CHAPTER–2

AIR QUALITY MONITORING SYSTEM

2. Air Quality Monitoring System

In order to ensure optimal air quality, it is necessary to identify the pollutants and their acceptable levels in ambient air; and measure their actual concentration in ambient air. Defining Air quality is a complex process as there are multiple pollutants with different acceptable levels[10]. In order to simplify the complex air quality data, Central Pollution Control Board launched (April 2015) National Air Quality Index.

The Comprehensive Action Plan (CAP)[11] prepared by Environmental Pollution (Prevention and Control) Authority (EPCA) to mitigate air pollution had stipulated (April 2017) setting up of 20 more real time air quality monitoring stations, in addition to 18 existing real time monitoring stations in Delhi, to make it representative of population distribution and land use. Accordingly, DPCC had set up 20 additional monitoring stations during 2017-18 making available 38[12] Continuous Ambient Air Quality Monitoring Stations (CAAQMS) in Delhi (as of March 2021).

Audit examined the appropriateness of location of CAAQMSs, adequacy of air quality data generated to calculate AQI and identification of sources of pollution by the Government. Audit observations on these issues are discussed in subsequent paragraphs.

2.1. Inappropriate location of Air Quality Monitoring Stations

The CPCB Guidelines for Air Quality Monitoring Stations specified *inter alia*, the following requirements regarding location of CAAQMSs:

- All sides should be open, i.e., the intake should not be in a confined space
- Height of the inlet must be 3-10 meters above the ground
- More than 20 meters away from nearby trees
- More than 200 meters from unpaved roads/ streets
- No nearby furnace or incinerator fumes

The location of CAAQMS should be representative of average exposure over a geographic area. If the location of the instrument is such that it does not satisfy the physical requirements of monitoring stations, the data generated may be incorrect and thus, not be of much use in determining status and trends of level of pollutants.

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[10] These air quality standards were notified by CPCB in 2009. The standards levels for 24 hours weighted average for pollutant $PM_{2.5}$, PM_{10}, NOx, SO_2, Lead and Ammonia are 60 ug/m^3,100 ug/m^3, 80 ug/m^3, 80 ug/m^3, 1.0 ug/m^3 and 400 ug/m^3 respectively and eight hours weighted average for pollutants CO and Ozone are 2 mg/m^3 and 100 ug/m^3 respectively.

[11] A Comprehensive Action Plan (CAP) was submitted by EPCA to Supreme Court in April 2017 with the objective to present a pollution source wise action plan to be implemented in a time bound manner in Delhi and NCR by agencies concerned with adequately stringent monitoring and compliance system to meet the clean air targets.

[12] Out of these 24 belonged to DPCC and remaining 14 were with central agencies (six with CPCB and eight with Indian Metrological Department)

Audit conducted (September 2020) joint physical verification of 13 CAAQMSs (out of total 24 CAAQMSs of DPCC) and observed that though the height of the inlet was approximately four meter in all these stations, there were issues relating to parameters such as proximity to trees, major roads, obstacles, high rise buildings, unpaved roads, etc.

Incorrect location might result in incorrect observations by these monitoring stations and generation of unreliable data. Status of these 13 stations against the CAAQMS requirements noticed during joint physical verification is given in **Annexure-I**.

Illustrative cases are discussed below:

- All the 13 CAAQMSs had proximity to trees on multiple sides. As per the CPCB guidelines, trees may also be sources of particulate matter in the form of detritus, pollen or insect parts.
- CAAQMSs at Anand Vihar and Wazirpur were located adjacent to roads catering to heavy vehicular traffic.
- CAAQMSs at Civil Lines, Wazirpur, and Okhla had proximity to high rise buildings and construction sites.

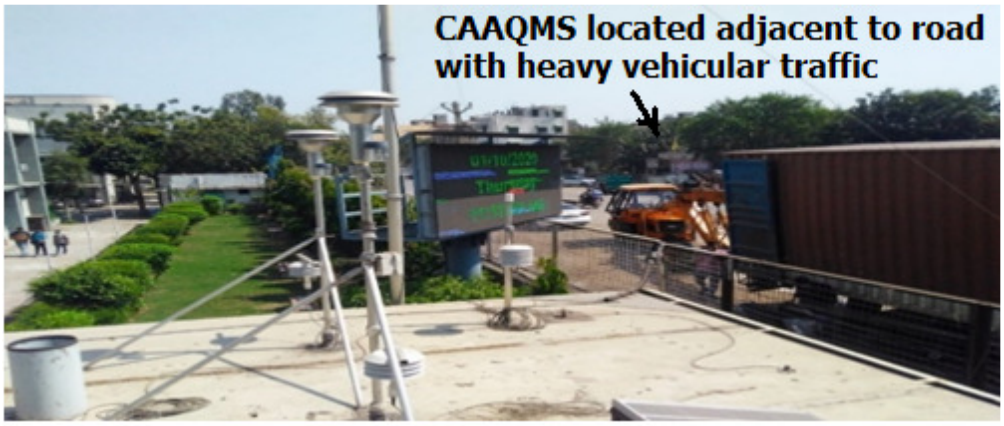

Figure 2.1: CAAQMS Wazirpur

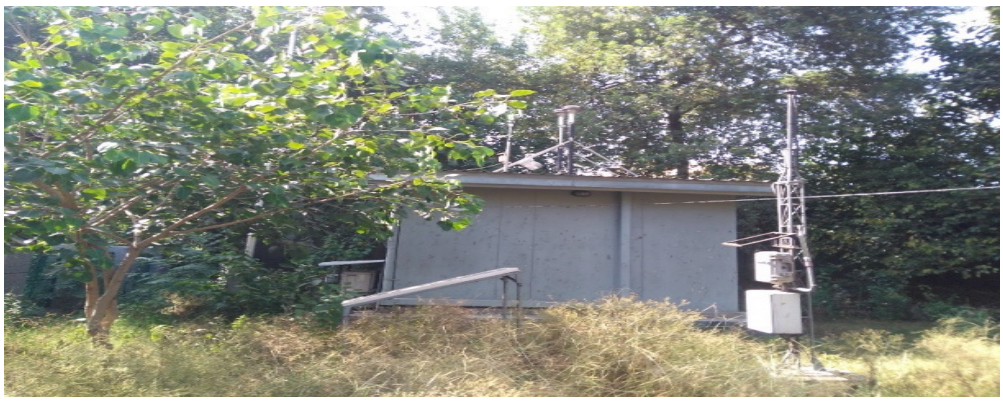

Figure 2.2: CAAQMS R.K. Puram, surrounded by trees on three sides

Thus, Audit observed that the location of CAAQMSs did not fulfill the requirements laid down by the CPCB, indicating possible inaccuracies in the data generated by these CAAQMSs, rendering the AQI values unreliable.

DoE stated (October 2021) that necessary action shall be taken to comply with the CPCB norms.

2.2. Calculation of AQI on the basis of inadequate data

CPCB had notified (November 2009) National Ambient Air Quality Standards (NAAQS) for 12 identified pollutants[13]. Subsequently, a national AQI was launched (April 2015) based on eight pollutants[14] to monitor air quality in major urban cities on a real time basis and to enhance public awareness by disseminating air quality information in simple terms easily understood by common person. A minimum of 16 hours (sixty-four observations as CAAQM stations are required to generate 15-minute average values on real time basis) data in a day should be available for minimum three pollutants, out of which one should necessarily be either $PM_{2.5}$ or PM_{10} for generating daily AQI.

Audit observed that despite having the capacity to generate 16 hours' data, these were not available on all the days during 2019-20 for all the seven pollutants (except Pb which was not measured at all). Thus, AQI was calculated without considering adequate data for all the seven pollutants. Details are given in **Annexure-II**.

Further, CPCB had categorized the station-wise availability of monthly air quality data into three categories[15]. Audit noted that in respect of 24 DPCC stations the monthly AQI data for less than 21 days was available for 12 *per cent* months during the period April 2014 to January 2021.

Lead (Pb) is a toxic metal and its exposure results in increased Lead levels in blood. Depending on the level of exposure, Pb may adversely affect the central nervous system, kidney function, immunity, reproductive, cardiovascular and respiratory systems. Audit observed that none of the 24 air quality monitoring stations of DPCC were measuring Pb levels.

DoE replied (October 2021) that requisite mechanism to measure Lead (Pb) at all monitoring stations shall be considered. As regards lack of sufficient data, DoE stated that 20 new stations installed in October 2017 started functioning between February 2018 and November 2018 onwards and since stations were under calibration and stabilization, stations were not connected for generation of AQI.

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13 Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), PM_{10}, $PM_{2.5}$, Ozone, Lead (Pb), Carbon Monoxide (CO), Ammonia (NH_3), Benzene, Benzo (a) Pyrene, Arsenic and Nickel.

14 PM_{10}, $PM_{2.5}$, NO_2, CO, SO_2, O_3, NH_3 and Pb.

15 (i) data available for more than 21 days in a month (Green), (ii) data available for more than 11 days but less than 21 days in a month (Orange) and (iii) data available for less than 10 days in a month (Red).

The fact remains that lack of adequate data resulted in deficient air quality monitoring by DPCC.

2.3. Lack of real-time information regarding sources of pollutants

AQI values only indicate the total concentration of pollutants in an area. The source of each pollutant is measured by source apportionment/emission inventory study. Emission inventory is a comprehensive listing by sources of air pollutants and amount of air pollutants released into air because of a specific anthropogenic process in a particular geographic region during a specific time period. Thus, a real-time emission inventory helps to effectively plan appropriate mitigation strategies to minimize emission and improve the air quality. GNCTD considered (July 2018) to carry out a real-time emission inventory study essential for effective planning to improve the air quality.

Audit noted that GNCTD had not taken-up/finalised any study till March 2021. An agreement was however, signed in December 2018 with a foreign university which was terminated in December 2020 on technical ground by DPCC as the report had not addressed/fulfilled the overall requirements. However, the payment of ₹ 87.60 lakh was made to the university for the project, which remained unfruitful.

DoE while admitting (September 2021) the fact stated that real time source study is a new field for dynamic systems like Ambient Air and it is in the process to awarding real time source apportionment study for Delhi through IIT Kanpur led team.

In absence of real-time emission inventory study, strategies adopted to minimize emission are not based on scientific analysis of real-time data.

2.4. Lack of information on vehicular emission load

The last two emission source apportionment studies[16] conducted (2018) for NCT of Delhi revealed that vehicles are one of the major local contributors ($PM_{2.5}$ – 39 *per cent,* PM_{10} – 19 *per cent,* NO_x – 81 *per cent,* CO – 84 *per cent* and NMVOC-80 *per cent)* to Delhi's poor air quality. This necessitates that GNCTD should maintain information regarding vehicular traffic and vehicular emission[17] load in Delhi, in order to devise appropriate strategies to control vehicular traffic and/or emission from these vehicles plying in Delhi. Guidelines for Ambient Air Quality Monitoring, issued by CPCB in 2003, also prescribed obtaining of information on type and number of vehicles and estimation of emission load.

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16 Source Apportionment of $PM_{2.5}$ & PM_{10} of Delhi NCR for Identification of Major Sources by TERI and High-Resolution Emission Inventory of Major Air Pollutants of Mega City Delhi by System of Air Quality and Weather Forecasting and Research (SAFAR).

17 The major pollutants in vehicular emission are carbon monoxide, nitrogen oxides, photochemical oxidants, air toxics namely benzene, aldehydes, 1-3 butadiene, Lead, particulate matter, hydrocarbons, oxides of sulphur and polycyclic aromatic hydrocarbons. While the predominant pollutants in petrol/gasoline driven vehicles are hydrocarbons and carbon monoxide (the predominant pollutants), these are oxides of nitrogen and particulates from diesel-based vehicles.

Audit observed that information regarding type and number of vehicles plying on Delhi roads and assessment of their emission load was not available with DoE/ DoT.

As a result, the GNCTD was not in a position to identify the emission from different types of vehicles that are generating significant concentration of pollutants for framing source-wise strategies for specific type of vehicle or particular area, to mitigate vehicular air pollution in Delhi.

DoE stated (October 2021) that quantification of emission load on normative basis shall be explored. DoT stated (November 2021) that an MoU has been signed with IIT Delhi for assessment of vehicular emission load in Delhi, report of which is expected in January 2022.

2.5. Benzene emission not measured at source

Benzene, which is one of the pollutants, emanates mainly from evaporation at fuel stations during loading and dispensation, making fuel stations high emission areas. As per the World Health Organization, acute (short term) occupational exposure to benzene may cause narcosis, headache, dizziness, drowsiness, confusion, tremors and loss of consciousness. Escape of benzene can be controlled through Vapour Recovery Systems (VRS) which sucks back the fumes that escapes from a pipe when fuel is being pumped into a vehicle or an outlet.

The National Ambient Air Quality Standards (NAAQS) specified the permissible levels for Benzene as 5µg/m^3.

In order to reduce Benzene emission, Comprehensive Action Plan (CAP) stipulated (April 2017) installation of Vapour Recovery System (VRS) at all the fuel outlets[18] in Delhi by May 2018. DoT, DoE and DPCC were also responsible for its implementation, apart from Union Ministry of Petroleum and Natural Gas (MoPNG).

Analysis of monthly average data of Benzene levels monitored at DPCC's 24 CAAQMSs revealed that the Benzene levels were in excess of permissible limits during 26.94 *per cent* for the period from January 2018 to March 2021. The ten most affected AQI monitoring locations where Benzene levels were reported high during this period are shown in **Table 2.1**.

Table 2.1: Benzene levels at various monitoring locations

Sl. No.	AQI Station	Range of Benzene level monitored beyond 5 ug/ m^3
1	Punjabi Bagh	5.56 to 26.04 ug/m^3
2	Anand Vihar	5.05 to 14.82 ug/m^3
3	R.K. Puram	5.01 to 13.90 ug/m^3
4	National stadium	6.31 to 13.45 ug/m^3
5	Mundka	5.08 to 11.39 ug/m^3
6	Nehru Nagar	5.22 to 10.67 ug/m^3
7	Jahangir Puri	5.16 to 10.46 ug/m^3
8	Pusa	5.27 to 11.89 ug/m^3
9	Ashok Vihar	5.13 to 13.54 ug/m^3
10	Wazirpur	5.14 to 9.53 ug/m^3

Source: AQI Data provided by DPCC

[18] With capacity of 300 KLM and more.

Despite the overall high Benzene levels, GNCTD was not monitoring benzene level at fuel stations/petrol pumps, i.e., the key source of benzene emission. Further, it was observed that DoT, DoE, and DPCC were not aware of the status of installation of VRS in fuel stations in Delhi.

Thus, the GNCTD neither monitored Benzene levels at the fuel stations (major source), nor followed-up on the installation of VRS at fuel stations to reduce Benzene emission. Meanwhile, benzene levels remained higher than permissible limits at ten out of 24 CAAQMSs.

DoE stated (October 2021) that the possibility of installation of monitoring sensors at fuel stations shall be deliberated upon.

2.6. Conclusion

Air quality monitoring by DPCC was deficient as CAAQMSs were located at sites not fulfilling the norms. Further, Lead (Pb) was not measured at any CAAQMSs of DPCC and the remaining seven pollutants were also not measured regularly. This resulted in unavailability of AQI values on several days.

GNCTD did not collect any information on vehicular traffic and emission load in Delhi, without which targeted approach for emission control to tackle air quality problem could not be adopted. Besides, GNCTD did not undertake real-time emission inventory study.

Despite high Benzene concentrations reported at CAAQMSs, GNCTD neither monitored Benzene concentrations at fuel stations, nor ensured installation of vapor recovery device at fuel stations to control these emissions. Thus, GNTCD was in no position to analyse the impact of its strategies to bring down pollution.

2.7. Recommendations

Recommendation #1: The Government should ensure that the CAAQMSs are relocated at suitable places or obstacles are removed. If equipment is not fit to monitor all pollutants like Lead, they should be suitably augmented or replaced.

Recommendation #2: Government should ensure sufficient data for all pollutants is generated by every monitoring station, so that air quality at various locations in Delhi is known on all days. Government needs to monitor benzene level at fuel stations and follow up installation of Vapour Recovery System at fuel stations to reduce Benzene emission.

Recommendation #3: Government needs to maintain information regarding type and number of vehicles and their emission load for devising appropriate strategies to control vehicular traffic and/or emission. Without this information, impact and success of any measure to control pollution cannot be assessed.