ISSN: 0973-4929, Vol. 20, No. (3) 2025, Pg. 967-970

Current World Environment

www.cwejournal.org

Air Pollution in NCR-Delhi: Drivers and Measures

UMESH CHANDRA KULSHRESTHA

School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, India.

Article History

Published on: 06 January 2025

Air pollution is a very hot topic at present in the Indo-Pacific region. Air quality in Delhi also continues to face one of the world's most severe air pollution crises, with Delhi's AQI frequently in the "very poor" to "severe" category, often above 300–400 in winter months.[1] Across India, toxic air is linked to millions of premature deaths annually, highlighting urgent gaps in urban planning, regulation, and sustainable economic development.[2] There are a number of reports which suggest a number of reasons and measures of air pollution.[3-7]

Recently presented data in Parliament reveals a public health crisis more severe[2] (AQI, 2025). According to the statistics shared by Minister of State for Health, in response to a comprehensive question whether the government had assessed the relationship between worsening air pollution and the respiratory health of urban residents across India, over 2,04,758 individuals sought medical attention for acute respiratory illnesses at premier government hospitals of Delhi from 2022 to 2024. The Ministry recognized air pollution as a significant contributor to respiratory illnesses, notably triggering asthma, COPD flare-ups, and acute respiratory infections. However, it emphasized that health outcomes are shaped by a broader set of factors, including diet and nutrition, occupational exposure, socio-economic status, medical history, immunity, and genetic.

This winter severity of air pollution reached on its peak keeping the management team on high alert. As part of emergency pollution control actions under GRAP Stages III and IV, the Delhi government has taken several actions under GRAP (Graded Response Action Plan). For example, time to time it suspended all construction and industrial activities. It has mandated that 50% of employees in both government and private sectors work from home (WFH).[8] Schools are asked to conduct classes in hybrid mode.[9] However, `Camel-ride push' of winds promoted dispersion of pollutants due to which long term stagnation was not

CONTACT Umesh Chandra Kulshrestha umeshkulshrestha@gmail.com School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, India.

Doi: http://dx.doi.org/10.12944/CWE.20.3.1

seen.[10] Probably, this allowed AQI towards cleaner side in the last week of December 2025 and beginning of January, 2026. CPCB data show an improved AQI ranging from satisfactory at some of sites to moderate category at most of the sites in NCR on 2nd January at 4 p.m.[11]

GRAP (Graded Response Action Plan) is enforced by the Commission for Air Quality Management (CAQM) and is designed to be proactive, with each stage activated as pollution levels rise. GRAP is a set of emergency measures implemented in Delhi-NCR to combat escalating air pollution, structured into four stages based on the Air Quality Index (AQI). Stage 1of GRAP is implemented when air quality is poor (AQI 201–300). This stage includes basic measures like banning open waste burning and enforcing dust control at construction sites. Stage 2 (AQI 301–400, *Very Poor*) introduces restrictions on diesel generator use, enhances parking fees, and increases public transport services. Stage 3 (AQI 401–450, *Severe*) mandates a halt to construction and demolition activities (except for essential projects), and shuts down brick kilns, stone crushers, and mining operations. Stage 4 (AQI above 450, *Severe*+ or *Emergency*) enforces the strictest controls, including bans on truck entry (except essential goods), non-BS VI diesel vehicles, and potential closure of schools and non-essential offices.[12]

One of the reasons of severe air quality is violation of GRAP. In a major crackdown on pollution control violations, 19 teams from the Haryana State Pollution Control Board (HSPCB) and district administration inspected more than 140 industrial units in Sonepat as part of the Graded Response Action Plan (GRAP) enforcement. The inspections, conducted across Kundli, Rai, and Barhi industrial areas, revealed several violations, including unauthorized fuel usage, lack of emission control systems, and improper waste disposal practices.

Other major contributors to poor air quality in NCR Delhi include crustal dust, vehicular emissions, industrial activities, brick kilns, pyrolysis units, and thermal power plants. Compared to southern India, northern India experiences naturally higher mineral dust loadings, which significantly worsen air quality. In this region, elevated particulate levels are primarily driven by soil dust, road dust, construction activities, and long-range transported dust from the Sahara and Thar deserts.[6] Consequently, particulate concentrations in northern Indian cities consistently exceed those in southern India.[13]

A natural way to reduce particulate pollution is through rainfall, which removes dust and gaseous pollutants. To replicate this process in NCR Delhi, it is proposed to build two large artificial lakes on the city's outskirts.[14] The evaporation from these lakes would moisten the atmosphere, stimulate precipitation, and improve air quality. Beyond pollution control, the lakes would offer multiple co-benefits including reduced road-dust resuspension, groundwater recharge, prevention of desertification, long-term water supply security, biodiversity enhancement, and recreational green spaces. Since Delhi lacks major natural water bodies, such nature-based solutions are essentialjust as medicine is returning to naturopathy, air pollution management also requires a return to nature. Moreover, the presence of water bodies in close vicinity has always been fundamental to human civilization, as they provide essential resources for survival, agriculture, transportation, and cultural development.

It is important to mention that the Air Quality Index (AQI), while widely used as a public communication tool, often simplifies the complexity of air pollution by aggregating multiple pollutants into a single composite value. This approach can undermine the presence and impact of specific harmful constituents, particularly black carbon (BC) a critical pollutant with profound implications for both public health and climate. Black carbon, a potent short-lived climate pollutant, is primarily emitted from incomplete combustion of fossil fuels and biomass.[15-16] It serves as a key tracer for anthropogenic sources such as construction work, vehicular emissions, industrial processes, brick kilns, thermal power plants, tyre pyrolysis units, and the open burning of plastic waste. Transboundary sources such as crop residue burning also need to be controlled.[17] Despite its significance, black carbon is not explicitly represented in the current AQI framework, nor is it included among India's National Ambient Air Quality Standards (NAAQS). This limits our ability to assess and manage

the specific risks associated with BC exposure and hinders targeted mitigation strategies. There is an urgent need to recognize black carbon as a distinct criterion pollutant under NAAQS. Doing so would enable more accurate source attribution, facilitate regulatory action on high-emitting sectors, and strengthen the scientific basis for linking air quality interventions with health and climate change.

Air pollution prevention and control in the NCR-Delhi can effectively be achieved through a holistic approach that integrates atmospheric reactions, pollutant sources, the role of dominant chemical species in a region, meteorological factors, co-emissions, natural scavenging processes, and existing regulatory frameworks. Also, to strengthen air quality management in the NCR Delhi, it is essential to redefine particulate matter standards using lockdown baseline values. Separate standards should be established for North India, where desert dust transported from the Thar and Sahara significantly raises particulate concentrations compared to southern and coastal regions. In addition, monitoring frameworks must be expanded to include new pollutants such as chlorine compounds (Cl_2/HCl from plastic burning) and mercury, which pose serious health risks. Finally, particulate matter should be chemically speciated as metallic, carbonaceous, and organicto enable more accurate health impact assessments and to regulate industrial emissions more effectively.

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