Air Quality Index (AQI) Report

Data Source: West Bengal Pollution Control Board
Station: Bhasa,2nd Campus of Asutosh College
(November 2024)

The Air Quality Index (AQI) is a crucial tool for assessing and communicating air pollution levels, translating complex data into a simple scale ranging from 0 to 500, with higher values indicating poorer air quality. During November, air quality often deteriorates significantly due to a combination of seasonal and human-induced factors. Cooler temperatures, reduced wind speeds, and atmospheric inversion trap pollutants close to the surface, intensifying pollution levels. Key contributors during this period include agricultural stubble burning, particularly in regions where it is a common post-harvest practice, leading to elevated levels of particulate matter (PM2.5 and PM10). Urban emissions from vehicles, industries, and construction activities further aggravate the situation, while festive celebrations involving fireworks can cause sudden spikes in pollution. Additionally, the lack of precipitation and dry conditions during this season hinder the dispersion of pollutants. These factors collectively result in higher AQI values, especially in urban and densely populated areas, where health impacts such as respiratory and cardiovascular issues become more pronounced. Monitoring AQI in November is essential for implementing mitigation strategies, raising public awareness, and minimizing health risks.

The month of November is particularly critical for air quality management, as it often marks the transition into winter, when pollution levels peak in many regions. This period sees a rise in fine particulate matter (PM2.5), which poses serious health risks due to its ability to penetrate deep into the lungs and bloodstream. The compounded effect of pollution sources such as vehicular emissions, industrial output, and seasonal agricultural practices like stubble burning creates a challenging scenario for environmental authorities. Urban areas face the brunt of this pollution, with thick smog and reduced visibility becoming common. Moreover, festive activities, including the use of fireworks, exacerbate air pollution, contributing to a sudden surge in harmful gases like sulfur dioxide and nitrogen oxides. These pollutants, combined with stagnant weather conditions, make November one of the most polluted months in many parts of the world, necessitating robust policy interventions and public participation to curb emissions and protect public health.

Description of the Data

statistic	AQI	$PM_{2.5}$ AVG (µg/m³)	PM_{10} AVG (µg/m³)	REL HUMI (%)	TEMPERATURE (°C)
Min.	70.38	39.53	70.43	71.13	22.39
1st Qu.	103.21	57.91	102.22	74.98	23.51
Median	127.29	66.65	118.18	76.24	24.88
3rd Qu.	139.32	71.62	126.9	78.47	27.64
Max.	211.25	93.48	164.66	86.53	28.71
Mean	128.72	65.71	116.4	76.9	25.46
St. d.	36.37	13.89	24.39	3.13	2.29

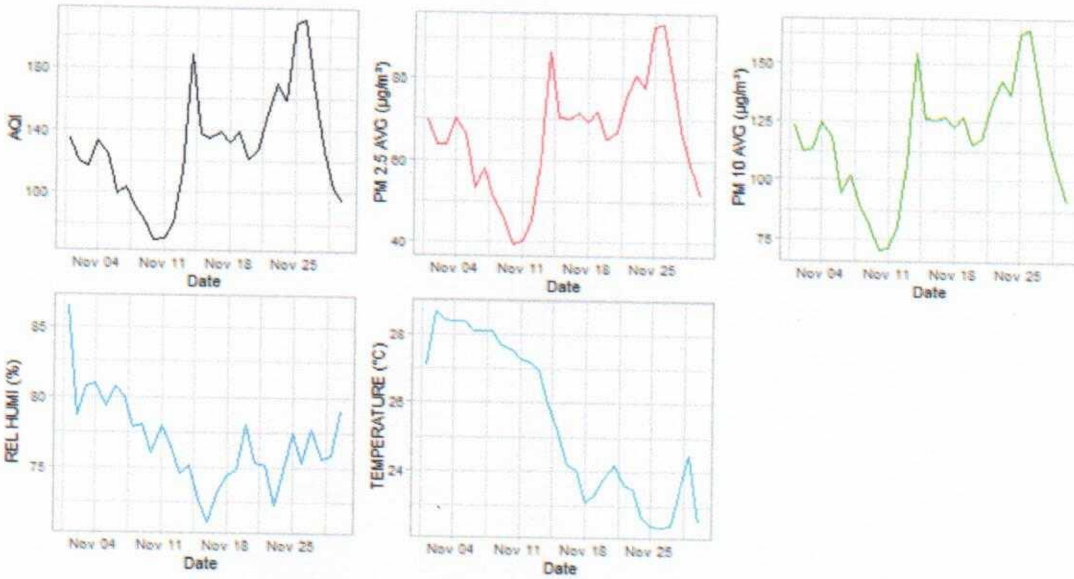
Source: PCB (Station: Bhasa ,2nd Campus of Asutosh College)

The statistical summary of air quality and meteorological conditions for the month provides a comprehensive view of pollution levels and their interaction with weather parameters. The **Air Quality Index (AQI)** ranged from a minimum of 70.38, indicative of "Satisfactory" air quality, to a maximum of 211.25, classified as "Very Poor." The mean AQI was 128.72, corresponding to "Moderate" pollution levels, with a standard deviation of 36.37. This variation suggests significant fluctuations in air quality during the month, likely influenced by periodic spikes in emissions or weather conditions limiting pollutant dispersion. The first quartile (103.21) and third quartile (139.32) indicate that half of the AQI observations were in the "Moderate" to "Poor" categories, underscoring consistently high pollution levels.

The concentration of **$PM_{2.5}$**, the finer particulate matter known for its severe health impacts, averaged 65.71 µg/m³, with a range from 39.53 µg/m³ (relatively low but still above safe limits) to a peak of 93.48 µg/m³. Similarly, **PM_{10}** concentrations, which measure larger particulates, ranged from 70.43 µg/m³ to 164.66 µg/m³, with an average of 116.4 µg/m³. These values indicate sustained exposure to air pollution beyond the permissible limits recommended by health guidelines. The median values of $PM_{2.5}$ (66.65 µg/m³) and PM_{10} (118.18 µg/m³) reveal that more than half the days of the month experienced pollution levels in the "Unhealthy" range for sensitive groups.

Relative humidity exhibited a relatively narrow range, with values between 71.13% and 86.53%, and a mean of 76.9%. The 1st quartile (74.98%) and 3rd quartile (78.47%) suggest that the majority of the month experienced moderately high humidity. Such conditions can exacerbate pollution by trapping fine particles and slowing their dispersal. Similarly, the **temperature** during the month ranged from 22.39°C to 28.71°C, with an average of 25.46°C and a median of 24.88°C. The temperature's interquartile range (23.51°C to 27.64°C) and a low standard deviation (2.29°C) suggest stable warm conditions throughout the month, which could contribute to the persistence of pollution, as stagnant atmospheric conditions often hinder dispersion.

Overall, this dataset highlights a challenging air quality scenario during the month, with frequent episodes of poor to very poor air quality, particularly influenced by high particulate matter concentrations. The stable meteorological conditions, including warm temperatures and high humidity, may have amplified the impact by reducing pollutant dispersion. These findings underline the need for targeted interventions to control emissions and mitigate health risks during similar periods.



The five graphs collectively present the variation in **Air Quality Index (AQI), $PM_{2.5}$ concentrations, PM_{10} concentrations**, **Relative Humidity**, and **Temperature** throughout the month of November. The data showcases patterns, trends, and interrelationships between air quality and meteorological conditions, highlighting their influence on each other.

Air Quality Index (AQI) Trend :

- The AQI values fluctuated significantly throughout November, indicating alternating periods of poor and relatively better air quality.
- **Key Observations:**
  - The AQI started with moderately high values around **November 4th**, dropped slightly by mid-November, and peaked sharply around **November 18–20** and again at the end of the month.
  - The two significant peaks suggest sudden pollution spikes, possibly due to external factors like stubble burning, festivals (fireworks), or industrial/vehicular emissions under stagnant weather conditions.

Overall, AQI remained mostly within "Moderate" to "Poor" categories, with certain days reaching "Very Poor," signaling unhealthy air conditions.

2. $PM_{2.5}$ Average (µg/m³) Trend (Top Middle Graph):

- $PM_{2.5}$ levels, which represent fine particulate pollution, mirrored the AQI trend, with noticeable peaks.
- **Key Observations:**
  - $PM_{2.5}$ concentrations showed sharp rises around **November 18** and again in the last few days of the month.
  - The lowest values occurred at the start and mid-November. However, even the minimum levels exceeded safe limits, indicating consistently elevated fine particle pollution.
- **Conclusion:** High $PM_{2.5}$ concentrations correlate with spikes in AQI, suggesting that fine particulates were a significant contributor to the deteriorating air quality.

3. PM10 Average (µg/m³) Trend (Top Right Graph):

- PM_{10}, which represents coarser particulate matter, also showed notable peaks and fluctuations similar to $PM_{2.5}$ but with more variability.
- **Key Observations:**
  - A sharp peak around **November 11–12** and a higher peak at the end of the month indicate substantial dust or coarse particulate pollution, likely from construction, vehicular dust, or biomass burning.
  - PM_{10} levels were generally above safe limits throughout the month.
- PM_{10}, like $PM_{2.5}$, heavily contributed to air pollution, with prominent spikes on specific days, reflecting increased emissions or local dust disturbances.

4. Relative Humidity (%) Trend (Bottom Left Graph):

- Relative humidity displayed a decreasing trend throughout the month with occasional fluctuations.
- **Key Observations:**
  - At the start of November, humidity was high (above 80%) but gradually declined to as low as 70% in mid-November before recovering slightly toward the month's end.
  - This drop in humidity coincided with peaks in AQI and PM concentrations, suggesting that lower humidity facilitated the suspension of particulates in the air, reducing their settling rate.

Lower relative humidity may have exacerbated pollution levels by reducing pollutant dispersion.

5. Temperature (°C) Trend (Bottom Right Graph):

- Temperature showed a clear downward trend throughout November, reflecting the seasonal cooling pattern.
- **Key Observations:**
  - Early November recorded temperatures above 28°C, but they steadily declined to around 24°C or lower by the month's end.
  - This temperature drop coincided with increasing AQI, $PM_{2.5}$, and PM_{10} values, indicating the impact of atmospheric inversion, where cooler air near the surface traps pollutants.

Falling temperatures during November likely contributed to worsening air quality by limiting vertical dispersion and trapping pollutants close to the ground.

Overall Interpretation:

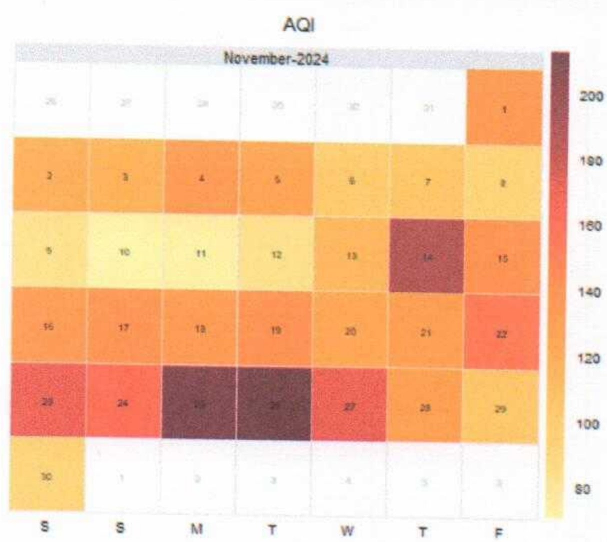
The graphs reveal a clear relationship between air quality (AQI, $PM_{2.5}$, PM_{10}) and meteorological conditions (relative humidity and temperature).

1. **Air Quality Trends:** AQI, $PM_{2.5}$, and PM_{10} showed recurring peaks, particularly around **November 11–12, November 18–20**, and the month's final days, indicating multiple pollution episodes.

2. **Meteorological Influence:**
   - **Lower humidity** and **falling temperatures** created stagnant conditions, limiting pollutant dispersion and worsening air quality.
   - These patterns suggest that meteorological factors, combined with external pollution sources, played a major role in driving poor air quality.

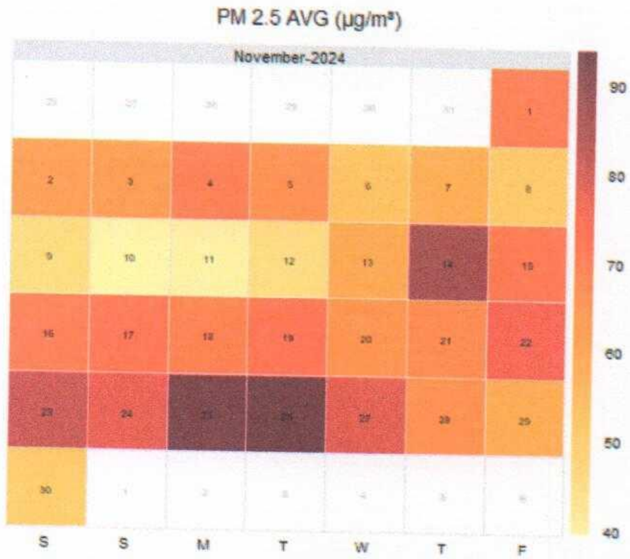
The data emphasizes the need for timely intervention, particularly during mid to late November, when pollution levels spiked significantly.

The AQI heatmap for **November 2024** reveals significant variations in air quality throughout the month, with a clear trend of deteriorating conditions in the second half. In the first half of the month, AQI values largely remained in the **"Moderate"** category, represented by orange shades, with some instances of relatively better air quality seen in **lighter yellow shades**. However, a notable spike occurred on **November 14th**, where AQI values surpassed 200, indicating **"Very Poor"** air quality. Similarly, days like the **7th, 8th, and 15th** also experienced elevated pollution levels.



In the **second half of November**, the air quality worsened considerably, with AQI values frequently entering the **"Poor" to "Very Poor"** categories. A critical period occurred between **November 23rd and 27th**, where the heatmap shows dark red to maroon shades, signaling sustained AQI levels above 200. This prolonged period of poor air quality suggests the influence of seasonal factors, such as cooler temperatures, atmospheric stagnation, and possibly external contributors like stubble burning or industrial emissions. Toward the end of the month, air quality showed a slight improvement, as indicated by lighter orange shades on **November 28th–30th**, suggesting a reduction in pollution levels.

Overall, the heatmap highlights the worsening trend of air quality during November, particularly in the latter half, with several days crossing into the **"Very Poor"** category. This underscores the need for effective mitigation measures to address rising pollution levels, especially during critical periods like the fourth week of November.

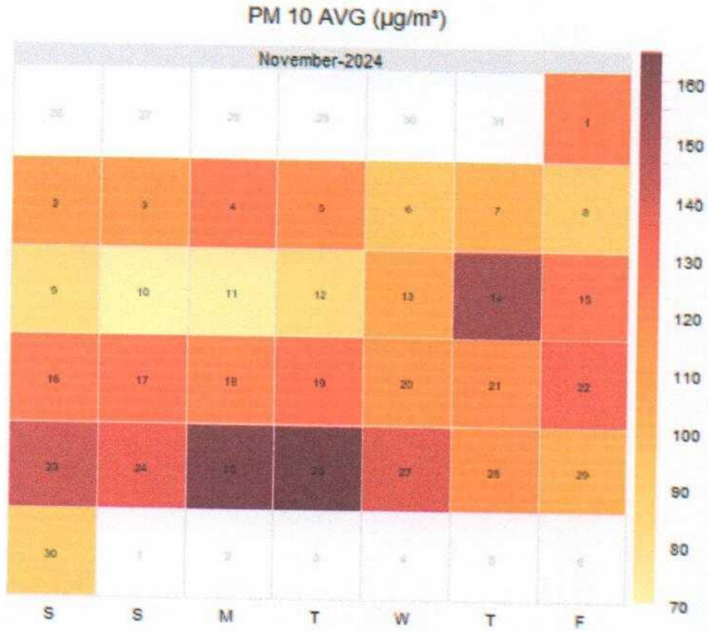


The heatmap for **PM $_{2.5}$ average concentrations (µg/m³)** in **November 2024** shows a clear variation in fine particulate matter levels throughout the month, with a notable worsening trend in the second half. During the **first half of November**, PM $_{2.5}$ levels remained **moderate to high**, mostly ranging between **60–80 µg/m³**, as indicated by the orange shades. However, a significant spike occurred on **November 14th**, where PM $_{2.5}$ concentrations exceeded **90 µg/m³**, shown by the dark red color, signaling severely poor air quality. Periods of improvement were observed between **November 9th and 12th**, where the yellow shades indicate relatively lower levels closer to **40–50 µg/m³**, representing a temporary decline in pollution.

In the **second half of the month**, PM $_{2.5}$ concentrations consistently worsened, reaching critical levels between **November 23rd and 26th**, where the darkest shades indicate concentrations surpassing **90 µg/m³**. This sustained period of high pollution reflects a significant pollution episode, likely influenced by external factors such as emissions, stubble burning, or stagnant weather conditions. Toward the **end of the month** (November 28th–30th), PM $_{2.5}$ levels showed a slight decline, returning closer to **50 µg/m³**, as seen in the lighter yellow shades, indicating mild improvement in air quality.

Overall, the data highlights a concerning trend, with elevated PM $_{2.5}$ levels dominating much of November and peaking severely in the latter half. The consistently high concentrations of fine particulate matter pose significant health risks, as PM $_{2.5}$ can penetrate deep into the respiratory system and bloodstream. This emphasizes the need for effective mitigation strategies, particularly during critical pollution periods such as late November.

The heatmap for **PM $_{10}$ average concentrations (µg/m³)** in **November 2024** highlights significant fluctuations in particulate pollution levels throughout the month, with a noticeable increase in severity during specific periods. During the **first week of November** (1st–8th), PM_{10} levels remained moderate, ranging between **90–130 µg/m³**, as shown by the orange and yellow shades. However, on

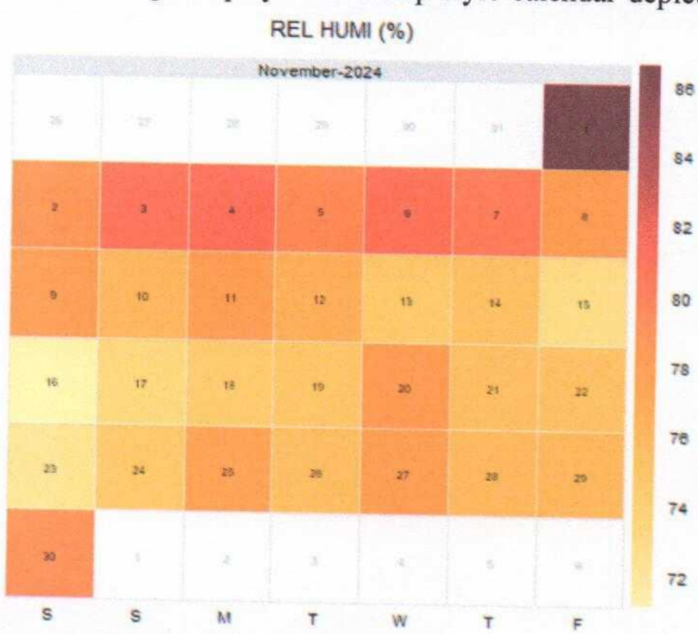


November 14th, the heatmap reveals a dark red shade, indicating a sharp spike where PM10 concentrations exceeded **160 µg/m³**, reflecting significantly poor air quality.

In the **middle weeks of November** (9th–22nd), PM_{10} concentrations generally fluctuated within the **100–130 µg/m³** range, as evidenced by orange and light red tones. A gradual worsening trend becomes evident as the second half progresses, with concentrations increasing and peaking between **November 23rd and 27th.** During this period, the darkest red shades are visible, indicating PM_{10} values consistently exceeding **160 µg/m³**, categorizing these days as highly polluted and hazardous. This peak likely reflects external pollution sources such as industrial emissions, vehicle exhaust, and weather conditions facilitating particulate accumulation.

Toward the **end of November** (28th–30th), PM_{10} levels showed slight improvement, returning to **90–100 µg/m³** (yellow shades), suggesting better air quality conditions. Overall, the data indicates a **progressive worsening** of air quality during the month, with severe pollution episodes concentrated in the **third week** and persisting until the **27th of November**. The sustained high levels of PM_{10} present a major health concern, particularly for respiratory and cardiovascular systems, emphasizing the importance of targeted pollution control measures during this critical period.

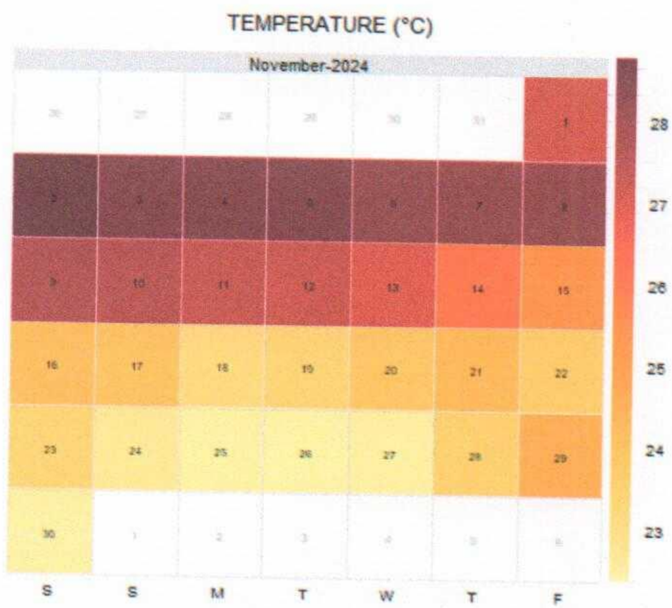
The image displays a heatmap-style calendar depicting the relative humidity (REL HUMI %) for November 2024. The calendar uses a color gradient ranging from dark red to yellow to represent different humidity levels, with darker reds indicating higher humidity percentages (closer to 86%) and lighter yellows representing lower humidity (closer to 72%).



- **November 1st** shows the highest relative humidity, represented by dark red (around 86%).
- The first week, covering **November 2-8**, generally has higher humidity levels, shown in shades of orange and red, suggesting values between 80-85%.

- The second week, **November 9-15**, displays slightly lower humidity with values mostly in the yellow-orange range (between 76-80%).
- **November 16-22** shows a further drop in humidity, represented by lighter shades (around 72-76%).
- **November 23-29** has mixed humidity levels, with values gradually increasing toward the end of the week.
- **November 30** returns to slightly higher humidity levels, shown in a moderate orange shade.

The color gradient on the right helps interpret exact humidity values, where the spectrum ranges from deep red (86%) to pale yellow (72%). The weekdays are labeled along the bottom, with Sundays on the left and Fridays on the right. Overall, the humidity trends show variability throughout the month, starting high, dropping mid-month, and rising slightly again toward the end.



The image is a heatmap-style calendar displaying the **temperature (°C) for November 2024**. The calendar uses a color gradient ranging from dark red to pale yellow to illustrate temperature variations, with dark red indicating higher temperatures (close to **28°C or higher**) and pale yellow indicating lower temperatures (around **23°C**).

Key observations:

1. **November 1st** shows the highest temperature, marked in dark red, indicating temperatures around **28°C**.
2. The first two weeks, **November 2-15**, display consistently high temperatures, predominantly shown in dark red and deep orange, suggesting values between **27°C to 28°C**.
3. Starting **November 16-22**, temperatures moderate slightly, represented by lighter shades of orange and yellow, indicating temperatures between **24°C and 26°C**.
4. The week of **November 23-29** continues the cooling trend, with most days depicted in pale yellow, suggesting temperatures between **23°C and 25°C**.
5. **November 30** shows the coolest temperature of the month, indicated by a very pale yellow, implying around **23°C**.

The color bar on the right reinforces the temperature range, transitioning from dark red (28°C) to pale yellow (23°C). This visual representation highlights a general cooling trend as the month progresses, starting with high temperatures in the first half and cooling towards the end.

CONCLUSION

In **November 2024**, both temperature and relative humidity display a gradual decline as the month progresses. The month begins with high temperatures, around **27-28°C**, and elevated humidity levels between **84-86%**. During the first two weeks, the conditions are characterized by hot and humid weather, shown through darker reds and oranges in the heatmaps. As the month continues, temperatures gradually decrease to **23-25°C**, and relative humidity drops to between **72-76%**. By the end of November, the cooler temperatures and lower humidity, represented by lighter shades in the heatmaps, suggest a transition to more comfortable and drier weather conditions. This consistent downward trend indicates a seasonal shift, likely moving towards cooler and less humid conditions.

Note: Report produced by Air Quality Monitoring System Committee

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