season is very low PM humidity and evaporative stress, dehydration, respiratory irritation.

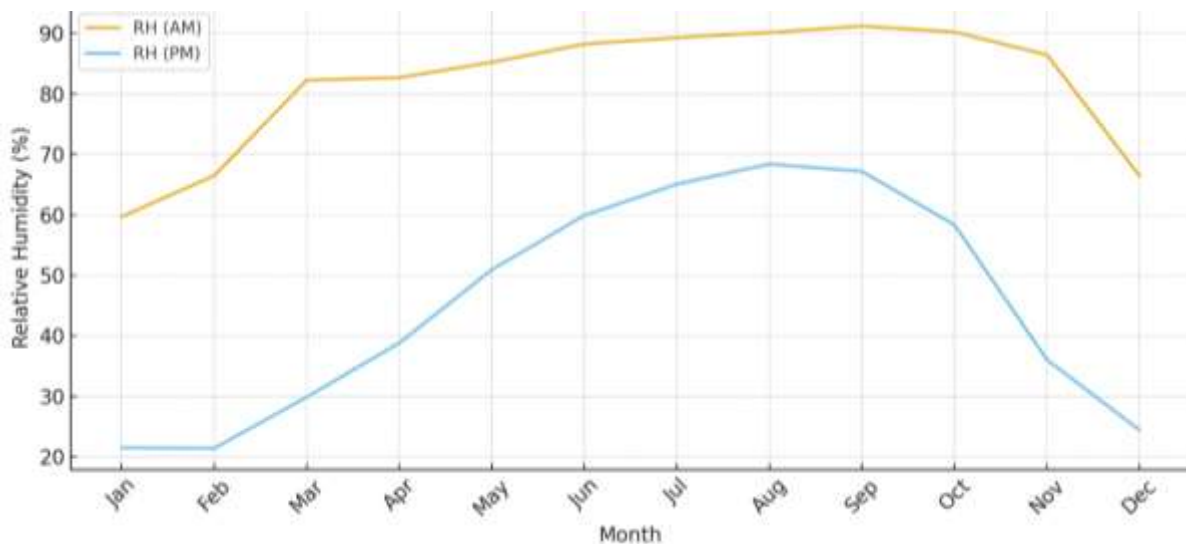


Figure 22 Morning and Evening Relative Humidity in Lafiaji

Source: Author's compilation from field data, 2025

Wet season is persistently high humidity is poor evaporation, sweating inefficiency, mould growth, thermal discomfort. Figure 22 confirms strong diurnal humidity variation in the dry season and strong atmospheric saturation during the wet season.

Strongest winds: March (6.6 m/s) and April (7.0 m/s), is Linked to pre-monsoon pressure gradients and thunderstorm gust fronts. Stable strong winds: May–August (6–6.5 m/s). Associated with deep monsoon flow. Weakest winds: October (4.5 m/s) and November (4.4 m/s). As the monsoon retreats and atmosphere becomes more stable. Strong winds enhance natural ventilation during heat, but increase storm damage risk. Weak winds in early Harmattan contribute to dust accumulation and stagnation.

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