

CHAPTER-1
INTRODUCTION

1. Introduction







1.1. Pollution in Delhi

Clean air is a basic necessity for human health and well-being. Mega-cities including National Capital Territory (NCT) of Delhi have been experiencing deterioration of air quality for many years. The air quality gets affected through emission of natural as well as anthropogenic (man-made) sources.

NCT of Delhi with an area of 1483 km² supports a population of more than two crore, making it one of the most densely populated cities of the world. Such high population density leads to increased demand for vehicles, construction activities and energy, which in turn affects air quality.

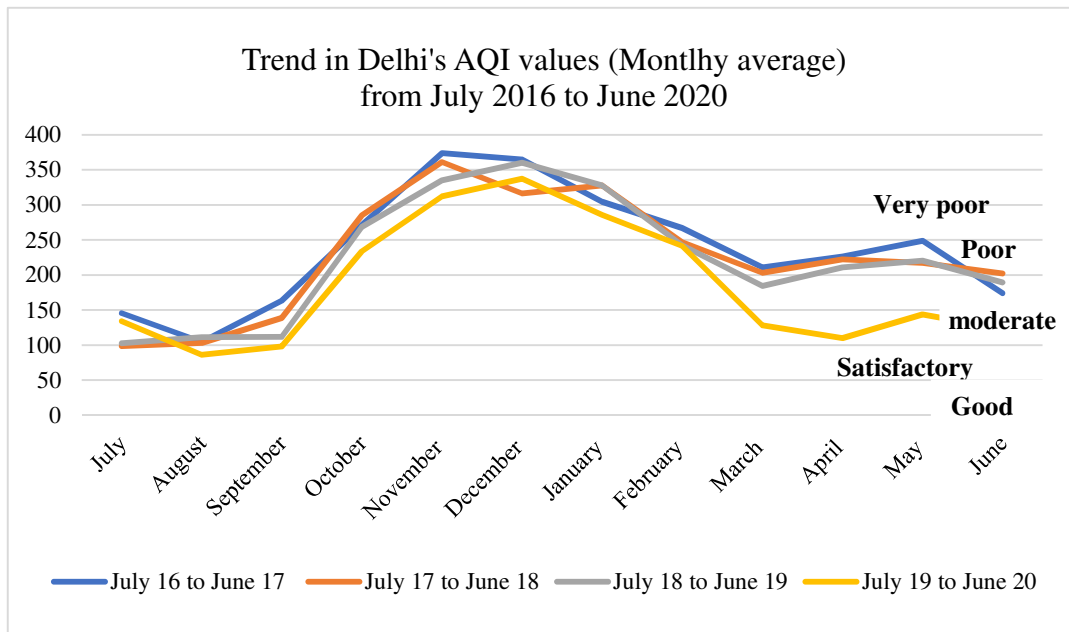
Air Quality Index (AQI) is a tool for effective communication of air quality status in easy to understand terms. It transforms weighted values of eight air pollutants, viz. Particulate Matters¹ (PM_{2.5} and PM₁₀), Nitrogen Dioxide (NO₂), Sulphur Dioxide (SO₂), Carbon Monoxide (CO), Ozone (O₃), Ammonia (NH₃), and Lead (Pb) into a single number. Further, it categorizes air quality into six broad categories, viz. good, satisfactory, moderate, poor, very poor and severe with different colour codes as shown in **Figure 1.1**.

Figure 1.1: Categorization of Air Quality Index

AQI	Remark	Color Code	Possible Health Impacts
0-50	Good		Minimal impact
51-100	Satisfactory		Minor breathing discomfort to sensitive people
101-200	Moderate		Breathing discomfort to the people with lungs, asthma and heart diseases
201-300	Poor		Breathing discomfort to most people on prolonged exposure
301-400	Very Poor		Respiratory illness on prolonged exposure
401-500	Severe		Affects healthy people and seriously impacts those with existing diseases

¹ Particulate matter are tiny pieces of particles which may include dust, dirt, soot, smoke and drops of liquid. PM_{2.5} and PM₁₀ consist of pollution particle of diameter less than 2.5 and 10 micrometers respectively.

Chart 1.1: Trends in Delhi’s AQI values



Source: CPCB data of AQI for Delhi

From the chart above, it can be seen that, in NCT of Delhi, AQI (monthly average) values has been in the categories of ‘Poor’ to ‘Very Poor’ for the period from October to February during 2016 to 2020. Poor AQI has adverse impact on human health and causes cardio vascular diseases, pulmonary diseases, lung infection, leukemia, etc.

The above chart also shows that there has been no significant reduction in the pollution level from 2016 to 2020 except in the period of lockdown in 2020. Thus, the impact of any steps taken by the GNCTD to control air pollution in Delhi did not lead to any significant abatement of air pollution.

Central Pollution Control Board (CPCB) had notified (November 2009) National Ambient Air Quality Standards (NAAQS) for 12 identified pollutants. These standards are milder², compared to World Health Organisation’s (WHO) 2005 norms. WHO has further lowered³ the recommended levels of pollutants that can be considered safe for human health, achievement of which will be challenging for Delhi.

The pollutant wise data for PM_{2.5}, PM₁₀, SO₂, NO_x, O₃, CO, NH₃ and Benzene received from Department of Environment, GNCTD in respect of 24 monitoring stations of DPCC for the period 2018-2020 was analyzed. During analysis, the annual baseline data of number of vehicles (with annual addition and deletion) was assumed as constant. Audit noted that out of these eight pollutants, concentration

² For example, the recommended PM_{2.5} concentration over a 24-hour period is 60 micrograms per cubic metre, compared to 25 micrograms advised by WHO’s 2005 guidelines.

³ While a PM_{2.5} concentration of 25 micrograms per cubic metre in a 24-hour period was considered safe earlier, the WHO has now said that a concentration of over 15 micrograms is not safe.

of four pollutants viz. PM_{2.5}, PM₁₀, NO_x, and Benzene largely remained above the NAAQ Standards. The related health effects of these four pollutants on human health are given in **Table 1.1**.

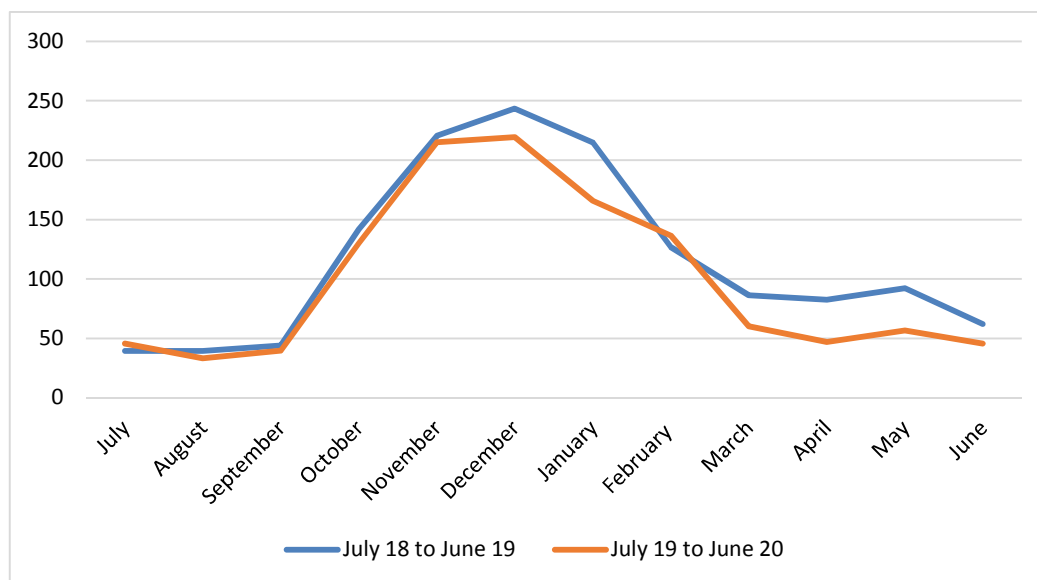
Table 1.1: Effects of pollutants on Human health

Pollutant	Effect of human health
PM _{2.5} and PM ₁₀	Particles with a diameter of 10 microns or less, (\leq PM ₁₀) can penetrate and lodge deep inside the lungs, while particles with diameter of 2.5 microns or less, (\leq PM _{2.5}) can penetrate the lung barrier and enter the blood system. Chronic exposure to particles contributes to the risk of developing cardiovascular and respiratory diseases, as well as of lung cancer.
NO _x	NO ₂ exposure can cause decrement in lung function and chronic lung disease.
Benzene	Short term exposure to benzene may cause narcosis, headache, dizziness, drowsiness, confusion, tremors and loss of consciousness.

Trends in concentration of these pollutants in the ambient air are discussed in succeeding paragraphs.

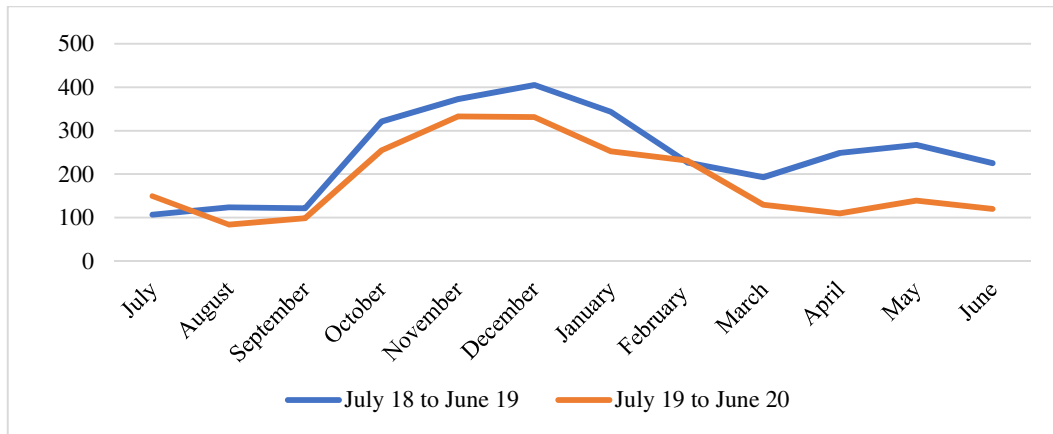
PM_{2.5} and PM₁₀: National Ambient Air Quality Standards stipulates the permissible annual concentration of PM_{2.5} and PM₁₀ as 40 and 60 respectively. High PM_{2.5} and PM₁₀ can be seen during the period October – January in **Chart 1.2** and **Chart 1.3**.

Chart 1.2: Trends in concentration of PM_{2.5} in Delhi



Source: Data provided by Department of Environment

Chart 1.3: Trends in concentration of PM₁₀ in Delhi



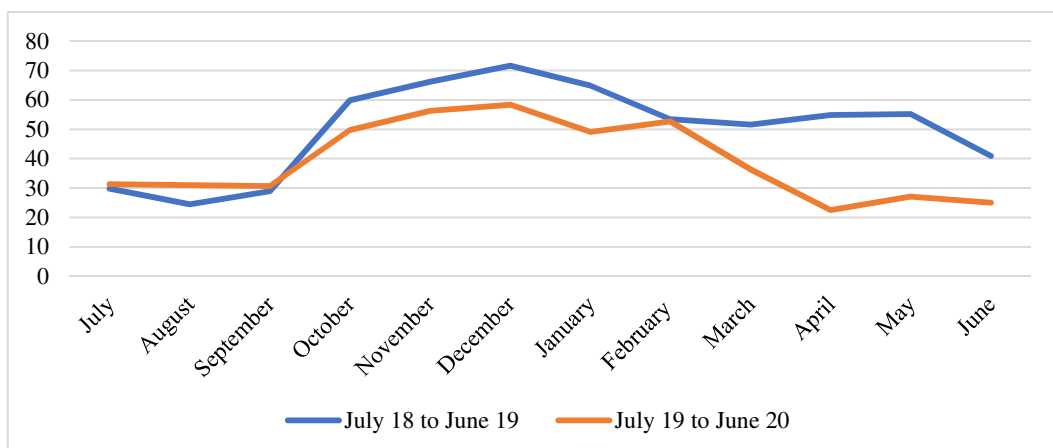
Source: Data provided by Department of Environment

Peaking of PM_{2.5} and PM₁₀ during winter season may indicate factors other than transport sector such as biomass/solid waste burning/construction activities contributing towards increase in PM_{2.5} and PM₁₀ concentration which require detailed examination by GNCTD.

Besides, it was reported⁴, based on the analysis of composition of PM_{2.5} during October 2019 to January 2020, that post-monsoon (end of October to around mid-November) haze was largely affected by biomass burning particles likely from “agricultural residue burning emissions in the upwind states of Delhi”, whereas haze in the winter (end of November to early January) was also affected by biomass burning, but “likely from the local burning of wood, coal and/or roadside trash for heating and/or cooking purposes.

NO₂: NAAQS stipulates the permissible annual concentration of NO₂ as 40. High NO₂ can be seen during the period October – January in the **Chart 1.4**.

Chart 1.4: Trends in concentration of NO₂ in Delhi



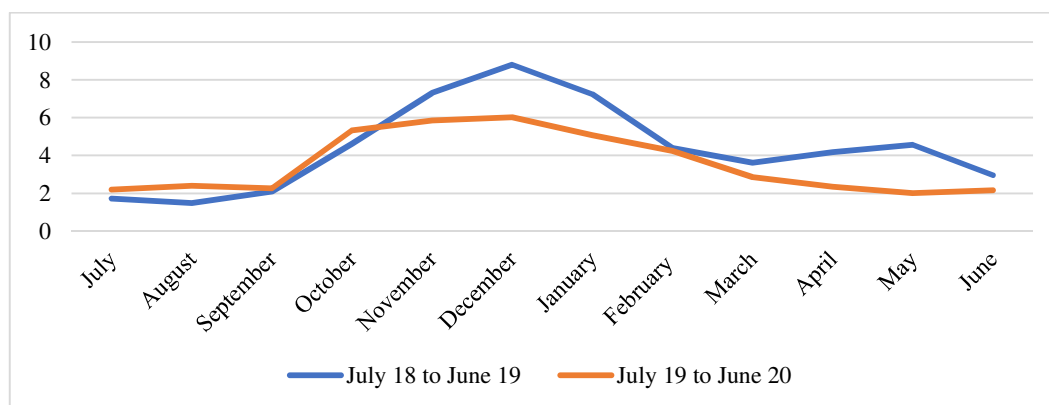
Source: Data provided by Department of Environment

⁴ Study conducted by scientists from IIT-Kanpur, IIT-Delhi, Indian Institute of Tropical Meteorology, Central Pollution Control Board (CPCB) and others

Peaking of NO₂ may indicate factors other than transport sector such as burning of biomass contributing towards increase in concentration of NO₂ which require detailed examination by GNCTD.

Benzene: NAAQS stipulates the permissible annual concentration of Benzene as five. High concentration of Benzene can be seen during the period October – January in the **Chart 1.5**.

Chart 1.5: Trends in concentration of Benzene in Delhi



Source: Data provided by Department of Environment

Peaking of benzene concentration during winter season may be attributed to non-dispersal of benzene emanating from fuel pump as discussed in Para 2.5.

As per the CPCB data for the period 2015-16 to 2020-21, particulate matter (PM) was prominent pollutant responsible for deteriorating Delhi AQI. As per the Berkley Earth Study on Equivalence of Air Pollution and Cigarette, PM_{2.5} concentrations of 200 µg/m³ is equal to consuming nine-ten cigarettes per day on an average. It has also been reported⁵ that children growing up in the polluted environs of Delhi suffer from reduced lung growth, as compared to children growing up in developed countries. Another scientific report⁶ has suggested that residents in the Delhi could add 10 years more to their lives if air pollution was reduced to meet the World Health Organisation (WHO) guideline of 10 µg/m³. As per another study⁷, the per capita economic loss due to lost output from premature deaths and morbidity attributable to air pollution in India was \$26.5 (₹ 1,866⁸) and was highest in Delhi \$62.0 (₹ 4,365). These and other reports highlight extremely adverse effects of air pollution in Delhi on its residents.

⁵ Another study on children in Delhi, led by pulmonologist Prof. S.K. Chhabra, former Director-Professor, Department of Pulmonary Medicine at Vallabhbhai Patel Chest Institute, Delhi.

⁶ The Air Quality Life Index report by EPIC (Energy Policy Institute of the University of Chicago).

⁷ Health and economic impact of air pollution in the states of India: the Global burden of disease study 2019 published in Lancet Planetary Health in January 2021.

⁸ Average Rate of Exchange (2019) USD to INR = ₹ 70.40.

The air quality in Delhi is impacted by activities in different sectors such as transport, residential, solvents, power plants, road dust and others.

An analysis of contribution of major pollutants in Delhi's air has been done to arrive at the role of vehicular emission on its air quality. As per the report⁹, vehicles are one of the major local contributors (PM_{2.5} - 39 per cent, PM₁₀ – 19 per cent, NO_x – 81 per cent, CO – 84 per cent and Non-Methane Volatile Organic Compounds - 80 per cent) to Delhi's poor air quality.

Similar trend was also observed in the Special Scientific Report by Indian Institute of Tropical Meteorology, Pune on 'High Resolution Emission Inventory of Major Air Pollutants of Mega City DELHI for 2018' and 'Comprehensive Study on Air Pollution and Green House Gases (GHGs) in Delhi' conducted by IIT Kanpur.

Vehicular emission was the major source of pollution with its origins in Delhi, and thus, potentially controllable by the Government of National Capital Territory of Delhi (GNCTD). Emission from other sources i.e., Industry and Power sectors have their origins mostly outside Delhi. Hence, this Performance Audit is targeted at vehicular emission.

1.2. Pollution from Transport sector

This report focuses on pollution from 'Transport' sector from burning of fuel which releases Particulate Matter (PM), NO_x, CO and Non-Methane Volatile Organic Compounds (NMVOC) into the atmosphere. These emissions have damaging effects on human health causing cardio vascular disease, pulmonary disease, lung infection, leukemia, etc.

PM is a common proxy indicator for air pollution and affects more people than any other pollutant.

For management of pollution from 'Transport' sector, it is important to understand the problem and adverse impacts of vehicular emission and identify possible solutions. The first step is to be aware of the severity of air pollution which requires a reliable air quality monitoring system.

Vehicular emission can be reduced by improvements in the urban transport system, changes in transportation modes through infrastructure investment, restraining vehicle movements through location and time-specific bans on certain categories of vehicles, setting up of monitoring and enforcement system for checking emission and ensuring fitness of motor vehicles.

1.3. Departments concerned

The Department of Environment (DoE), GNCTD is responsible for improving environmental quality (including air quality) of Delhi by engaging itself in

⁹ Source Apportionment of PM_{2.5} & PM₁₀ of Delhi NCR for Identification of Major Sources' prepared (August 2018) for Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises, Government of India, different sources affecting Delhi's air quality for the year 2016.

environmental assessment, monitoring, protection and raising awareness amongst people of Delhi.

The responsibility of monitoring of air pollution levels in Delhi and laying down the standards for automobile emission under Section 17(1) of the Air (Prevention and Control of Pollution) Act 1981, is with the Delhi Pollution Control Committee (DPCC). DPCC has been delegated (March 1991) with all the powers and functions of the State Pollution Control Board in relation to NCT of Delhi by the Central Pollution Control Board (CPCB) under the provisions of Section 4 (4) of the Water (Prevention and Control of Pollution) Act, 1974 and Section 6 of the Air (Prevention and Control of Pollution) Act, 1981 (Air Act). DPCC acts as a regulatory body for various Pollution Control Acts, Rules and Notifications in NCT of Delhi. The Secretary (Environment), GNCTD is the Chairperson and Special Secretary (Environment) is the Member Secretary of DPCC.

The responsibility of controlling vehicular emission lies with the Department of Transport (DoT) under Central Motor Vehicles Act, 1988 and Central Motor Vehicles Rules, 1989, framed thereunder. DoT has also been entrusted with the policy making, co-ordination, implementation, and monitoring functions of all the transport related aspects of NCT of Delhi. It is headed by the Principal Secretary-cum-Commissioner (Transport) and assisted by two Special Commissioners. In accordance with Section 20 of the Air Act, 1981, GNCTD, in consultation with DPCC, is to instruct DoT to ensure compliance with the standards laid down in connection with vehicular emission.

It is the overall responsibility of GNCTD to devise and implement strategies for prevention and mitigation of vehicular emission. Considering the importance of clean air and impact of vehicular emission on it, the Performance Audit on 'Prevention and Mitigation of Vehicular Air Pollution in Delhi' was undertaken during May 2019 to July 2021.

1.4. Audit Objectives

This Performance Audit on 'Prevention and Mitigation Vehicular Air Pollution in Delhi' has been conducted to assess whether:

- The air quality monitoring system was adequate and effective, in order to provide accurate and reliable information;
- The Government of NCTD took adequate and effective steps to prevent and mitigate vehicular emission affecting air quality; and
- Adequate and effective steps were undertaken for adoption of cleaner transportation in Delhi.

1.5. Audit Criteria

The audit criteria were derived from the following:

- Air (Prevention and Control of Pollution) Act, 1981 of Government of India (GoI) and Rules framed thereunder;
- The Central Motor Vehicles Rules, 1989 notified under the Motor Vehicle Act, 1988 and Delhi Motor Vehicles Rules, 1993;
- Notifications, circulars and orders issued by the Government of India, Government of NCT of Delhi, Central Pollution Control Board and Delhi Pollution Control Committee (DPCC); and
- Recommendations/orders issued by various Courts/Authorities/Commissions including World Health Organisation (WHO).

1.6. Audit scope and methodology

This audit examined data, different policies and their implementation for the period of seven years from April 2014 to March 2021. Audit methodology involved test check of records at various units of DoT, DoE, Delhi Pollution Control Committee and Delhi Transport Corporation. Joint physical verifications, wherever required, were also conducted.

The audit scope, objectives, criteria and methodology were discussed with the Government during the Entry Conference held in January 2020. Thereafter, the draft audit report was discussed with the Government during Exit Conference in October 2021. The replies of the Government, wherever received, have been suitably incorporated in the Report.

1.7. Structure of the Report

Chapter-1 gives a brief background of the sources impacting air quality in Delhi, and the contribution of transport sector as the primary source affecting Delhi's Air quality.

Chapter-2 includes the issues related to air quality monitoring in Delhi.

Chapter-3 discusses the adequacy and effectiveness of public transport system.

Chapter-4 covers the preventive and enforcement strategies of GNCTD to regulate vehicular emission. These include effectiveness of emission and fitness testing systems in Delhi, and robustness of mechanism to enforce the same.

Chapter-5 examines the mitigation and promotion strategies, which includes promotion of zero-emission transportation, management of congestion and increasing public awareness about air quality issues.