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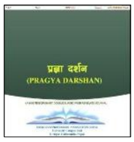

# BASELINE WEATHER AND CLIMATE ASSESSMENT OF THE KSAFTER SITE IN PUTALIBAZAAR-2, SYANGJA, NEPAL

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**Abstract**

*This study presents a comprehensive assessment of the weather, climate, and air quality conditions at the KSAFTER (Kushechaur Simriklek Agrimed Forest Tourism Education and Research) site in Putalibazaar-2, Syangja District, Gandaki Province, Nepal. Using secondary data from January 2023 to early 2024, sourced from the Department of Hydrology and Meteorology (DHM), Accuweather, and other online platforms, the study analyzed monthly variations in temperature, atmospheric pressure, relative humidity, wind speed, rainfall, sunshine duration, and cloud cover. Results indicate distinct seasonal patterns characteristic of Nepal's mid-hill subtropical climate. Winters were dry and cool (low of 1.4°C in January), while the monsoon months (June–August) brought peak humidity (82%), maximum rainfall (347 mm in July), and the lowest atmospheric pressure (1005.5 mbar). Wind speeds peaked during the pre-monsoon (7.5 km/h in April), while sunshine hours were highest from March to May. In addition to climatic parameters, the study evaluated real-time air quality using the Air Quality Index (AQI). Pollutants such as PM2.5, PM10, $O_3$, $NO_2$, $SO_2$, and CO were monitored using publicly available data. AQI readings in Putalibazaar generally ranged between "Fair" and "Good," with localized fluctuations. On 14th November 2024, the AQI was recorded within the "Fair" category (20–49). These findings provide an essential environmental baseline for agroforestry, eco-tourism, and land-use planning at the KSAFTER site and offer a scalable model for climate-smart development in similar Himalayan mid-hill regions.*

**Keywords:** *Mid-hill climate, Seasonal weather variability, Air Quality Index (AQI), Agroforestry planning, Climate-resilient development*

## Introduction

Understanding local weather and climate dynamics is essential for sustainable land-use planning, agricultural development, environmental conservation, and disaster preparedness, especially in mountainous and ecologically sensitive regions. Climate influences everything from vegetation patterns and water availability to infrastructure resilience and human well-being. In Nepal—a country characterized by sharp altitudinal gradients and diverse topographic conditions—climate studies play a critical role in managing the impacts of both natural and anthropogenic changes (IPCC, 2006)(MoLJPA, 2019)

Situated in the central Himalayas, Nepal spans elevations from 60 meters in the Terai lowlands to 8,848 meters at the summit of Mount Everest. This altitudinal diversity results in highly variable microclimates, ranging from subtropical to alpine within short spatial scales. The mid-hill regions, such as Syangja District in Gandaki Province, are particularly dynamic zones where agriculture, biodiversity, and rural settlements converge. However, despite their ecological and economic importance, many of these areas remain under documented in terms of localized weather and climate trends (MoFE, 2021)(ICIMOD, 2020).

The **Kushechaur Simriklek Agrimed Forest Tourism Education and Research (KSAFTER)** site, located in Ward No. 2 of Putalibazaar Municipality, Syangja, has emerged as a model for integrating agroforestry, eco-tourism, and sustainable forest entrepreneurship. The success of these initiatives, however, depends significantly on understanding the site's **climatic conditions**, particularly about seasonal patterns in **temperature, humidity, precipitation, atmospheric pressure, and wind speed**. These parameters affect land use decisions, crop cycles, water availability, erosion control, and the long-term viability of climate-sensitive activities such as medicinal and aromatic plant (MAPs) cultivation and ecotourism (Parajuli, 2023).

This study aims to provide **a comprehensive weather and climate assessment** of the KSAFTER site by analyzing secondary meteorological data sourced from both national and international platforms. The variables examined include **monthly average temperature, atmospheric pressure, relative humidity, wind speed, and sunshine duration**, covering the period from January 2023 to early 2024. Data were obtained from the **Department of Hydrology and Meteorology (DHM), Government of Nepal**, and verified through global sources such as **Accuweather, Time and Date,** and **Weather & Climate Station archives** ((DHM), 2024)(Accuweather, 2024)(Timeanddate, 2024).

By synthesizing these data, this study establishes **a seasonal climatic profile** of the KSAFTER site. The findings aim to inform future agroforestry planning, rural development strategies, and adaptive land management practices in mid-hill Nepal. In doing so, this research provides a replicable model for integrating localized climate data into sustainable development planning in other similar geographic regions.

## Materials and Methodology

### Study Area

The study was conducted at the KSAFTER (Kushechaur Simriklek Agrimed Forest Tourism Education and Research) site, located in Ward No. 2 of Putalibazaar Municipality, Syangja District, Gandaki Province, Nepal. The region spans approximately 8.12 km², with an altitudinal range from 800 to 2,000 meters above sea level. The topography includes a mix of moderate to steep slopes with both north- and south-facing aspects, resulting in microclimatic variations. The climate in this area transitions from **subtropical** at lower elevations to **temperate** at higher altitudes, supporting diverse ecological systems. Previous temperature records for this region range from **11.2°C in January** to **32.9°C in June** (DHM, 2024). The local population consists of various ethnic communities, including Gurung, Magar, Kumal, Damai, Sarki, Brahmin, and Chhetri (CBS, 2021).

**Climatic and Meteorological Data Collection**

This study focused exclusively on the **weather and climate characteristics** of the KSAFTER site. No physical field sampling or vegetation assessments were conducted. All meteorological data were obtained from **secondary sources**, including: The **Department of Hydrology and Meteorology (DHM), Government of Nepal, and** Online meteorological platforms such as **Accuweather, Weather & Climate**, and **Time and Date.** These sources provided **monthly and daily records** of key climatic variables for the Syangja District, including: **Temperature** (maximum, minimum, and average), **Atmospheric pressure, Relative humidity, Wind speed, Sunshine duration, etc.** Data were collected and analyzed for the year **2023 through early 2024** to capture seasonal variations and trends. The information was used to interpret the **local climatic pattern** at the KSAFTER site, with emphasis on identifying seasonal extremes, monsoonal impacts, and transitional weather phases relevant to agroforestry, tourism, and environmental planning. Descriptive statistics and trend analysis were applied to highlight monthly variability, seasonal groupings (winter, spring, monsoon, autumn), and climate-influenced phenomena such as diurnal range and monsoon onset. Graphical interpretations and comparative month-by-month evaluations were used to support climate assessment.

**Results and discussion**

**Thermal and seasonal variation**

The average high and low temperatures in Syangja, Nepal, for the year 2024 is presented in Figure 1.

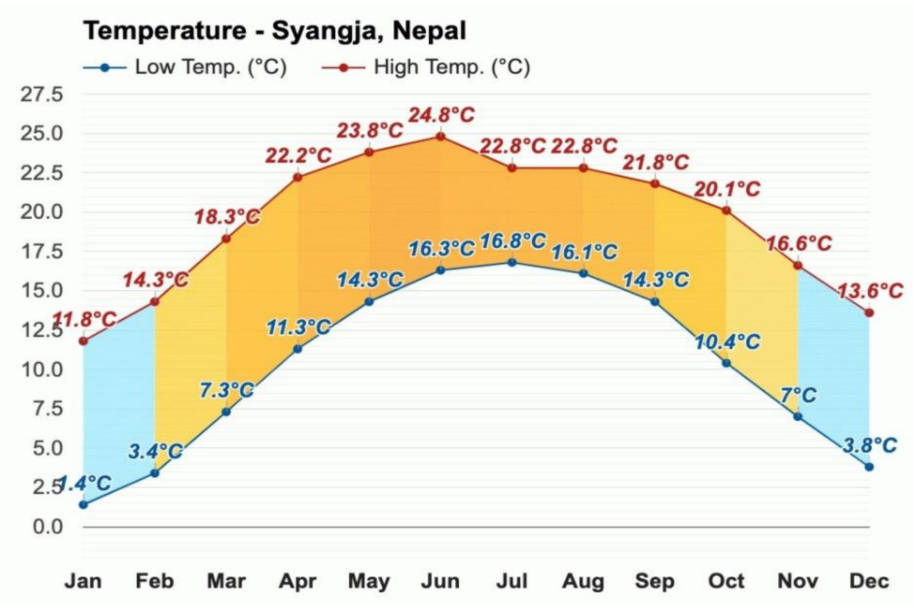


**Figure 1: Average temperature in Syangja, Nepal** (Syangja, 2024)

General climatic observations from Syangja District reveal a clear pattern of seasonal temperature fluctuation, influenced by its elevation and subtropical mid-hill setting. The annual temperature range spans from a **low of 2.4°C in January** to a **high of 24.8°C in June**. Seasonal distinctions are evident: **winter (December–February)** is marked by the coldest conditions, with January experiencing average highs of 11.8°C and lows down to 2.4°C, accompanied by chilly mornings and evenings. **Spring (March–May)** shows a steady warming trend, with temperatures rising from 18.3°C in March to 22.8°C in May, making it a transitional period characterized by comfortable weather. The **summer and monsoon season (June–August)** brings the highest temperatures, peaking in June (24.8°C high, 16.8°C low), although monsoonal cloud cover and rainfall (not detailed here) help moderate heat extremes. **Autumn (September–November)** reflects a gradual decline in temperature, with daily highs decreasing from 22.8°C in September to 16.6°C in November. The **post-monsoon transition** toward winter, especially in December, brings cooling conditions, with lows falling to 3.8°C. June stands out as the hottest month, while January is the coldest. Throughout the year, the **diurnal temperature range remains relatively stable**, suggesting moderate daily variation. Overall, **March to May and September to November** are identified as the most climatically comfortable periods for outdoor activities and land-based operations. These trends underscore the region's **distinct seasonal dynamics**, which are key to planning for agriculture, forest growth cycles, and ecotourism activities in the KSAFTER area.

Average pressure

The average atmospheric pressure in Syangja, Nepal, for the year 2024, measured in millibars (mbar) is shown in Figure 2.

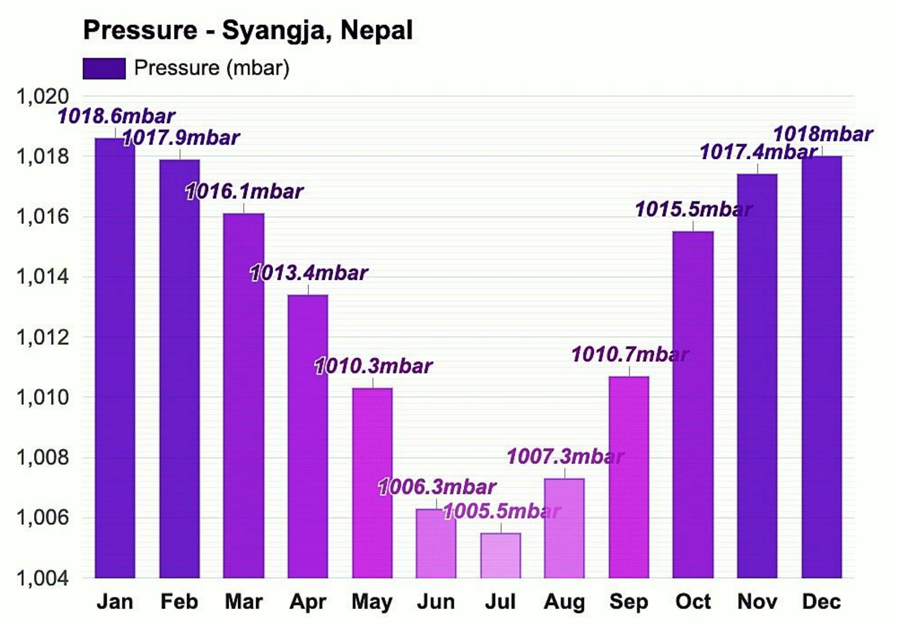


**Figure 2: Average pressure in July Syangja, Nepal** (Syangja, 2024)

Atmospheric pressure data for Syangja District reflects well-defined seasonal trends that align with its subtropical mid-hill climate. The **annual pressure range extends from a low of 1005.5 mbar in July** to a **high of 1018.6 mbar in January**. The highest pressures are observed during the **winter months (December–February)**, with January marking the peak at 1018.6 mbar. This is consistent with cooler temperatures and denser air masses typical of the winter season. In **spring (March–May)**, atmospheric pressure begins a gradual decline, reaching 1010.3 mbar by May. The **lowest pressure values occur during the summer/monsoon period (June–August)**, particularly in July, which registers the annual minimum of 1005.5 mbar. This decline corresponds to rising temperatures and the onset of the southwest monsoon, which brings increased humidity and rainfall. **Post-monsoon months (September–November)** show a steady recovery in pressure, with values rising from 1011.7 mbar in September to 1017.4 mbar in November. By **December**, pressure levels return to winter highs at approximately 1018 mbar. The **monsoon's influence is clearly evident**, as the lowest pressures coincide with the period of peak precipitation and atmospheric instability. Overall, the pressure pattern remains **seasonally consistent and gradual**, with no abrupt fluctuations, reflecting a stable subtropical climate system. These pressure variations, governed by temperature gradients and seasonal wind patterns, are crucial in understanding the region's weather dynamics and in planning for climate-sensitive activities such as agriculture, plantation management, and eco-tourism in the KSAFTER site.

Average wind speed

The average wind speed and maximum wind speed (km/h) in Syangja, Nepal, for the year 2024 (Figure 3).

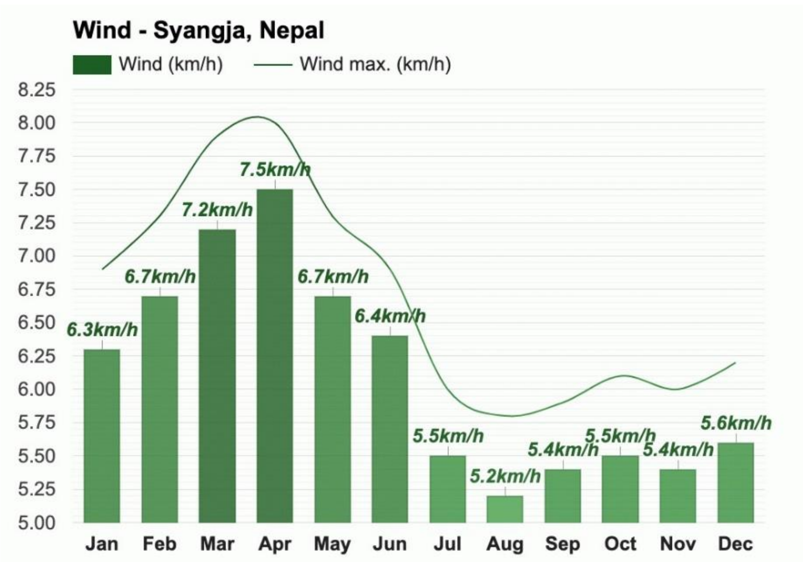


**Figure 3: Average and maximum wind speed** (Syangja, 2024)

Wind speed observations for Syangja District in 2024 demonstrate a clear pattern of **seasonal variation** influenced by the region's subtropical climate and monsoonal dynamics. Annual wind speeds range from a **low of 5.2 km/h in August** to a **high of**

**7.5 km/h in April**. During the **winter months (December–February),** wind speeds are moderate, starting at 6.3 km/h in January and increasing slightly to 6.7 km/h by February. **Spring (March–May)** emerges as the **windiest season,** with wind speeds peaking in **April at 7.5 km/h**, likely due to increased atmospheric instability and pre-monsoon circulations. May maintains a relatively high speed of 6.7 km/h, supporting the characterization of spring as a dynamic transition period. In contrast, the **monsoon season (June–August)** brings a significant drop in wind velocity, with **August registering the calmest conditions at 5.2 km/h.** This decrease aligns with high humidity levels and heavy atmospheric pressure during the peak monsoon. **Autumn (September–November)** continues this trend of relatively subdued wind activity, with stable speeds ranging from 5.4 to 5.5 km/h. By **December**, wind speeds begin to increase slightly (5.6 km/h), indicating a shift to cooler, drier air masses and the onset of early winter. The **monthly analysis confirms April as the windiest month** and **August as the calmest,** both corresponding with expected regional weather patterns. Overall, the wind speed data show a **consistent seasonal rhythm**, decreasing during the monsoon and rising during spring. These wind trends have practical implications for **agricultural planning, structural engineering, and eco-tourism logistics**, as wind conditions affect crop stability, construction safety, and comfort in outdoor activities.

Average humidity

The monthly average relative humidity for Syangja District, Nepal, over the course of a year (Figure 4).

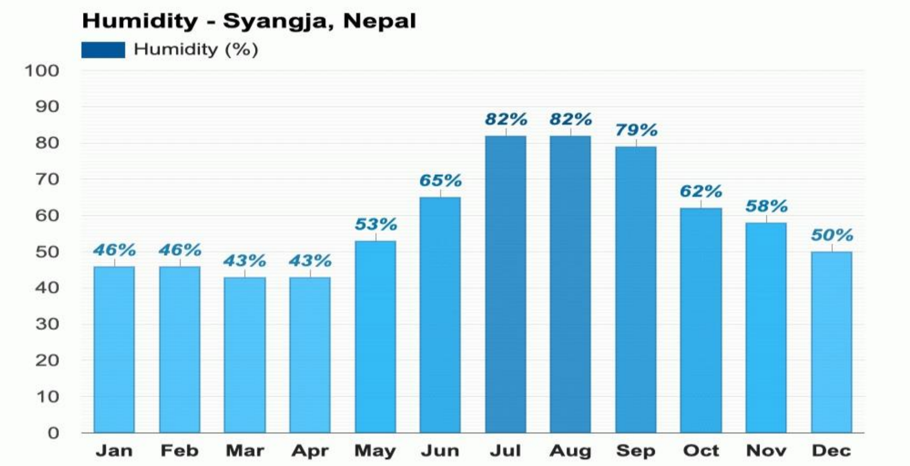


**Figure 4: Average humidity** (Syangja, 2024)

The relative humidity patterns observed in Syangja District exhibit a well-defined **seasonal variation**, characteristic of a **subtropical monsoon-influenced climate. Lowest humidity levels** occur from **January to April**, ranging between **43% and 46%,** corresponding to the dry winter and pre-monsoon periods. As temperatures begin to rise in **May**, humidity increases to 53%, signaling the approach of the monsoon season. The **highest humidity levels**, peaking at **82%,** are recorded in **July and August**, coinciding with the peak monsoon rainfall and heavy atmospheric moisture. Following the monsoon, humidity gradually declines—from 79% in September to 50% by December—marking a return to cooler and drier winter conditions. These transitions are clearly demarcated: the **pre-monsoon period (April–May)** shows a steady build-up in atmospheric moisture, while the **post-monsoon phase (September–October)** reflects a consistent decrease in humidity as the region dries out. This bimodal behavior underscores the dominance of the monsoon system in shaping annual humidity dynamics. Notably, **March and April** represent the **driest months**, each with relative humidity as low as **43%**, while **July and August** are the **most humid**, at **82%**. The overall pattern reveals a distinct **dry season from October to April,** and a **wet, humid season from June to August**, consistent with broader climatic trends in Nepal's mid-hill regions. These findings are particularly relevant for forest growth, agricultural planning, and ecological studies, as humidity plays a critical role in plant transpiration, disease susceptibility, and habitat suitability.

Average rainfall

The monthly rainfall distribution for Syangja District, Nepal is shown in **Figure 5**.

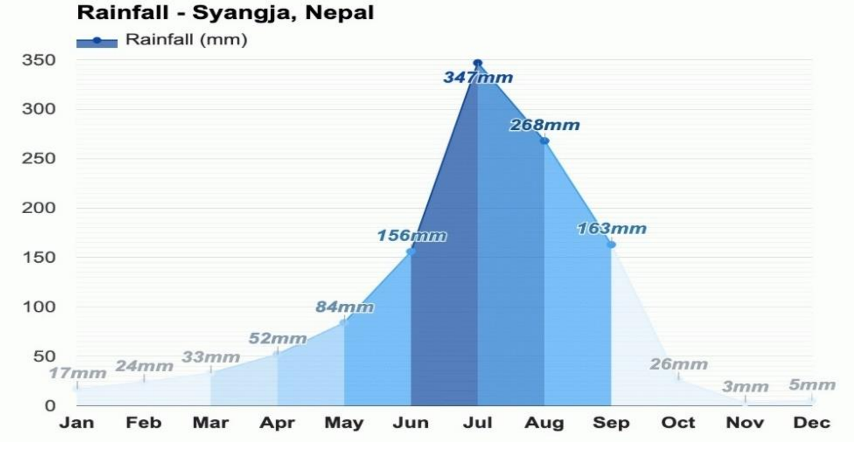

**Figure 5: Average rainfall** (Syangja, 2024)

The rainfall patterns in Syangja District reveal distinct seasonal variations closely tied to the monsoon cycle. The highest rainfall is recorded in July, with 347 mm, followed by August with 268 mm and September with 163 mm, marking the peak monsoon period. In contrast, rainfall is minimal from November to February, with November receiving as little as 3 mm and December around 5 mm, reflecting the dry winter season. A gradual increase in rainfall begins in March, starting at 33 mm, and rises significantly by May to 84 mm, indicating the approach of the monsoon. After the monsoon peak, rainfall declines sharply from September to October, dropping from 163 mm to 26 mm as the region transitions into the drier months. Seasonally, the monsoon period from June to September accounts for the majority of annual rainfall, exceeding 800 mm, which underscores the monsoon's dominant role in Syangja's precipitation regime. Conversely, the dry season from October to April experiences considerably lower rainfall, totaling less than 200 mm, highlighting a pronounced seasonal contrast. These rainfall dynamics have important implications for agriculture and the local ecosystem. The heavy monsoon rains support the cultivation of crops like rice and maize but also pose risks of soil erosion and landslides in the hilly terrain of Syangja. Meanwhile, the dry season's limited rainfall constrains water availability for irrigation and drinking purposes, emphasizing the need for effective water management in the region. Overall, July stands out as the wettest month, while November is the driest.

Average rainfall days

The average number of rainfall days per month in Syangja District, Nepal is shown in **Figure 6.**

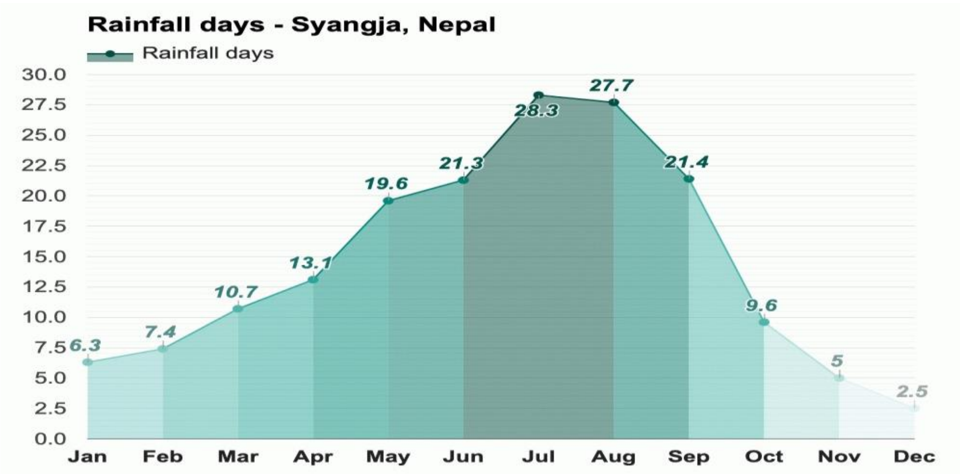


**Figure 6: Average rainfall days** (Syangja, 2024)

The key observations regarding rainfall days in Syangja District highlight pronounced seasonal patterns strongly influenced by the monsoon. July records the highest average number of rainy days at 28.3, closely followed by August with 27.7 days, both coinciding with the peak monsoon season when precipitation is most frequent. During the dry season from November to February, the number of rainy days drops significantly, with December experiencing the fewest at just 2.5 days. The transition periods show a gradual increase in rainy days from March (7.4 days) to May (13.1 days), reflecting the buildup toward the monsoon. Following August, rainfall days steadily decline, reaching 9.6 days in September and 5 days in October, before decreasing further in the dry months. Collectively, the monsoon months of June to September average over 21 rainy days per month, underscoring this period's importance for water availability and agriculture. Conversely, the dry winter months have fewer than eight rainy days each month, indicating limited water resources. These patterns have several implications: crops dependent on consistent water benefit from the extended monsoon rainfall, while winter crops may require supplemental irrigation due to reduced rainfall days. Water management strategies like rainwater harvesting are vital to mitigate the dry season's challenges. However, the consistent and heavy monsoon rains also increase the risk of soil saturation, erosion, and landslides in Syangja's hilly terrain. Additionally, the reduced rainfall from October to April creates more favorable conditions for outdoor tourism and trekking. Overall, July stands out as the month with the highest number of rainy days, while December has the least.

Average daylight and Average sunshine

The monthly daylight hours (in blue) and sunshine hours (in orange) in Syangja, Nepal, is shown in **Figure 7**.

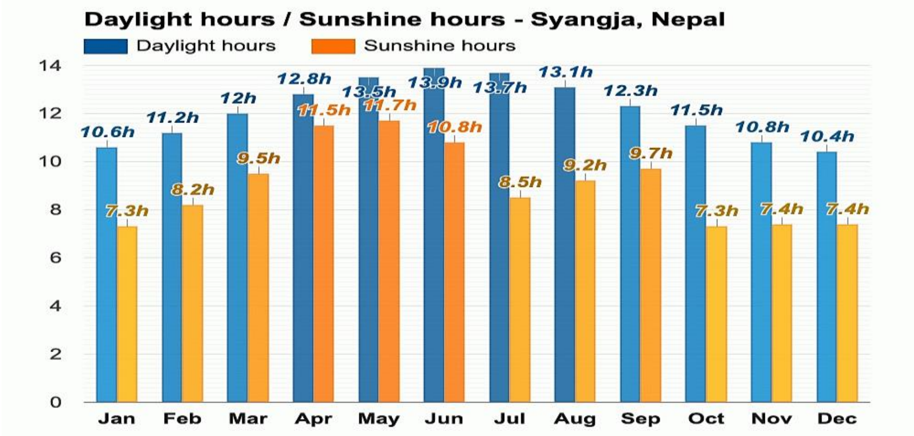


**Figure 7: Average daylight and Average sunshine** (Syangja, 2024)

The key observations regarding daylight and sunshine hours in Syangja District reveal distinct seasonal variations influenced by both geographic location and the monsoon climate. Daylight duration ranges from about 10.4 hours to 13.9 hours throughout the year, with the shortest days occurring in December (10.4 hours) and January (10.6 hours), and the longest daylight observed in June (13.9 hours), coinciding with the summer solstice. Sunshine hours vary between approximately 7.3 and 11.7 hours per day annually. The highest sunshine hours occur in April (11.7 hours) and May (11.5 hours), reflecting relatively clear skies during spring, while the lowest sunshine is recorded in July (8.5 hours), likely due to heavy cloud cover during the monsoon season. Seasonal patterns show that winter (December to February) has shorter daylight hours (around 10–11 hours) with reduced sunshine (7.3–8.2 hours), though clear skies contribute to more consistent sunshine relative to daylight. During spring (March to May), both daylight and sunshine hours increase, peaking in April and May. In summer and monsoon months (June to August), daylight hours reach their maximum (12.3–13.9 hours), but sunshine hours drop significantly (8.5–9.2 hours) because of monsoonal cloud cover. Autumn (September to November) sees a stabilization of both daylight and sunshine hours, with sunshine gradually decreasing as winter approaches. Overall, sunshine hours remain consistently lower than daylight hours due to weather factors such as cloud cover, fog, and precipitation, with the largest disparity occurring during the monsoon. This pattern highlights how Nepal's geographic position and monsoon-driven climate shape Syangja's light availability. In summary, June has the longest days with an average of 13 hours and 54 minutes of daylight, December the shortest at 10 hours and 24 minutes, May offers the most sunshine with 11 hours and 42 minutes on average, while January and October have the least sunshine at about 7 hours and 18 minutes. Average sunshine days. The number of sunshine days per month in Syangja, Nepal is shown in **Figure 8.**

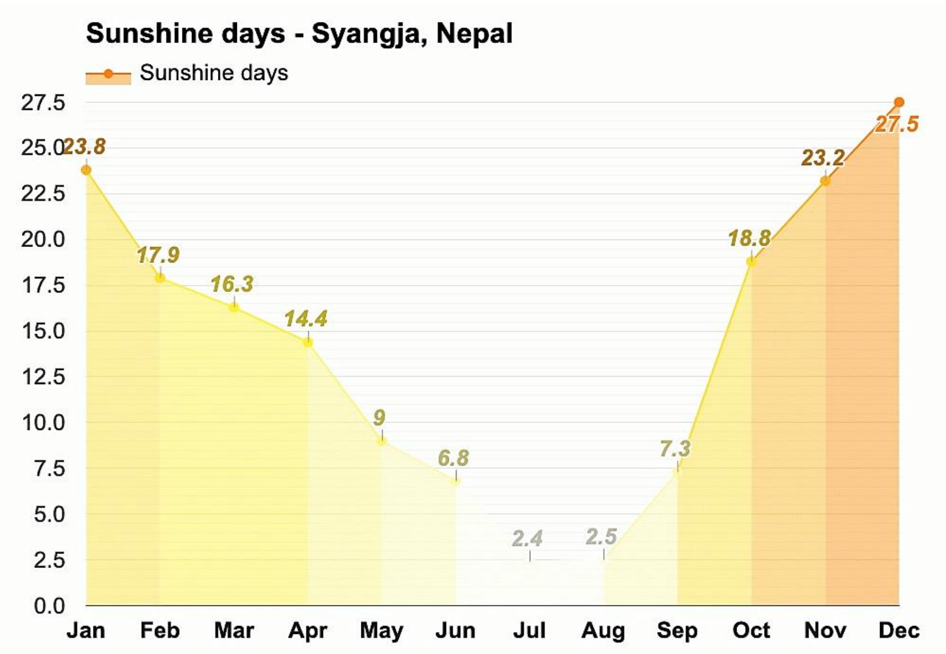


**Figure 8: Average sunshine days** (Syangja, 2024)

The key analysis of sunshine days in Syangja District reveals pronounced seasonal variations typical of a subtropical monsoon climate. Sunshine days, defined as the number of days in a month with significant sunlight, range widely from as low as

2.4 days in July to as high as 27.5 days in December. During winter (December to February), the skies are mostly clear, with December having the highest sunshine days at 27.5, followed by January with 23.8 and February with 17.9 days. This reflects the dry, cloud-free conditions typical of the winter season. In contrast, spring (March to May) sees a gradual decline in sunshine days, dropping from 16.3 days in March to just 9 days in May, as pre-monsoon cloud cover and occasional rains increase. The monsoon months of June through August record the fewest sunshine days, with June at 6.8, July—the least sunny month—at only 2.4, and August at 2.5 days, indicating persistent cloudiness and heavy rainfall. After the monsoon, sunshine days begin to recover in autumn (September to November), rising sharply from 7.3 days in September to 18.8 in October and 23.2 in November, marking the return of drier, clearer conditions. The transition from the heavily overcast monsoon period to the sunnier post-monsoon season highlights the drying of the atmosphere. Climatically, the reduced sunshine during the monsoon reflects Syangja's location within the monsoon belt, while the abundant sunshine in winter and autumn supports activities like agriculture and tourism that benefit from clear skies. In summary, December stands out as the month with the most sunshine days, while July has the fewest, underscoring the strong seasonal contrast in sunlight typical of the region.

Average UV index

The **UV index** for Syangja, Nepal, throughout the months of the year is shown in **Figure 9**.

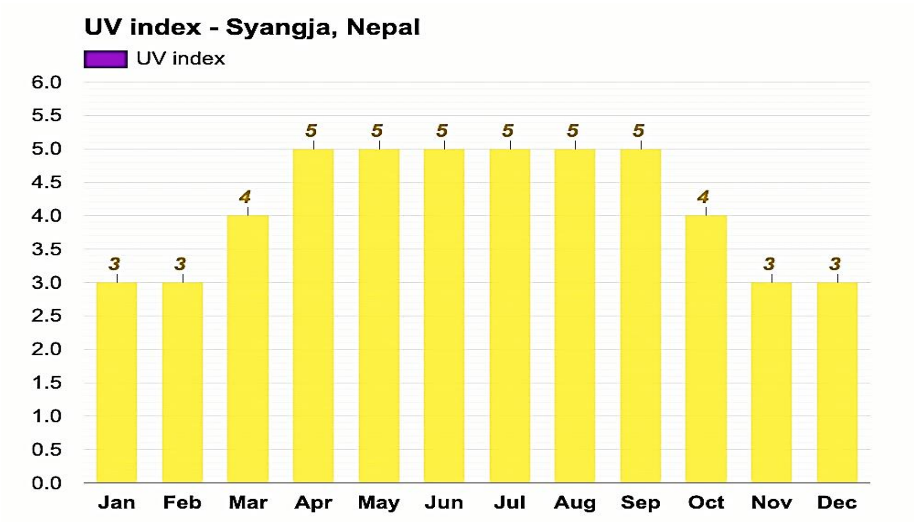


**Figure 9: Average UV index** (Syangja, 2024)

The UV index in Syangja, Nepal, reflects a consistent pattern throughout the year, with values ranging from 3 to 5, indicating low to moderate ultraviolet radiation levels. This index, which measures the strength of the sun's UV rays and its potential effects on human health, shows limited fluctuation, suggesting a relatively stable exposure risk year-round. During the winter months—December, January, and February—the UV index remains at a low level of 3, corresponding to the cooler season when the sun is lower in the sky and its rays are less intense. In spring, the index rises slightly to 4 in March and maintains this level through April and May as the region transitions into warmer conditions with increased solar exposure. The summer months, despite being part of the monsoon season, record the highest UV index of 5 (from June to August), indicating that even with considerable cloud cover, moderate UV radiation still penetrates, warranting protective measures. In autumn, the UV index gradually declines to 4 in September and October, and then drops back to 3 in November, reflecting reduced sun intensity and a return to cooler temperatures.

From a health perspective, a UV index of 3 to 5 signals a moderate risk of harm from unprotected sun exposure. While the risk is lowest during the winter months (January, February, November, and December), the highest UV levels are observed from April through September, when more caution is advised. Protective measures such as sunscreen, sunglasses, and appropriate clothing are recommended, particularly during this period of heightened UV intensity. Overall, the UV index remains within a moderate range across the year, with the months of April, May, June, July, August, and September recording the highest values (UV index 5), and January, February, November, and December showing the lowest (UV index 3).

Average cloud cover
The monthly average cloud cover percentage in Syangja, Nepal is shown in **Figure 10**.

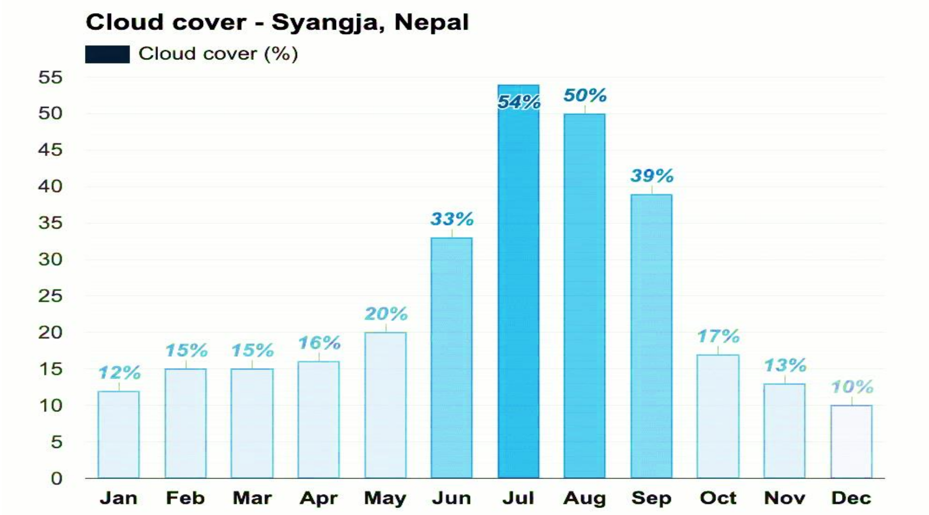


**Figure 10: Average cloud cover in Syangja, Nepal** (Syangja, 2024)

The detailed analysis of cloud cover in Syangja District reveals clear seasonal patterns that correspond closely with the region's monsoonal climate. The dry season months—including January (12%), February (15%), March (15%), April (16%), November (13%), and December (10%)—are characterized by low cloud cover, indicating predominantly clear skies and minimal precipitation. These months typically experience drier weather conditions. In contrast, May (20%) and October (17%) represent transitional periods with moderate cloud cover, likely reflecting the pre-monsoon buildup and post-monsoon retreat, respectively. The monsoon season, spanning June through September, shows significantly higher cloud cover: June at 33%, peaking sharply in July at 54%, followed by August at 50% and September at 39%. This pattern coincides with the heavy rainfall and overcast skies typical of Nepal's monsoon. The seasonal trend begins with increasing cloud cover starting in May, reaching its maximum in July, and then declining steadily through October, consistent with the monsoonal cycle. December experiences the least cloud cover at just 10%, reflecting the clear skies of the winter season. These cloud cover patterns have important implications for local agriculture, tourism, and daily life; clear skies during the dry season favor outdoor activities such as farming and tourism, while the heavy cloud cover in the monsoon months may restrict outdoor movement and affect transportation. Overall, July emerges as the month with the highest cloud cover, while December is the clearest month.

Average visibility

The monthly average visibility in kilometers (km) for Syangja, Nepal is shown in **Figure 11**.


**Figure 11: Average visibility** (Syangja, 2024)

The analysis of visibility in Syangja reveals distinct seasonal variations closely linked to the region's climatic patterns. For the majority of the year—specifically from January to June and October to December—visibility remains at an optimal 10 km, indicating clear atmospheric conditions. These periods correspond to the dry season and post-monsoon months, characterized by lower moisture levels and minimal cloud cover. However, during the monsoon months of July, August, and September, visibility reduces slightly to 9 km, likely due to heavy rainfall, increased humidity, and denser cloud cover, which aligns with the previously observed higher cloud cover in these months. Overall, visibility is stable and generally favorable throughout the year except during the monsoon season, reflecting Syangja's predominantly clear skies. This pattern has practical implications, as reduced visibility during monsoon can affect aviation, road transport, and outdoor activities, while the consistently high visibility in other months supports tourism, sightseeing, and trekking. Thus, the highest visibility of 10 km occurs from January to June and October to December, with the lowest visibility of 9 km observed during July to September.

The summary is listed in Table 12.

**Table 12: Summary of the Weather/Climate parameter of Syangja** (Syangja, 2024)

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$HT_{av}$ (°C/°F)** | 11.8 (53.2) | 14.3 (57.7) | 18.3 (64.9) | 22.2 (72) | 23.8 (74.8) | 24.8 (76.6) | 22.8 (73) | 22.8 (73) | 21.8 (71.2) | 20.1 (68.2) | 16.6 (61.9) | 13.6 (56.5) |
| **$LT_{av}$ (°C/°F)** | 1.4 (34.5) | 3.4 (38.1) | 7.3 (45.1) | 11.3 (52.3) | 14.3 (57.7) | 16.3 (61.3) | 16.8 (62.2) | 16.1 (61) | 14.3 (57.7) | 10.4 (50.7) | 7 (44.6) | 3.8 (38.8) |
| **$P_{av}$ (mbar/in Hg)** | 1018.6(30.08) | 1017.9 (30.0) | 1016.1 (30.01) | 1013.4 (29.9) | 1010.3 (29.83) | 1006.3 (29.72) | 1005.5 (29.69) | 1007.3 (29.75) | 1010.7 (29.85) | 1015.5 (29.99) | 1017.4 (30.04) | 1018 (30.06) |
| **$WS_{av}$ ($kmh^{-1}$/mph)** | 6.3 (3.9) | 6.7 (4.2) | 7.2 (4.5) | 7.5 (4.7) | 6.7 (4.2) | 6.4 (4) | 5.5 (3.4) | 5.2 (3.2) | 5.4 (3.4) | 5.5 (3.4) | 5.4 (3.4) | 5.6 (3.5) |
| **$MWS_{av}$($kmh^{-1}$/mph)** | 6.9 (4.3) | 7.3 (4.5) | 7.9 (4.9) | 8 (5) | 7.3 (4.5) | 6.9 (4.3) | 6 (3.7) | 5.8 (3.6) | 5.9 (3.7) | 6.1 (3.8) | 6 (3.7) | 6.2 (3.9) |
| **$WSG_{av}$($kmh^{-1}$/mph)** | 10.7 (6.6) | 11.3 (7) | 11.9 (7.4) | 11.8 (7.3) | 9.9 (6.2) | 8.7 (5.4) | 7.4 (4.6) | 7.1 (4.4) | 7.5 (4.7) | 8.6 (5.3) | 8.7 (5.4) | 9.3 (5.8) |
| **$H_{av}$** | 46% | 46% | 43% | 43% | 53% | 65% | 82% | 82% | 79% | 62% | 58% | 50% |
| **$RF_{av}$** | 17mm0.67" | 24mm0.94" | 33mm1.3" | 52mm2.05" | 84mm3.31" | 156mm6.14" | 347mm13.66" | 268mm10.55" | 163mm6.42" | 26mm1.02" | 3mm0.12" | 5mm0.2" |
| **$RFD_{av}$** | 6.3 | 7.4 | 10.7 | 13.1 | 19.6 | 21.3 | 28.3 | 27.7 | 21.4 | 9.6 | 5 | 2.5 |
| **$DL_{av}$** | 11h 1min | 12h 0min | 12h 5min | 12h 5min | 13h 3min | 13h 5min | 13h 4min | 13h 1min | 12h 2min | 11h 3min | 10h 5min | 10h 2min |
| **$SS_{av}$** | 7h 2min | 8h 1min | 9h 3min | 11h 3min | 11h 4min | 10h 5min | 8h 3min | 9h 1min | 9h 4min | 7h 2min | 7h 2min | 7h 2min |
| **$SSD_{av}$** | 23.8 | 17.9 | 16.3 | 14.4 | 9 | 6.8 | 2.4 | 2.5 | 7.3 | 18.8 | 23.2 | 27.5 |
| **$UV_{av}$** | 3 | 3 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 3 | 3 |
| **$Cl_{av}$** | 12% | 15% | 15% | 16% | 20% | 33% | 54% | 50% | 39% | 17% | 13% | 10% |
| **$V_{av}$** | 10km6.2mi | 10km6.2mi | 10km6.2mi | 10km6.2mi | 10km6.2mi | 10km6.2mi | 9km5.6mi | 9km5.6mi | 9km5.6mi | 10km6.2mi | 10km6.2mi | 10km6.2mi |

**Note:** $V_{av}$ Average visibility, $Cl_{av}$: Average cloud coverage, $UV_{av}$: Average UV index, $SSD_{av}$: Average sunshine days, $SS_{av}$: Average sunshine, $DL_{av}$: Average daylight, $RFD_{av}$: Average rainfall days, $RF_{av}$: Average rainfall, $H_{av}$: Average humidity, $WSG_{av}$: Average wind speed gusts, $MWS_{av}$: Average max. wind speed, $WS_{av}$: Average wind speed, $P_{av}$: Average pressure, $LT_{av}$: Average low temperature, $HT_{av}$: Average high-temperature (Syangja, 2024)

In summary, the months with the highest visibility are Jan are January, February, March, April, May, June, October, November, and December (10km). The months with the lowest visibility are July, August, and September (9km). Rainfall in January is modest, with precipitation accumulating to about 17mm (0.67") spread over approximately 6.3 days. Despite the cold, daylight lasts for an average of 10 hours and 36 minutes. At the start of the month, the sun rises at 7:01 am and sets at 5:25 pm, while by the end of January, sunrise occurs at 6:57 am and sunset at 5:48 pm. January, along with October, experiences the least sunshine in Syangja, with an average of 7.3 hours of sunlight per day. This limited sunshine is complemented by a low UV index. January, along with February, November, and December, records the lowest average maximum UV index of 3, signifying a moderate health risk from sun exposure.

Air Quality

Air quality is measured using various indicators and instruments that detect and quantify atmospheric pollutants (**Figure 12**). Air quality is measured using various indicators and instruments that detect and quantify atmospheric pollutants. One of the most widely used tools is the **Air Quality Index (AQI),** a standardized global scale that ranges from 0 to 500, with higher values indicating more severe pollution levels. AQI values are derived from the concentration of key air pollutants, including **Particulate Matter (PM2.5 and PM10)—**fine particles capable of penetrating deep into the lungs and bloodstream; **Ozone ($O_3$)—**a ground-level pollutant that can cause respiratory issues; **Nitrogen Dioxide ($NO_2$)—**a byproduct of vehicle and industrial emissions that irritates the respiratory system; **Sulfur Dioxide ($SO_2$)—**emitted from industrial processes and harmful to lung function; and **Carbon Monoxide (CO)—**a combustion byproduct dangerous to cardiovascular health. These pollutants are measured using a variety of instruments: **particulate matter sensors** (e.g., laser scattering and BAM methods) detect PM2.5 and PM10; **ozone monitors** use UV photometry; **electrochemical sensors** measure gases like $NO_2$, CO, and $SO_2$; and **optical analyzers** detect $CO_2$ and volatile organic compounds through infrared or ultraviolet absorption.

Monitoring systems include **fixed stations**, which provide continuous air quality data in urban and rural settings; **mobile monitoring units**, which allow spatial analysis by sampling multiple locations; and **satellite-based systems**, which track large-scale pollution patterns over time. Data collected from these sources are processed in real time by governmental or environmental agencies and disseminated through online platforms such as *Weather Atlas* and *Accuweather*, mobile applications, and sometimes public displays. In addition to institutional monitoring, **personal air quality monitors** are increasingly used by individuals to assess indoor and hyper-local conditions, while **community networks** operated by citizen scientists contribute localized data to broader environmental databases.

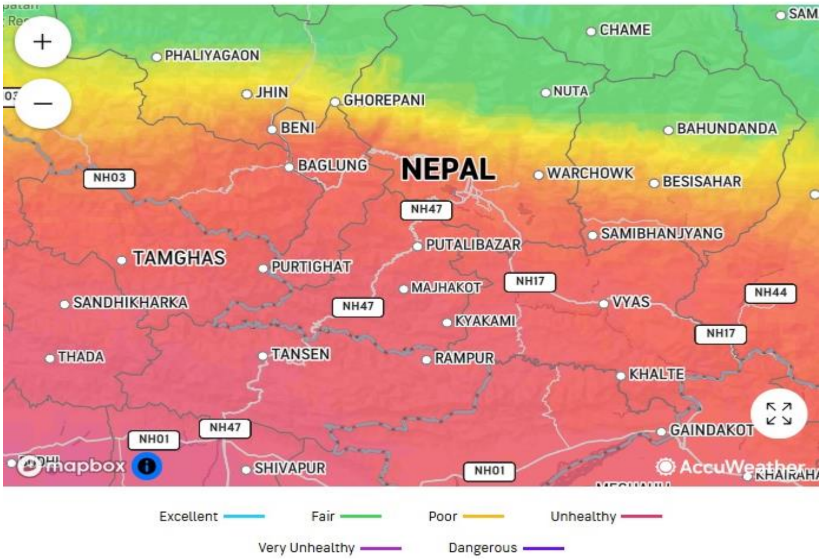


**Figure 12: Air Quality Index of Putalibazaar, Syangja on 14th November 2024** (Accuweather, 2024)

The AQI values are typically interpreted through categories that inform public health decisions: **0–19 (Excellent)** suggests ideal air quality; **20–49 (Fair)** is acceptable for most but may affect sensitive individuals with prolonged exposure; **50–99 (Poor)** can cause symptoms in vulnerable groups; **100–149 (Unhealthy)** affects both sensitive and, eventually, healthy individuals; **150–249 (Very Unhealthy)** necessitates limiting outdoor activity for all; and **250+ (Dangerous)** indicates severe health risks for everyone, requiring avoidance of outdoor exposure. Analyzing air pollutant concentrations using these tools helps guide **public health recommendations, environmental policies,** and **individual behaviors** to reduce exposure to harmful air quality conditions.

## Conclusion

The weather and climate analysis of the KSAFTER site in Putalibazaar-2, Syangja District, reveals well-defined seasonal patterns typical of Nepal's mid-hill subtropical region. Based on data from January 2023 to early 2024, the study identified clear annual variations in key parameters such as temperature, atmospheric pressure, humidity, rainfall, wind speed, sunshine duration, and cloud cover. These factors directly influence agricultural productivity, land-use planning, and ecosystem functioning. The site experiences a gradual transition from cold, dry winters (as low as 1.4°C in January) to warm, humid monsoon months (up to 24.8°C in June), with relatively stable and comfortable conditions in spring and autumn. Atmospheric pressure follows a typical seasonal trend, peaking in winter and dropping during the monsoon. Humidity and rainfall are highest from June to August, with July recording the peak precipitation (347 mm). Wind speeds are strongest in April, while sunshine hours are most abundant during spring, supporting optimal photosynthetic activity. In addition to meteorological trends, the study assessed air quality using the Air Quality Index (AQI), incorporating pollutants such as PM2.5, PM10, $O_3$, $NO_2$, and CO. Results indicated generally "Fair" to "Good" air quality, with the AQI on 14th November 2024 falling within the "Fair" range (20–49), suggesting acceptable conditions for most of the population, though sensitive groups may require caution during certain periods. The integration of climatic and air quality data provides a comprehensive environmental baseline for the KSAFTER site. These findings are critical for guiding climate-resilient agroforestry, eco-tourism development, and health-conscious planning in the region. Furthermore, the secondary-data-driven approach offers a replicable model for similar Himalayan mid-hill landscapes where localized environmental planning is needed but primary data may be limited.

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