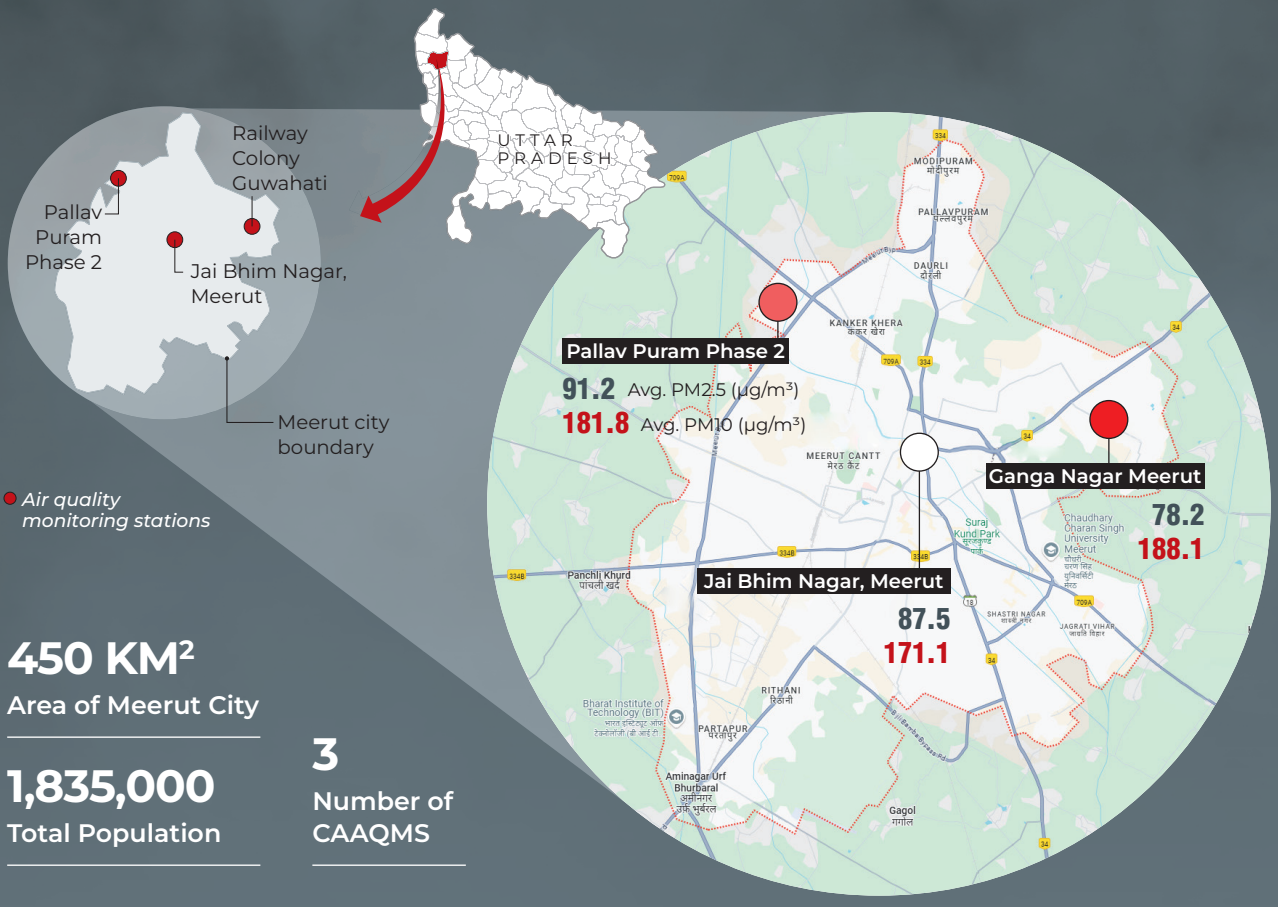
MEERUT AIR POLLUTION FACT SHEET

Meerut city, in Uttar Pradesh, has three Continuous Ambient Air Quality Monitoring Stations (CAAQMS) and two manual ones. Uttar Pradesh Pollution Control Board operates these Monitoring Stations. All CAAQMS are located in the Northern part of the city.



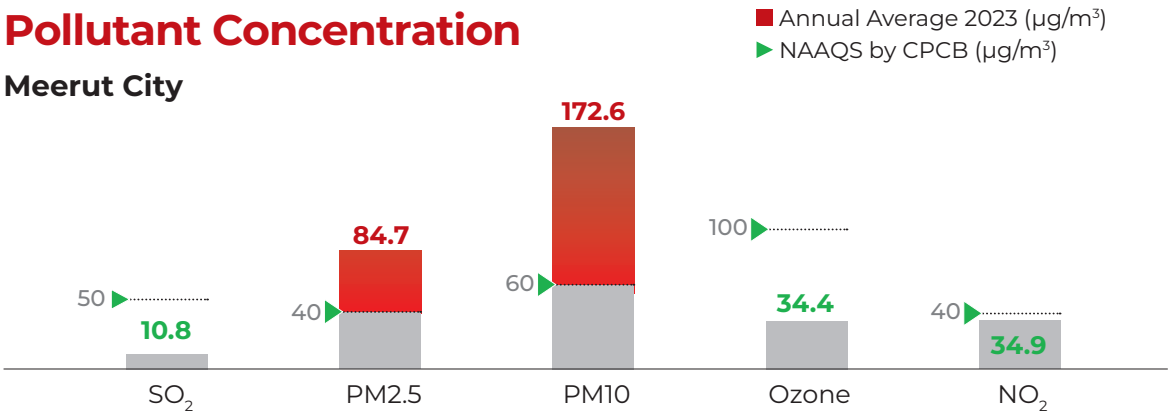
450 KM²
Area of Meerut City

1,835,000
Total Population

3
Number of CAAQMS

Pollutant Concentration

Meerut City



Source: iFOREST Analysis

The **annual average PM2.5** concentration **for 2023** was found to be **85 µg/m³**

The same for **PM10 was 173 µg/m³**

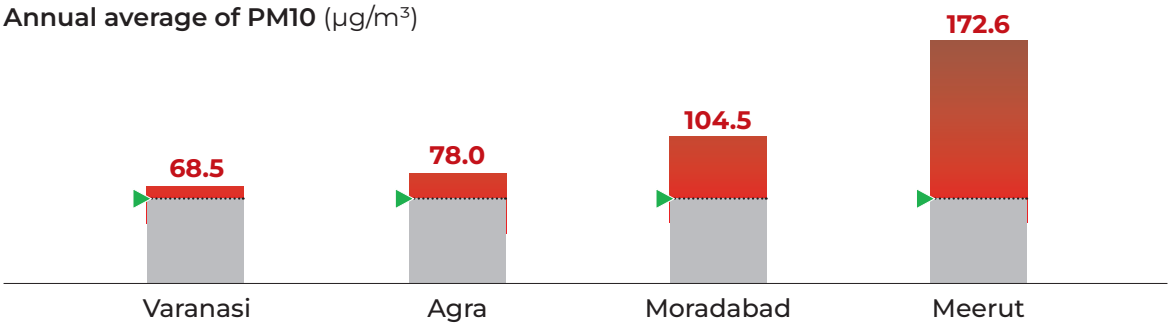
The **PM2.5** concentration **levels were twice** the permissible levels by NAAQS

The **PM10** concentration **level was around thrice** the permissible levels by NAAQS

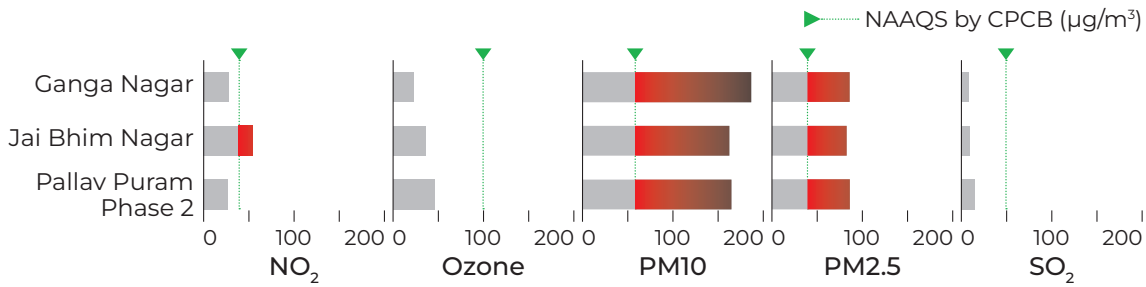
How Meerut's pollution compares to its neighbours

According to the Swachh Vayu Survekshan 2023, a programme by the MoEFCC that ranks cities on the basis of their air quality, Varanasi (2022), Agra and Moradabad (2023) topped as model cities for curbing pollution in recent years. Meerut, a stone's throw away, far exceeds its neighbours for PM 10 concentration levels.

Annual average of PM10 (µg/m³)



Concentration of major pollutants: 2023



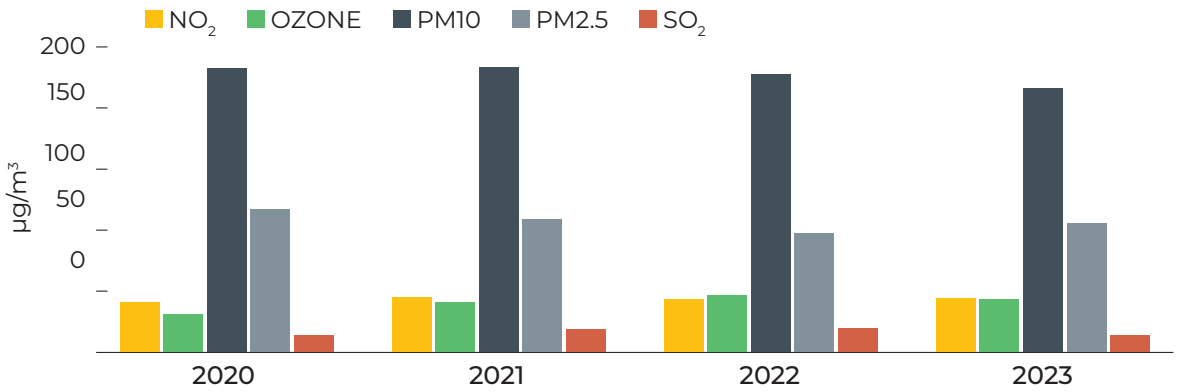
Ganga Nagar station has **highest PM10 concentration (187.6 µg/m³)** compared to other stations

Pallav Puram Phase 2 has **highest PM2.5 concentration (86 µg/m³)** compared to other stations

Concentration trends

ANNUAL

Average Concentration of key pollutants in years 2020-2023



The annual average **PM10** concentration **has decreased by 7% since 2020**.

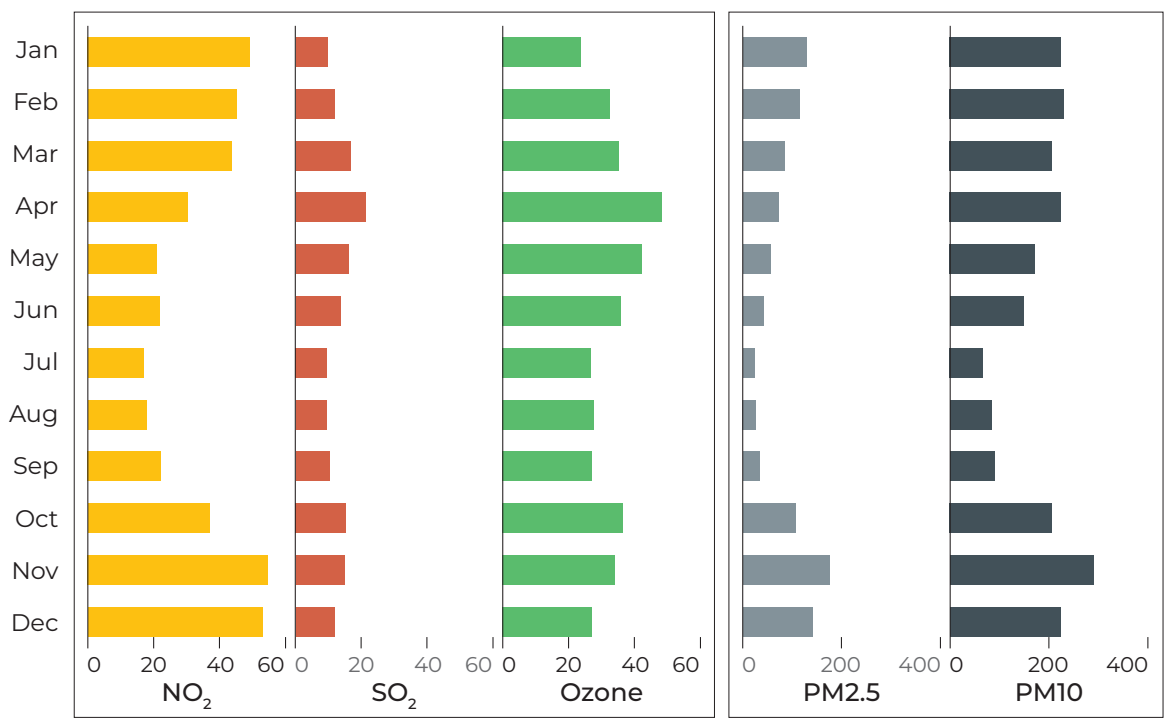
The annual average **PM2.5** concentration **has decreased by 10% since 2020**.

NO_2 and SO_2 concentrations are **relatively stable** in the assessment years.

Ozone Concentration has **increased by 40%** since 2020.

MONTHLY

Average Concentration (µg/m³) of key pollutants in year 2023

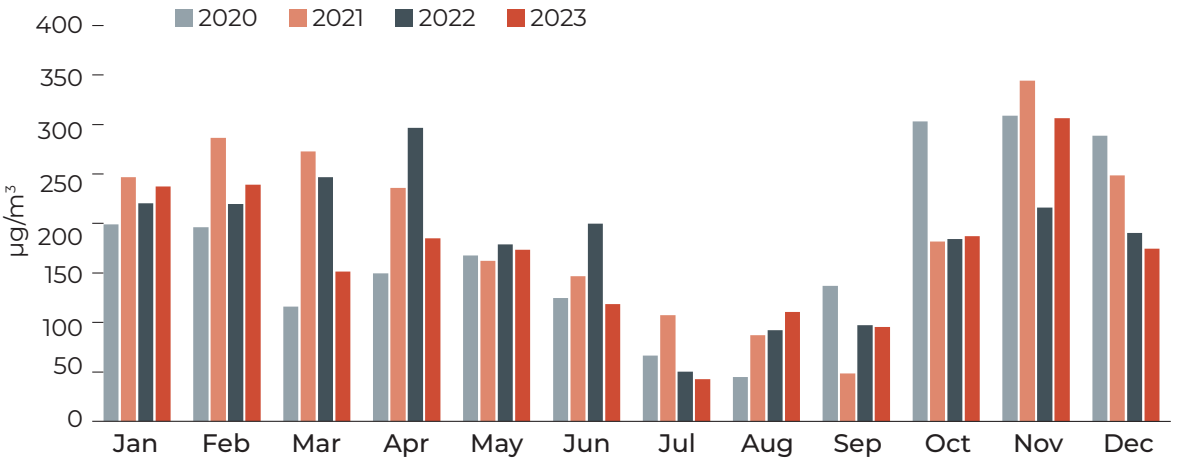


November is the month with **highest concentration** of **PM10, PM2.5 and NO_2** in the three assessment years (2020-23)

April is the **most polluted month** for **SO_2 and Ozone** respectively.

PM10 MONTH ON MONTH IN RECENT YEARS

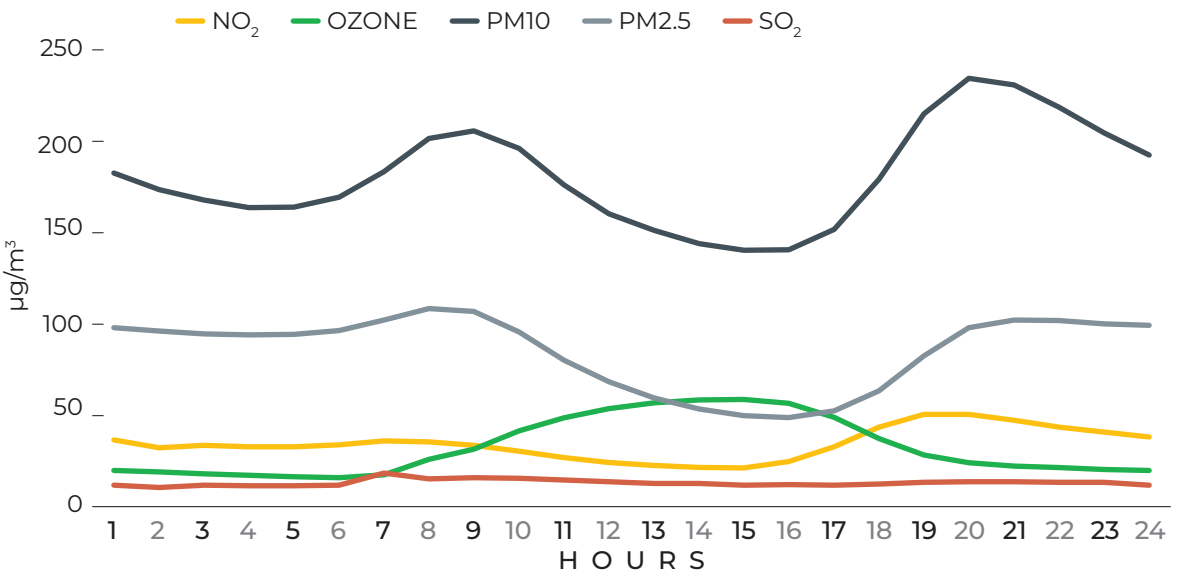
Average Concentration (µg/m³) of PM10 in years between 2020- 2023



The **average PM10 concentrations** for the **summer months (216.8 ug/m³)** are relatively **high and similar to winter month** concentration **(around 250 ug/m³)**

HOURLY

Average Concentration (µg/m³) of key pollutants in year 2020-2023



PM10 and PM2.5 hourly trends show peak hours observed in the mornings between 8-10AM and evenings between 7-11PM.	The NO_2 concentration was high during evenings between 6-8PM.	Ozone was observed to be high during afternoons between 12-4PM.

What PM2.5/PM10 Ratio Reveals?

At all locations, the PM2.5/ PM10 value varies between 0.38 and 0.47. A lower value (<0.5) indicates existence of higher PM particles. This could be attributed to the construction activities happening in the city such as Rapid Rail and highway construction.

Air pollution data availability in Meerut

ANNUAL AVERAGE (2019 - 2023)

Years	OZONE	NO_2	PM10	PM2.5	SO_2
2019	21%	21%	21%	21%	20%
2020	67%	59%	59%	62%	57%
2021	66%	55%	67%	65%	69%
2022	79%	87%	89%	79%	91%
2023	82%	76%	81%	78%	72%

MONTHLY AVERAGE (2021-2023)

Months	OZONE	NO_2	PM10	PM2.5	SO_2
January	79%	65%	78%	78%	78%
February	77%	68%	73%	74%	69%
March	70%	61%	64%	62%	62%
April	66%	56%	74%	73%	75%
May	66%	72%	67%	70%	66%
June	68%	67%	79%	76%	74%
July	70%	67%	71%	67%	72%
August	76%	76%	74%	64%	68%
September	79%	66%	72%	64%	71%
October	77%	74%	73%	75%	75%
November	72%	83%	80%	77%	76%
December	79%	75%	82%	72%	78%

LOCATION WISE (2021-2023)

LOCATIONS	OZONE	NO_2	PM10	PM2.5	SO_2
Ganga Nagar Meerut	87%	84%	91%	80%	91%
JAI BHIM NAGAR, MEERUT	64%	54%	63%	62%	56%
Pallav Puram Phase 2	69%	70%	67%	71%	69%

Refer to the methodology adopted in *page 7*.

Overall availability of air pollution data from CAAQMS in **Meerut City falls under 'Good' category** for year 2020-2023.

This is not the case for 2019, which has not been considered for pollutant concentration analysis.

Month wise data availability is **'Good'** for the assessment year 2020-2023.

Location wise, **Jai Bhim Nagar** data availability is in category **'Moderate'**. **Ganga Nagar** CAAQMS data quality is **'Excellent'** in the assessment years.

ANNEXURE

Context and significance of big data analytics for air pollution

- Understanding air pollution phenomena using big data analysis techniques helps support critical decision making for improving air quality
- The real time and continuous pollutant concentration data recorded by the ground air pollution monitoring stations in the city, typically known as Continuous Ambient Air Quality Monitoring Stations (CAAQMS), can be aggregated to form the big data that can be analysed to understand pollution patterns.
- CAAQMS record concentration of various pollutants at an average frequency of 15 seconds. Data recording at such short intervals of 15 seconds provides rich data for correlation with economic activities for source mapping.
- Big data regarding concentration of pollutants can also help policy makers understand the trends- Yearly, Monthly and Hourly of different pollutants in different locations and identify hot spots for suitable action.
- However, data cleaning to remove biases and poor quality data, is a critical step while using big data analysis before calculating average pollutant concentrations at every location.
- Recommendations based on this assessment can help in formulation of hyper-local action plans for the city.

Guidelines available for Air Pollution measurements

PM10	PM2.5	NO_2	SO_2	Ozone

- The key pollutants, as per the CPCB guidelines, for calculation of Air Quality Index and consideration of a zone as non-attainment or polluted zone are PM10, PM2.5, NO_2, SO_2 and Ozone .
- According to CPCB, the region or location is considered as polluted or is considered as a non-attainment region, if the annual average, taken of 104 measurements, that is 2-day data for each week, 4-hour sample for gaseous and 8-hour sample for PM, exceeds the values mentioned in the National Ambient Air Quality Standards (NAAQS). The permissible level or standard for the key pollutants are:
  - PM 10 : 60 µg/m^3.
  - PM2.5 : 40 µg/m^3.
  - NO_2 : 40 µg/m^3.
  - SO_2 : 50 µg/m^3.
  - Ozone : 100 µg/m^3.
- According to World Health Organization (WHO), a region or a zone is considered as prone to health risks, if the Annual average concentration and 99th percentile of day's average, particularly in case of SO_2, exceeds the values mentioned in the guidelines. The WHO guidelines for the key pollutants are :
  - PM 10 : 15 µg/m^3.
  - PM2.5 : 5 µg/m^3.
  - NO_2 : 10 µg/m^3.
  - SO_2 : 40 µg/m^3.
- According to National Centre for Biotechnology Information PM2.5/ PM 10 ratio is an important factor in understanding the source of pollution in the region. A high PM2.5/PM10 ratio (>0.5) typically suggests that fine particles and secondary particulates such as NO^3-, SO^42- NH4+, and organics, are major contributors. Conversely, a lower PM2.5/ PM10 ratio indicates the dominance of coarse particles.

METHODOLOGY ADOPTED

For Continuous Ambient Air Quality Monitoring Station (CAAQMS) data to be reliable, especially in cases where pollutant concentrations and meteorological parameters like wind speed are being recorded, a robust methodology for data cleaning, aggregation, and analysis is crucial. This ensures accurate yearly, monthly, and hourly trend analysis as well as hot spot identification based on 'Good' quality data.

Methodology

Collection of time series data (15 minute frequency) of pollutants recorded at different CAAQMS in the city from Central Pollution Control Board website.

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Aggregating data to form big-data of the complete city.

↓

Clearing out the monthly data points of pollutant, if the data recorded in any month for any year is less than 60%.

↓

Clearing out daily data points of pollutant, if the data recorded on any day is less than 60%.

↓

Data Visualisation and Analysis.

Data Quality Based on clean data availability

Data Availability %	Data Quality
>80%	Excellent
60%-80%	Good
40%-59%	Moderate
<40%	Poor

Major pollutant hots pots have been identified in this factsheet on the basis of relative average annual concentration of the pollutants across locations and the guidelines specified by Central Pollution Control Board.

Cleaned data → Relative pollutant concentration analyzed by taking an average of the pollutant for available data points

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