CREA

Data discrepancies in India's NCAP cities' air quality assessments

Key messages

- The number of cities with PM10 levels exceeding the National Ambient Air Quality Standards (NAAQS) by twice the limit rose from eight in FY17-18 to a peak of 26 in FY22-23, before slightly dropping to 22 in FY23-24.
- The analysis of PM10 concentration changes revealed significant variation between continuous ambient air quality monitoring stations (CAAQMS) data and data integrated with that of the National Air Quality Monitoring Programme (NAMP).
- CAAQMS reported increases in PM10 levels for 17 cities, while integrated data noted increases in 15 cities; for decreases, CAAQMS identified 23 cities with a 1-10% decrease, compared to 27 in integrated data, along with 16 cities with a 10-20% decrease, versus 12 in integrated data. Both sources reported six cities with a 20-30% decrease; and CAAQMS recorded one city with a 30-40% decrease, while integrated data showed two cities in that range.
- Notably, cities like Byrnihat showed differing PM10 levels between the two sources, highlighting integration challenges, where CAAQMS recorded a PM10 concentration of 266 $\mu g/m^3$, while integrated data showed only 104 $\mu g/m^3$.
- The significant variation between this data raises serious questions about data accuracy. These contrasting contributions have raised critical questions about the accuracy of air quality data, suggesting potential inconsistencies that could misrepresent actual improvements.
- Recommendations:
    - CAAQMS and NAMP data needs to be analysed separately in order to arrive at an accurate representation of the pollution.
    - The integrity of the data needs to be maintained by locating monitoring stations in proper locations, maintaining them adequately and finally ensuring that the stations and data are tamper proof.
    - It is important to continue to use both CAAQMS and NAMP methods to measure air pollution in India with a clear plan to convert NAMP stations to CAAQM stations in a time-bound manner.

Introduction

The National Clean Air Programme (NCAP), initiated by the Government of India, aims to reduce coarse particulate matter (PM10) concentrations by 40% by 2026, using FY17-18 levels as a benchmark. By focusing on enhancing air quality monitoring, implementing city-specific action plans, promoting public awareness, and fostering multi-level governance collaboration, NCAP seeks to mitigate the adverse impacts of air pollution on public health and the environment.

However, there are some major concerns due to the absence of legally binding targets and stringent enforcement mechanisms, which may undermine NCAP's effectiveness in ensuring compliance and achieving significant pollution reductions. Additionally, the reliance on city-specific action plans has been questioned for potentially overlooking broader regional and transboundary pollution sources. Furthermore, the lack of robust, consistent, transparent data collection and reporting mechanisms poses challenges to accurately assessing progress and holding decision-makers and stakeholders accountable.

Differing data sets

Monitoring air quality is essential for managing pollution and safeguarding public health, particularly in urban areas where pollution levels can fluctuate significantly. In many cities, this monitoring is carried out through continuous ambient air quality monitoring stations (CAAQMS) and/or manual monitoring stations under the National Air Monitoring Programme (NAMP). Each system plays a crucial role in tracking air quality, but they differ markedly in their data collection methods and overall effectiveness.

As of the end of January 2024, there were 561 continuous ambient air quality monitoring stations installed in 285 cities across the country. These stations provide real-time, continuous monitoring of various air pollutants offering a detailed and uninterrupted dataset throughout the year, allowing for accurate tracking of pollution trends and swift responses to changes in air quality. Due to their real-time nature, CAAQMS are considered a highly reliable system for air quality monitoring.

As of 19 November 2024, 966 manual air quality monitoring stations were established in 420 cities under the NAMP. Unlike CAAQMS, NAMP stations are operated manually, with monitoring conducted for 24 hours only twice a week, leading to a total of 104 observations per year. The limited frequency of data collection poses significant challenges in providing a complete picture of the air quality in these cities.

The reliance on twice-weekly monitoring means that pollution peaks or short-term fluctuations which can occur due to specific events such as traffic congestion, industrial activity, or weather changes are likely to be missed. The data collected through NAMP may not accurately reflect the pollution levels during the days when monitoring is not conducted. Therefore, the dataset lacks the continuous nature required for high-precision air quality assessments.

In cities where both CAAQMS and NAMP stations are present, the data from these systems is combined or integrated to produce daily air quality reports. However, this practice raises concerns about the integrity of the data. The CAAQMS provides continuous, high-quality data, while the manual NAMP data is sporadic and less reliable. When both datasets are combined, the resulting air quality assessment may be compromised. Therefore, comparison of integrated data with CAAQMS will be crucial to assess the influence of NAMP in integrated data.

Purpose of the study

The objective of this study is to analyse the variation in PM10 (particulate matter) concentrations between Integrated data and CAAQMS data in NCAP cities.

Methodology

CAAQMS data is collected from the Central Pollution Control Board for the FY17-18 to FY23-24 (1 April to 31 March). Integrated data for all 131 NCAP cities is collected from the portal for regulation of air-pollution in non-attainment cities (PRANA).

CAAQMS PM10 concentration in NCAP cities

The number of cities monitored with CAAQMS rose from 16 in FY17-18 to 93 in FY23-24, reflecting a concerted effort to track and manage air quality more comprehensively across India.

However, as monitoring has expanded, the data reveals that a growing number of these cities are facing severe air quality challenges. In FY17-18, all 16 cities with available data were above the National Ambient Air Quality Standards (NAAQS) of 60 µg/m^3. By FY23-24, 83 out of the 93 monitored cities still recorded air quality levels exceeding the national standards.

The number of cities where pollution levels are more than twice the NAAQS has fluctuated, rising from eight in FY17-18 to a peak of 26 in FY22-23, before slightly declining to 22 in FY23-24. This indicates that while there may be some recent improvements, a significant proportion of cities are still experiencing extremely high levels of air pollution.

Even more concerning is the number of cities where air quality levels are more than three times the NAAQS. Starting with two cities in FY17-18, this number increased to seven in both FY18-19 and FY20-21, and then slightly decreased to five cities by FY23-24.

The data on cities with the highest PM10 concentrations further illustrates the persistent air pollution issues in certain regions. Cities like Delhi, Noida, Ghaziabad, and Faridabad frequently appear among the top five for the highest levels of PM10, a harmful particulate matter. In FY23-24, Byrnihat recorded the highest PM10 concentration, followed by Delhi, Patna, Noida, and Faridabad. See Table 1.

Table 1. Trend of exceedances and most polluted NCAP cities

Fiscal Year	FY17-18	FY18-19	FY19-20	FY20-21	FY21-22	FY22-23	FY23-24
Cities with data	16	37	38	47	59	63	93
Cities > NAAQS	16	37	37	44	56	61	83
Cities >2x NAAQS	8	16	9	15	19	26	22
Cities >3x NAAQS	2	7	4	7	6	5	5
Top 5 Polluted Cities	Varanasi	Ghaziabad	Ghaziabad	Lucknow	Ghaziabad	Faridabad	Byrnihat
	Delhi	Noida	Noida	Ghaziabad	Faridabad	Delhi	Delhi
	Mandi Gobindgarh	Delhi	Delhi	Faridabad	Noida	Noida	Patna
	Durgapur	Varanasi	Muradabad	Noida	Delhi	Patna	Noida
	Amritsar	Muradabad	Jodhpur	Meerut	Durgapur	Ghaziabad	Faridabad

Variations between CAAQMS data and integrated data

In FY23-24, the analysis of PM10 concentration changes across cities compared to FY22-23 revealed some variations between CAAQMS and integrated data. According to CAAQMS data, 17 cities experienced an increase in PM10 levels, with none reporting no change. In contrast, integrated data showed 15 cities with increased levels and one city with no change.

Building on this city-level comparison, a state-level analysis was conducted to further explore which states exhibited significant differences between the two datasets. Several states experienced increases in PM10 levels, with Uttar Pradesh reporting one city in integrated data and three in CAAQMS. Gujarat had one increase in integrated data but none in CAAQMS. Rajasthan recorded two cities in integrated data and one in CAAQMS, while Karnataka had two cities in both datasets. Punjab noted one increase in CAAQMS but none in integrated data. Maharashtra reported three cities in integrated data and two in CAAQMS. Additionally, Assam, Telangana, Jammu and Kashmir, and Odisha each had one city with increased levels in both methods.

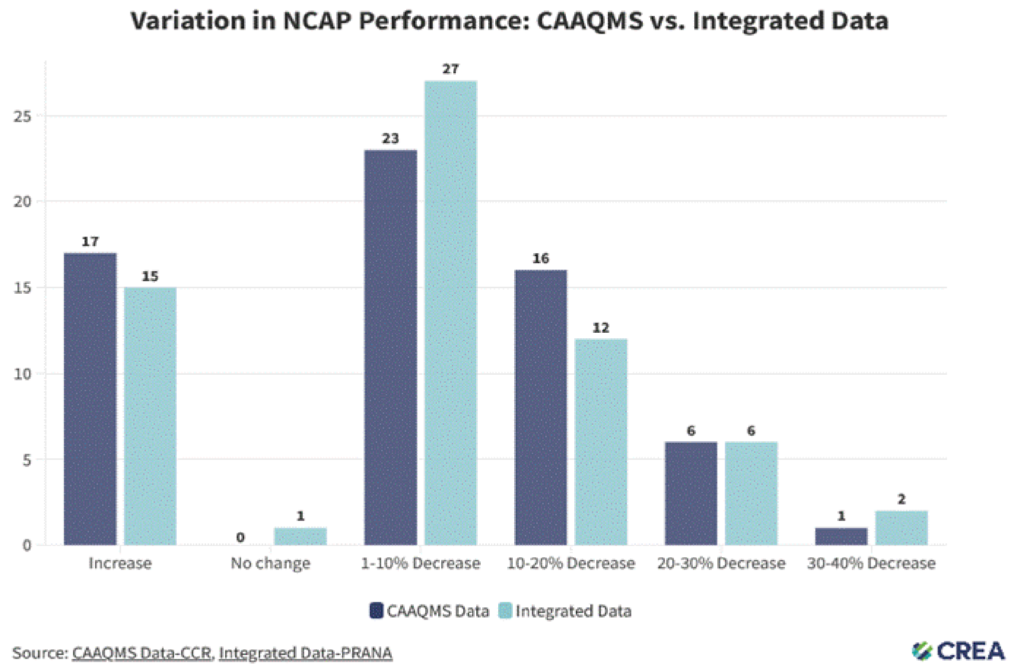

Figure 1. CAAQMS compared to integrated data: Variation in number of cities across different performance categories

For decreases, CAAQMS reported 23 cities with a 1-10% decrease, while integrated data indicated a slightly higher count of 27 cities in the same range. CAAQMS identified 16 cities with a 10-20% decrease, compared to 12 cities in the integrated data. Both data sources reported six cities with a 20-30% decrease. Additionally, CAAQMS recorded one city with a 30-40% decrease, while integrated data showed two cities in that category. See Figure 1.

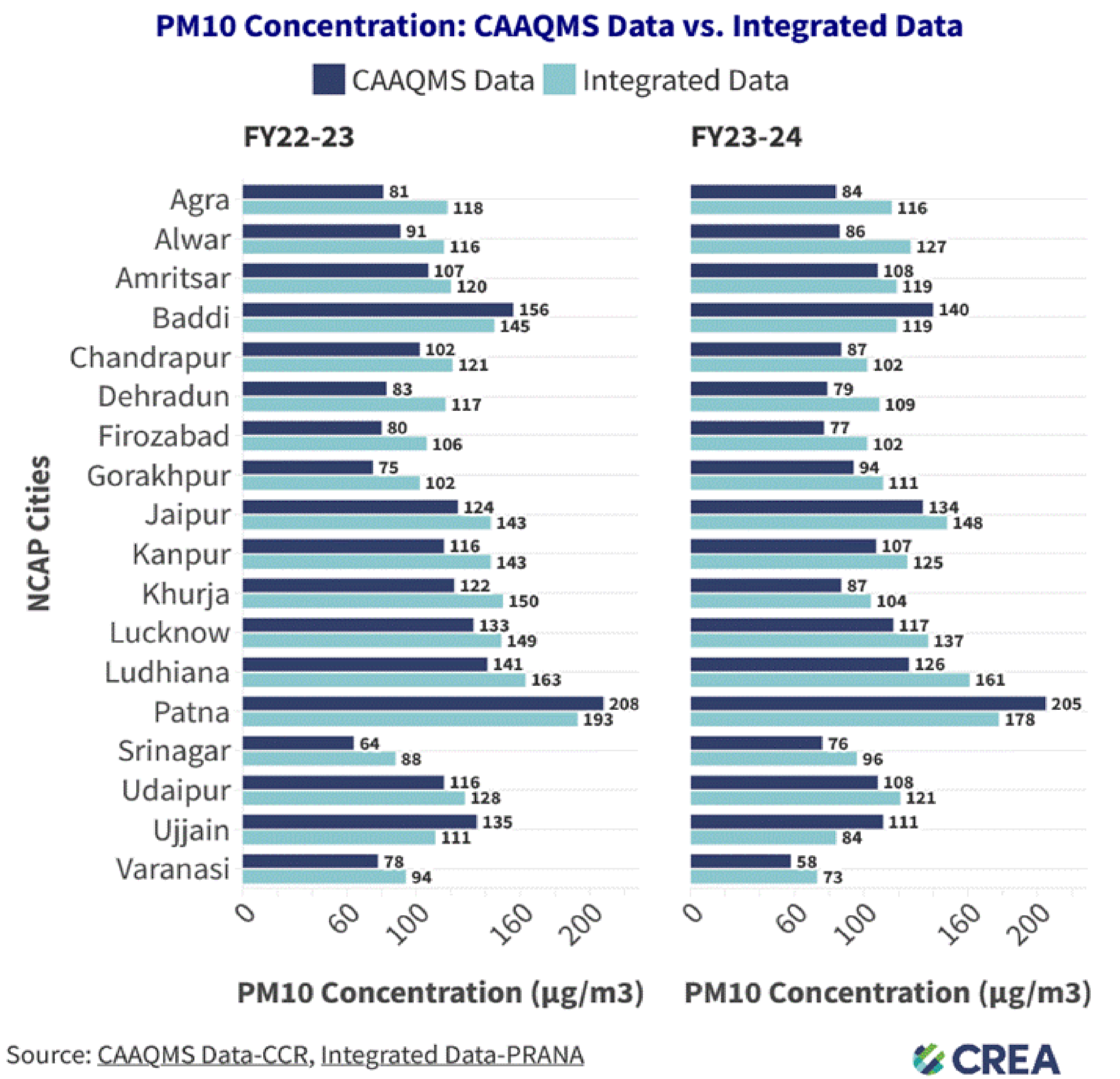

Figure 2. Variations in PM10 concentration between CAAQMS and integrated data in the last two fiscal years

Note: Only cities with a difference of 10 µg/m^3 or more are shown here.

CAAQMS data and integrated data: Understanding the methodologies

While CAAQMS data and integrated data present differing narratives of air quality, the disparities highlight the importance of understanding the methodologies behind each data source. One of the primary concerns with NAMP monitoring is the variability in sample periods across different cities.

The limited number of observations (104 per year) also makes it difficult to form a comprehensive understanding of the air quality trends, especially in comparison to the 365-day continuous monitoring provided by CAAQMS. The lack of uniformity in the data sample can lead to errors in pollution assessments and ultimately influence policy decisions based on incomplete or misleading information.

While it is acknowledged that these systems use entirely different techniques for measuring PM10, large variations raise critical questions about the accuracy of the data. Is the CAAQMS method underestimating the pollution levels, or is the manual method overestimating them? The inconsistency between these two measurements casts doubts on the reliability of the data, complicating efforts to accurately assess and respond to air quality concerns.

While manual PM10 data lacks the precision of continuous monitoring, it remains a vital tool for tracking air quality, especially in cities where CAAQMS are not yet available. Notably, 30 cities under the NCAP currently lack CAAQMS. This highlights the need for an increased number of monitoring days in these cities to capture seasonal patterns and better understand how pollution levels fluctuate throughout the year. Enhanced monitoring frequency would ensure more comprehensive data, particularly during critical periods like winter, when air quality can change dramatically.

Manual data collection, though less continuous, offers several advantages. It has historically played a key role in assessing preliminary pollution levels, providing an important baseline before transitioning to CAAQMS. Manual monitoring can offer practical insights in areas where installing continuous stations may not yet be feasible, and it can serve as a complementary source of data. Moreover, manual data, often overseen by trained professionals, tends to be quality-assured and can offer validation points for automated systems. It helps maintain continuity in air quality assessments, especially in regions where automated infrastructure is still developing.

However, increasing the use of automated systems like CAAQMS is crucial, as these systems allow for real-time, continuous monitoring, giving authorities the ability to respond more quickly to pollution spikes. This real-time data is invaluable for air quality management and public health protection. Yet, it is important to emphasize that both manual and automated monitoring have their place in an effective air quality management strategy.

Most critically, PM10, as a key indicator of particulate pollution, must be consistently monitored and never overlooked. PM10 has serious health impacts, particularly related to respiratory and cardiovascular diseases, making it an essential metric for understanding overall air quality. By ensuring both manual and continuous monitoring of PM10, we can build a more accurate and responsive system for tackling air pollution and protecting public health.

Both systems for measuring PM10 should be used independently but in a complementary manner. CAAQMS can provide real-time alerts and track short-term variations, while manual monitoring offers a broader, long-term perspective. By keeping these data sets separate and interpreting them within their respective contexts, we can ensure more accurate assessments and better-informed decisions.

The way forward

The assessment of PM10 concentration levels across cities monitored by the CAAQMS within the NCAP reveals a complex landscape of air quality management in India. Despite a notable increase in the number of monitored cities from 16 in FY17-18 to 93 in FY23-24, the persistent surpassing of the NAAQS in a significant proportion of these cities highlights ongoing challenges in achieving cleaner air. The fluctuations in cities exceeding 2x and 3x the NAAQS further emphasises the need for regional action and targeted interventions to address severe air pollution.

The current system of air quality monitoring, with reliance on both CAAQMS and NAMP, presents challenges in terms of data accuracy and consistency. CAAQMS, with its real-time, continuous monitoring, provides reliable and comprehensive data, making it the preferred system for air quality assessments. On the other hand, NAMP's intermittent data collection introduces significant gaps and inconsistencies, particularly when combined with continuous data from CAAQMS.

To ensure accuracy, it is essential to report data from CAAQMS and NAMP separately, as integrating manual and continuous data has led to inaccuracies in air quality reports, potentially impacting public health advisories and policy decisions. Expanding the use of CAAQMS to more cities and increasing the sampling days of manual monitoring would improve the accuracy of air quality assessments.

-End-

About CREA

The Centre for Research on Energy and Clean Air (CREA) is an independent research organisation focused on revealing the trends, causes, and health impacts, as well as the solutions, to air pollution. CREA was founded in December 2019 in Helsinki and has staff in several Asian and European countries. The organisation's work is funded through philanthropic grants and revenue from commissioned research. www.energyandcleanair.org.