Study on Air Quality of Meerut: Trends, Sources, Health Impact and Mitigation

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Abstract

Meerut is a major industrial and urban center in Uttar Pradesh, facing severe air pollution challenges. This study assesses Meerut air quality using real-time data from CPCB and AQI of three years 2023–2025. Findings indicate annual average PM2.5 levels of 95–102 µg/m³, exceeding WHO guidelines by 4–5× and NAAQS by 2.4×. The Air Quality Index fluctuates from "Good" to "Severe," with winter peaks of AQI > 300 due to stubble burning, vehicular emissions, and meteorological inversion. Major sources include vehicles (30%), industries (25%), road dust (20%), and biomass burning (15%). Health data from local hospitals shows a 22% rise in respiratory illnesses during high pollution months. Despite NCAP interventions, only marginal improvement has occurred. The study highlights the urgent need for source-specific action plans, expanded monitoring, and public engagement to reduce PM levels by 40% to meet NAAQS by 2030. This study also integrates temporal and spatial trend analysis to identify persistent pollution hotspots within the city, offering a more localized understanding of emission dynamics. Comparative assessment with other urban centers in the Indo-Gangetic Plain highlights Meerut's vulnerability within a broader regional pollution framework.

Keywords: Pollution, Air Quality, Industrial Effects, Health Impact, Emission Sources

Introduction

Meerut is NCR's second-largest city with 1.8 M population and rapid urbanization. Meerut is also known as educational hub in western Uttar Pradesh and also known as the "sports city of India". The city is also famous for being the starting point of the 1857 rebellion against British colonial rule. It covers an area about 3911 km². Unfortunately, the rapid growth of the city has resulted in a decline in air quality, primarily due to increase in automobile traffic and industrial activity. The city's air pollution often reported to exceed allowable limits set by national and international authorities, poses a serious threat to the environment and public health.

Air Quality Index

Air Quality Index is a tool for effective communication of air quality status to people in terms which are easy to understand. It transforms complex air quality data of various pollutants into a single number (index value), nomenclature and colour as shown below:

Table 1: Categories of Air Quality Index with the expected impact

Good (0–50): Minimal impact

Satisfactory (51–100): Minor breathing discomfort to sensitive people

Moderate (101–200): Breathing discomfort to people with lung, heart disease and older adults

Poor (201–300): Breathing discomfort to people on prolonged exposure

Very Poor (301–400): Respiratory illness to the people on prolonged exposure

Severe (>401): Respiratory effects even on healthy people

Sources of air pollution

There are some major sources contributing to the high concentration of pollutants ($PM_{2.5}$, PM_{10}, NOx, SOx) in Meerut:

- Vehicles (30%)- Every year the number of vehicles are increasing very fastly.
- Industrial emissions (25%) – small, medium and micro enterprises (MSMEs), etc.
- Road/Construction Activities (20%)- New road and building construction, Unpaved roads, poor maintenance.
- Biomass Burning- (15%)- Solid Waste buring, Stubble waste, Fernace burning, Crop residues burning.
- Others (10%)- Bricks production, domestic burning etc.

Pollution level in Meerut:

The situation in Meerut and surrounding districts is bad due to pollution. The air quality in Meerut is again deteriorating. The average amount of PM2.5 is five times the standards, which can be extremely fatal for the lungs. According to the findings, it will soon become a gas chamber. AQI 411 was recorded in Loni in Ghaziabad, which is the highest in the state (November, 2023). At the same time, this figure reached 350 in Jai bhimnagar in Meerut. The levels of nitrogen and carbon monoxide are also increasing at an alarming rate.

Findings

The studies show PM10 levels (107.0–116.6 µg/m³) often exceed National Ambient Air Quality Standards (NAAQS) of 100 µg/m³, while PM2.5 levels are also high (50.6–54.4 µg/m³).

- Winter crisis: During winter, AQI levels frequently cross 350 and sometimes exceed 400 (hazardous) due to cold air trapping pollutants.
- Pollution sources: Major contributors include vehicular emissions, road dust, waste burning and industrial activities, particularly in areas like Begum Bridge and Kesarganj.

- Temporal trends: Studies covering 2019–2023 show that while some pollutants showed slight transient decreases, the overall air quality remains severely affected.
- Health impact: High PM2.5 levels are linked to increased cases of respiratory allergies, asthma and COPD in the city.

The Air quality status and trend of fluctuations in study period according to data of UPPCB, Meerut showed variations and fluctuations in different months and seasons (Table-1).

Table-1: The cumulative Air Quality Index data of Meerut city in the year 2023-2025.

Year	Air Quality Index											
	January	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2023	208	192	138	145	131	150	125	100	85	166	166	236
2024	237	158	121	114	147	125	135	75	100	161	200	340
2025	159	126	117	151	103	95	151	120	151	160	180	359

Source:www.indiastat.com

Mitigating measures to improve the air quality in Meerut

During the religious ceremony of Diwali, it is common practice to set off firecrackers to aid the celebration. In November, 2020 Government of Uttar Pradesh banned the use of fire crackers on Diwali as an attempt to improve air quality.

Guidelines for vehicles uses and maintenance as; Cars and motorbikes should be regularly serviced and good quality gasoline should be used and not the cheaper variant which is often “extended” with cheaper hydrocarbons.

Solid fuel stoves are very popular due to their low running costs and availability of the fuel. Very often this is the dried animal dung which is surprisingly very efficient. However, converting stoves to LPG or electricity is expensive to install, operate and therefore not popular. Government of India distributed LPG connection for under privileged population as Ujjvala Yogna to mitigate the biomass fuel burning for cooking.

Large numbers of people in the surrounding rural areas of Meerut are burning of crop residues, polythene, plastics and old tyres in small scale sugarcane industry to produce jaggery. This increases the PM2.5-PM10, carbon particles and carbon monoxide level in the local atmosphere. Environmentalists are surprised at how pollution levels remain high despite intensive monitoring on industrial units, road dust, generators and brick kilns. To mitigate pollution from these activities, government banned the burning of plastic, rubber and polythene.

Status and Trend of Air Quality in Meerut

Non-attainment status of a city of consistent high level of air pollutants above the National ambient air quality standards. Regional air quality problem characterized by two inhalable particulate matter (PM10), fine particles (PM2.5), oxides of Nitrogen and Sulfur has become increasingly prominent, which harms people's health and affects social harmony and stability. As the deepening of the industrialization and urbanization, energy resource consumption keeps growing, and the pressure of air pollution prevention and control continues to increase (Table-2).

Table-2: Yearly Trend of pollutants concentration in Meerut City.

Year	Pollutants	
	PM2.5	PM10
2023	85 μg/m^3	173 μg/m^3
2024	80 μg/m^3	150 μg/m^3
2025	150 μg/m^3	175 μg/m^3

Source: www.iqair.com

Air pollution and health implications

Air pollution is a major environmental health problem affecting the developing and the developed countries alike. The effects of air pollution on health are very complex as there are many different sources and their individual effects are synergistic and additive. It is not only the ambient air quality in the cities but also indoor air quality in the rural and the urban areas that are causing concern. In fact, in the developing world the highest air pollution exposures occur in the indoor environment. Air pollutants that are inhaled have the highest air pollution exposures occur in the indoor environment. Serious impact on human health, affecting the lungs and respiratory system; they are also taken up by the blood and circulated in the body. These pollutants are also deposited on soil, plants and in the water, further contributing to human exposure.

Conclusion

The air quality of Meerut city has shown a marginal ~12% improvement since 2018 under NCAP, yet remains unsafe with PM2.5 at 2.4× the NAAQS limit. Seasonal spikes drive winter AQI to "severe" levels, causing a 22% rise in respiratory cases and reducing life expectancy in UP by 8.6 years. Key sources are vehicles, industry, dust, road/building construction and biomass burning. Current mitigation faces gaps in enforcement and monitoring. Achieving clean air by 2030 demands 40% emission cuts through alternative methods of transport (electric vehicles) and industrial norms (safe energy fuels), dust/garbage control (Solid Waste Management), regional stubble management, and stronger public participation. Integrated, sustained action across sectors is critical to protect health and ensure sustainable growth.

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