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Five years of the National Clean Air Programme

January 2024

1. Executive summary

The National Clean Air Programme (NCAP), launched in 2019 by the union government to combat air pollution in 131 non-attainment cities, has reached its initial five-year deadline. It has made air quality an important issue with good, consistent efforts, but challenges remain in achieving targets that have been set. The programme's initial target was to reduce PM_{10} and $PM_{2.5}$ (ultra-fine particulate matter) by 20-30% by 2024. The programme has received a substantial financial commitment of ₹9631.23 crores from the government to support its objectives. A positive development is the revision of the programme's initial target to a 40% reduction in particulate matter concentration by 2026, which demonstrates a commitment to more ambitious environmental goals.

A five-year status check of the NCAP's progress reveals a mixed scenario. For 49 cities, $PM_{2.5}$ data was available for all five years. Out of these, 27 cities recorded improvements in $PM_{2.5}$ levels from 2019 to 2023. Similarly, for $PM_{10,}$ data across five years was available for 46 cities. Of these, 24 cities saw an improvement in their PM_{10} levels.

An analysis of data from the continuous air quality monitors installed by the CPCB in various non-attainment cities shows that, between 2019 and 2023, Varanasi achieved a significant reduction in $PM_{2.5}$ and PM_{10} levels. Additionally, Agra and Jodhpur saw significantly lower $PM_{2.5}$ levels, and

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Talcher saw a considerable PM_{10} reduction. However, challenges persist, with certain cities experiencing increases in pollution concentrations. (For details, see sub-sections 3, I to 3, VI below.)

The dispersion of pollutants over a city is influenced by several factors, including its geographical location, diverse sources of particulate matter emissions, and meteorological conditions. Notably, the government has installed a number of new air quality monitoring stations in many of the NCAP cities, which is a positive development indeed. That said, an average of data from two monitors in crowded locations of a city can provide a different picture of air quality compared to an average of, say, data from five stations spread across the city.

While progress has been made, the report highlights that air pollution levels in most cities exceed national standards and international guidelines, emphasizing the ongoing challenges in achieving globally recognized air quality benchmarks. The least polluted cities still surpass the World Health Organization's safe limits, underscoring the need for more stringent regulatory frameworks. The findings highlight the positive strides made under the NCAP while emphasizing the need for continued efforts to attain cleaner air across the nation.

2. About the National Clean Air Programme

The Union Government launched the National Clean Air Program (NCAP) on January 10, 2019, to address air pollution in 102 cities. Subsequently, some cities were added to this list, and others were dropped. There are now 131 cities, which are called non-attainment cities as they did not meet the National Ambient Air Quality Standards (NAAQS), for the period of 2011-15, under the National Air Quality Monitoring Program (NAMP). The country's current annual average safe limits for $PM_{2.5}$ and PM_{10} are 40 micrograms/per cubic metre (ug/m^3) and 60 ug/m^3, respectively.

The NCAP's initial target was to reduce two key air pollutants, PM_{10} and $PM_{2.5}$ (ultra-fine particulate matter), by 20-30% by 2024, with 2017 levels as the base. In September 2022, the Centre revised this to a 40% reduction by 2026. To meet this target, approximately ₹ 9649.99 crores have been released to the non-attainment cities under NCAP and the Fifteenth Finance Commission.

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3. Progress at the five-year mark

I. Methodology

For the purpose of this analysis, $PM_{2.5}$ and PM_{10} data for 131 non-attainment cities was sourced from the Central Pollution Control Board's (CPCB's) Continuous Ambient Air Quality Monitoring Stations (CAAQMS) network. An uptime filter of 50% was applied to the data from all monitoring stations for the year 2023. Only those monitors with pollution data available for at least half of the year, or six months, were considered in this analysis.

The 50% uptime filter was applied to the 2023 data so that comparisons can be made between cities as monitoring stations across the country record data for varying periods of time. The uptime filter also ensures that the data has a common variable – uptime – and as such, the data is more representative of the period of a year than if no filter was applied to the data. After applying the 50% uptime filter, data from all the monitoring stations in a city was averaged to get the annual average city levels.

Of the 131 non-attainment cities, there are CAAQMS in 99 cities. The remaining 32 cities have manual monitors, which are part of the National Ambient Air Quality Monitoring Programme (NAMP). Of the 99 cities under the CAAQMS network, there was data in 2023 for all 99 NACs on the CPCB portal. Of these 99 cities, 92 had $PM_{2.5}$ data with an uptime of 50%, and 93 cities had PM_{10} data with an uptime of 50%. The 2023 averages for $PM_{2.5}$ and PM_{10} for all the cities can be found in the annexures here. Data until December 31, 2023, has been used in this analysis.

II. Trends in ambient air quality from CAAQMS

The study examines the annual concentrations of $PM_{2.5}$ and PM_{10} in non-attainment cities from 2019 to 2023 from the Continuous Ambient Air Quality Monitoring System (CAAQMS) data. In terms of reduction, Varanasi exhibits the most significant decrease in $PM_{2.5}$ and PM_{10} levels. It shows a 72% reduction in $PM_{2.5}$ (from 96 ug/m^3 to 26.9 ug/m^3) and a 69% reduction in PM_{10} (from 202.5 ug/m^3 to 62.4 ug/m^3), already ahead of its 2026 targets of a 40% reduction for both pollutants. During the five-year period, the city saw the number of active monitors increase to four in 2023, with an uptime of almost 100%, as compared to just one active monitor in 2019, with an uptime of just over 24%.

Agra was next with a 53% reduction in $PM_{2.5,}$ (from 73 ug/m^3 to 33.7 ug/m^3), followed by Jodhpur with a 50% decrease (from 81.8 ug/m^3 to 40.6 ug/m^3). Agra and Jodhpur saw an increase in both the number of active monitors and their uptime from 2019 to 2023. With respect to $PM_{10,}$ Talcher, Odisha, shows a reduction of 39% (177.1 ug/m^3 to 106.9 ug/m^3), followed by Kalaburagi, which saw

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its PM_{10} reduce by 32% (91.2 ug/m^3 to 61.7 ug/m^3). Talcher had one active monitor over the five years but improved its uptime marginally, while Kalaburagi, which increased its active monitors to two in 2022, also showed an increase in uptime from 43% to 73% during this period.

Among other cities that registered a more than 40% reduction in the $PM_{2.5}$ levels (as compared to 2019) were Jodhpur (50%), Kanpur (50%), Meerut (42%), and Lucknow (41%). Except for Jodhpur, all cities that have already achieved the 2026 reduction targets are from Uttar Pradesh. With respect to PM_{10} levels, apart from Varanasi and Talcher, no other cities have met the 40% reduction target yet.

Conversely, the cities experiencing the greatest increase in $PM_{2.5}$ from 2019 to 2023 include Navi Mumbai (46%), Ujjain (46%) and Mumbai (38%). Over the five years, Navi Mumbai's $PM_{2.5}$ went up from 38.8 ug/m^3 to 56.9 ug/m^3. Ujjain's $PM_{2.5}$ increased from 43.7 ug/m^3 to 64 ug/m^3, and Mumbai's levels went up from 35.8 ug/m^3 to 49.5 ug/m^3. The number of active monitors in Mumbai went up from nine in 2019, with an uptime of just 21%, to 22 in 2023, with an uptime of 83%. Navi Mumbai also saw an increase in active monitors and uptime, but Ujjain continued to have only one monitor with nearly 100% uptime.

Similarly, for PM_{10}, Durgapur, Thane, and Mumbai show an increase of 53%, 46% and 36%, respectively. The number of active monitors in Durgapur did not increase during the period, but the city's only active monitor improved its uptime from 59% in 2019 to 98% in 2023. Thane's active monitors increased to two in 2023, but uptime improved only marginally over the five years. Mumbai's uptime for PM_{10} went up from 20% for nine active monitors in 2019 to 84% for 23 monitors.

Please see the annexure for details of monitors and uptime for all cities.

The observed reductions in PM levels across cities can be attributed to various factors, including a city's location, diverse sources of particulate matter emissions, and meteorological conditions. Furthermore, the longer particulate matter resides in the atmosphere, the more it contributes to the levels of PM in those areas.

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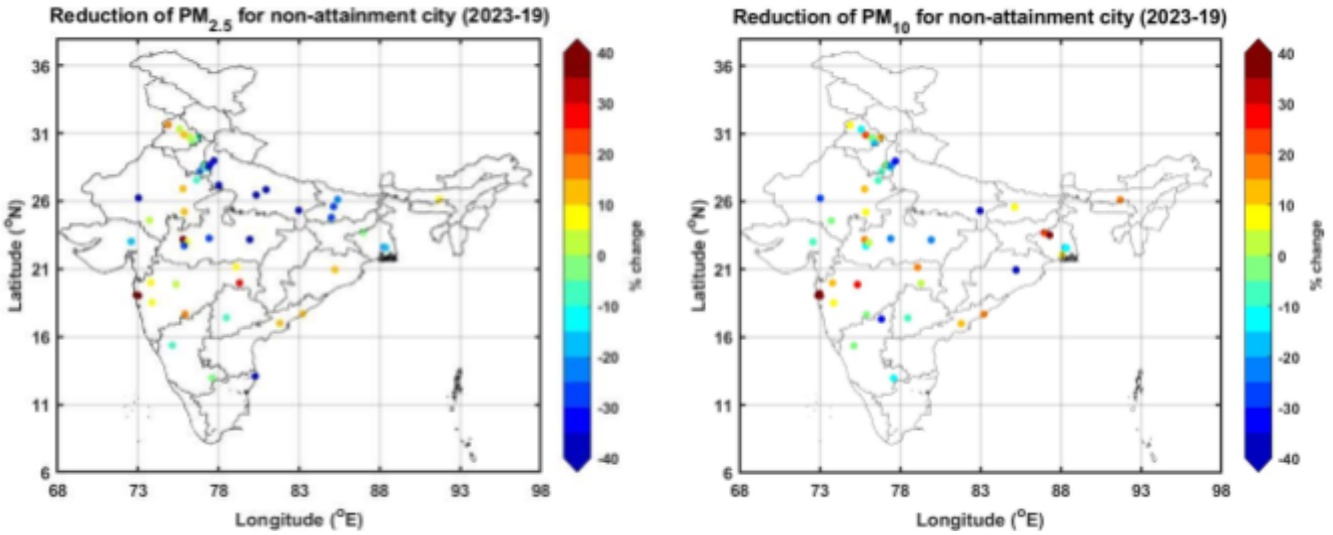
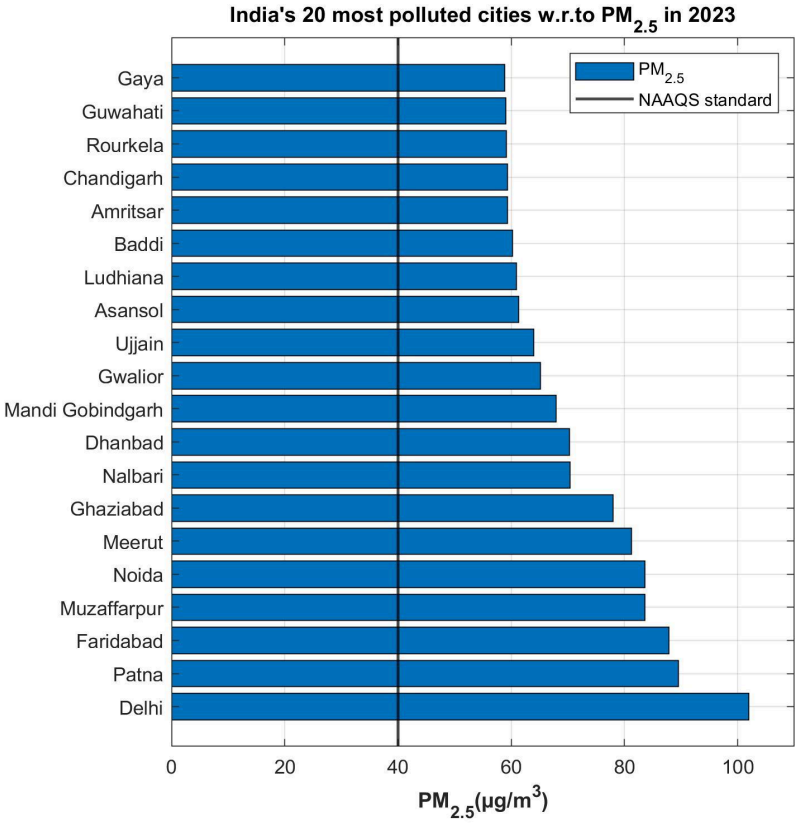


Figure 1.1. *$PM_{2.5}$ and PM_{10} percentage change in 2023 w.r.t. 2019.*

III. Most polluted non-attainment cities



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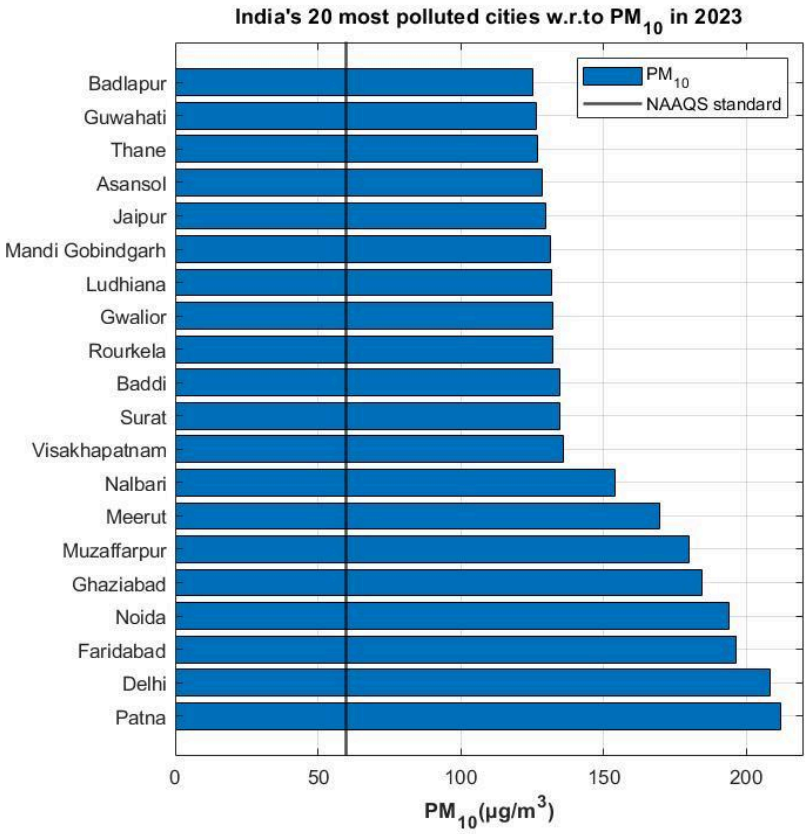

Figure 1.2. *Most polluted cities in 2023 for $PM_{2.5}$ (top panel) and PM_{10} (bottom panel).*

In 2023, Delhi recorded the highest $PM_{2.5}$ levels of 102 µg/m³, an increase of 2.5% compared to 2022. Delhi's $PM_{2.5}$ levels in 2023 are a marginal improvement of 5.9% from its levels in 2019. Patna exhibited the highest PM_{10} levels in 2023 at 212.1 µg/m³, up from 191.6 µg/m³ in 2022. The city has seen 5.8% deterioration in its PM_{10} levels from 2019.

In the assessment of air quality between 2019 and 2023, focusing specifically on $PM_{2.5}$ and PM_{10} levels, distinct patterns emerge, illuminating the environmental dynamics within and beyond the Indo-Gangetic Plain (IGP). Notably, 18 of the top 20 cities with the highest $PM_{2.5}$ levels in 2023 are clustered in the IGP, underscoring the region's vulnerability to heightened particulate matter concentrations. Conversely, only Guwahati and Rourkela, outside the IGP, secured positions among the 20 most polluted cities for $PM_{2.5}$. Similarly, for PM_{10}, 14 of the top 20 cities in 2023 are in the IGP, with Surat, Visakhapatnam, Rourkela, Thane, Guwahati and Badlapur standing out as non-IGP representatives.

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IV. Least polluted non-attainment cities

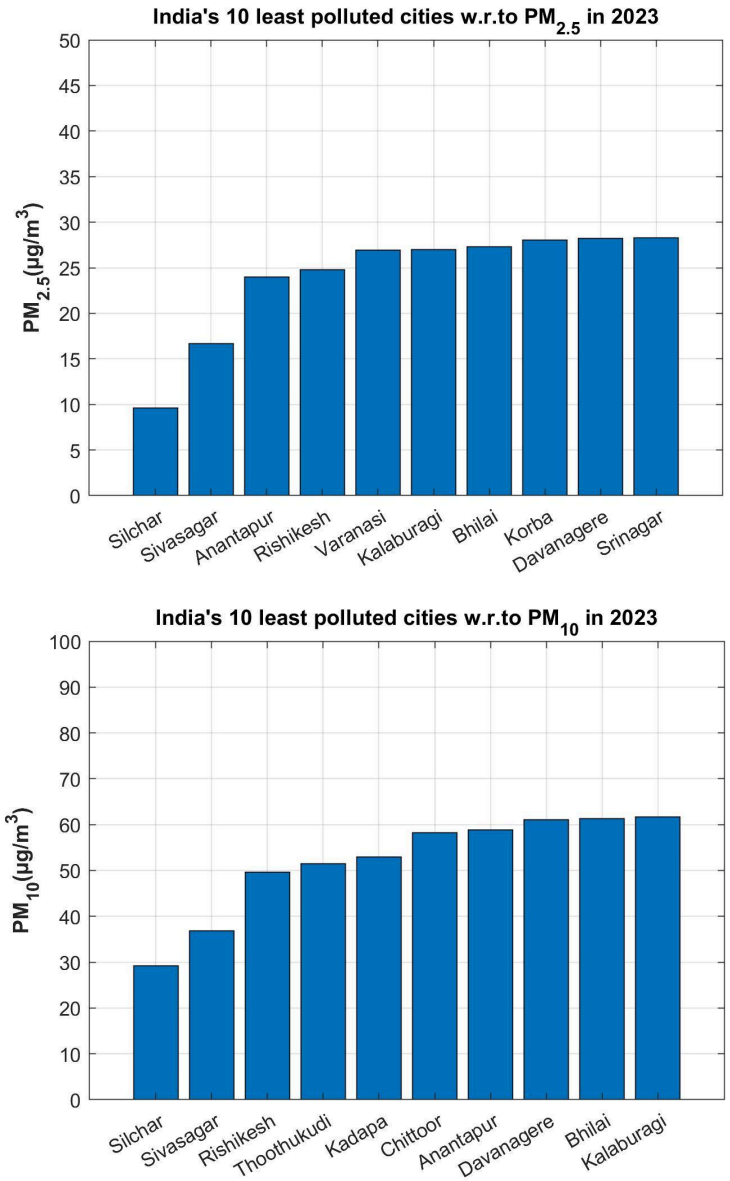

Figure 1.3. *Least polluted cities in 2023 for $PM_{2.5}$ (top panel) and PM_{10} (bottom panel).*

Even though all the least polluted cities in 2023 registered $PM_{2.5}$ levels within the 'good' category (0-30 µg/m³) or met the Central Pollution Control Board's (CPCB's) annual average safe limit of 30 µg/m³, a concerning observation emerges when their levels are compared to the World Health Organization's (WHO's) annual average safe limit of 5 µg/m³. All cities surpass the WHO threshold, highlighting the ongoing challenges in achieving internationally recognized air quality standards.

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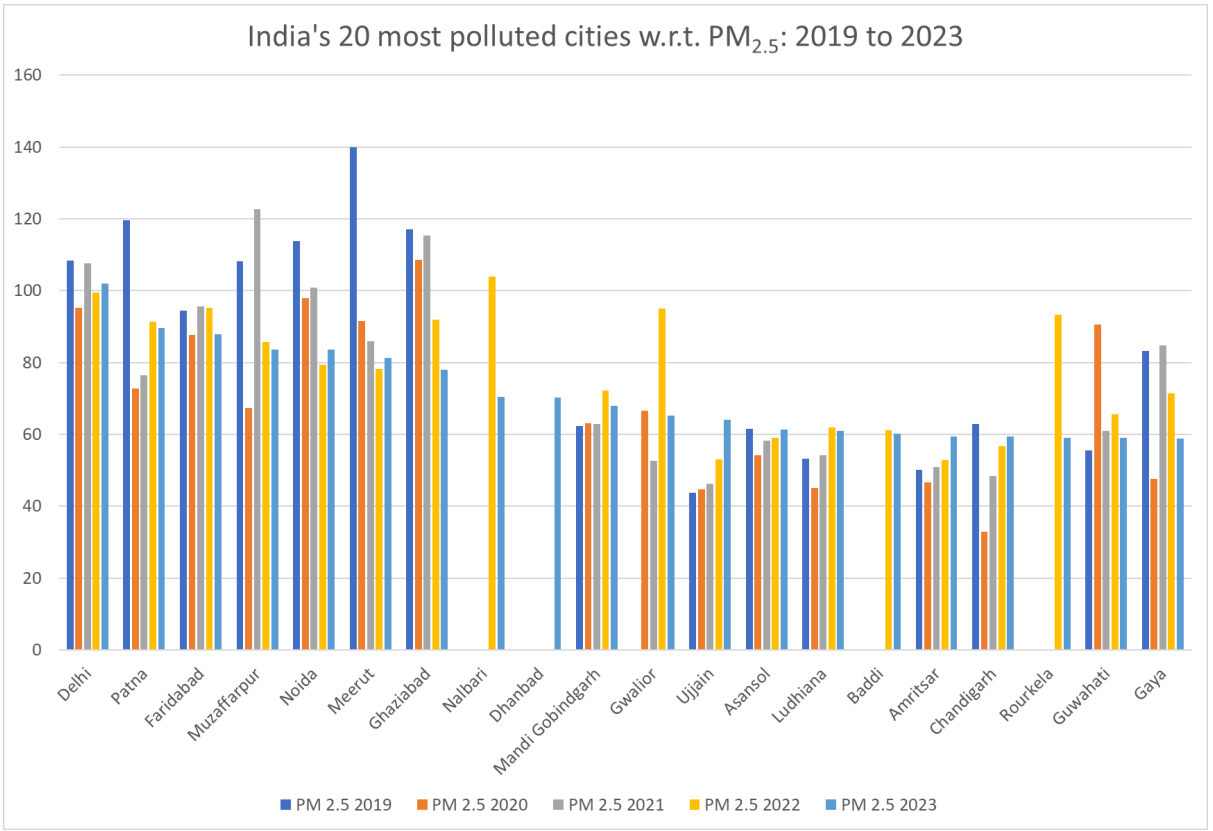
Silchar, Assam, records the lowest $PM_{2.5}$ level in 2023 at 9.6 µg/m³. However, it remains noteworthy that this seemingly low level is nearly double the WHO's stipulated safe limit of 5 µg/m³. Silchar also recorded the lowest PM_{10} level at 29.2 µg/m³; however, this seemingly moderate value is nearly double the WHO safe limit of 15 µg/m³. This underscores the critical need for more stringent air quality targets and enhanced mitigation measures to safeguard public health.

In a positive development, six of the eight least polluted cities saw improvements in $PM_{2.5}$ levels between 2022 and 2023, whereas, for PM_{10}, four out of seven cities saw improvements over the same period.

V. Trends in the Most and Least Polluted Cities: 2019-2023

Examining changes from 2019 to 2023, air quality improvements in $PM_{2.5}$ were observed in 10 out of 15 cities, including Delhi and Patna, the most polluted cities in 2023. Contrarily, Ujjain and Amritsar experienced a deterioration of 46.5% and 18.4%, respectively. As far as PM_{10} was concerned, a total of 14 out of 19 cities saw improvements, including Delhi, Noida, Ghaziabad, and Meerut, while cities that saw a deterioration included Patna, Muzaffarpur and Jaipur.



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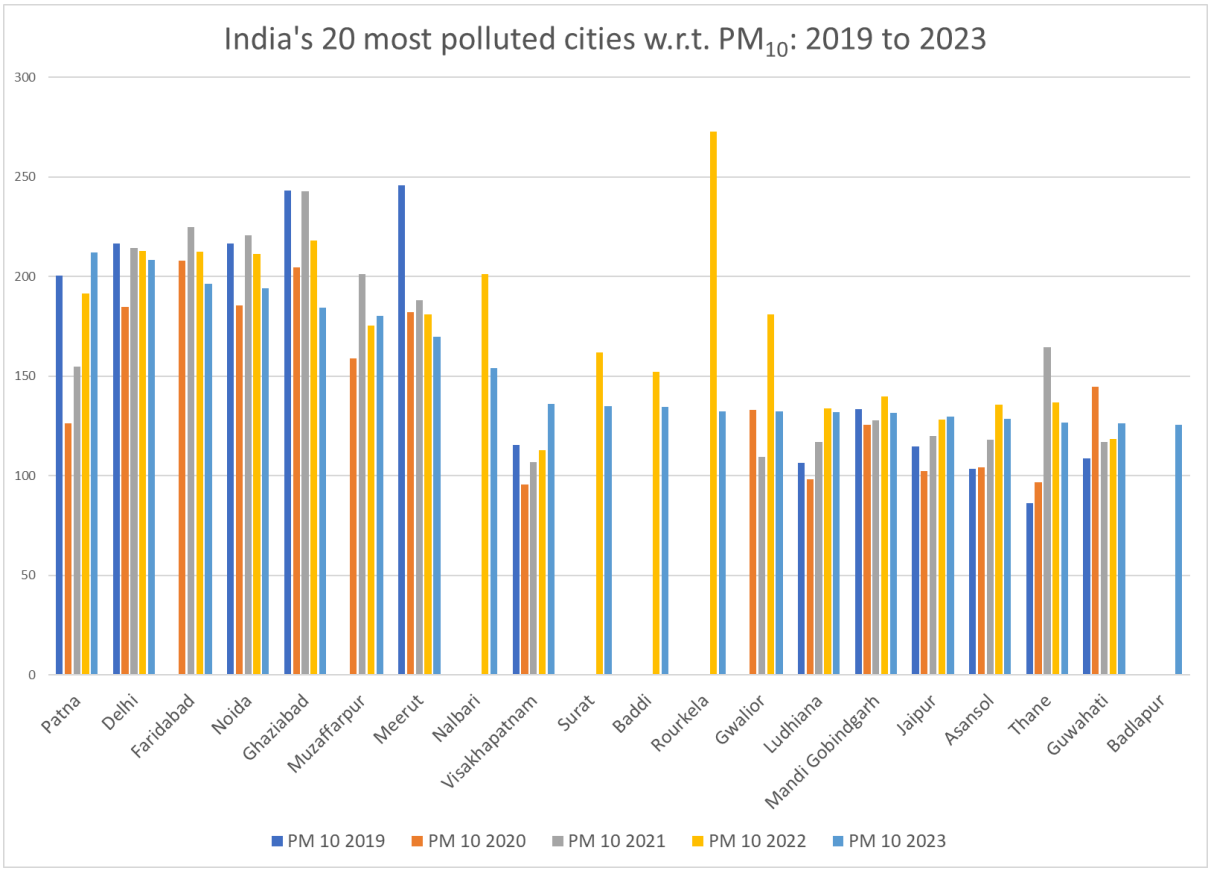

Figure 1.4. *Five-year air quality trends in 2023's most polluted cities - $PM_{2.5}$ (top panel) and PM_{10} (bottom panel).*

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VI. Air quality trends in some capital cities

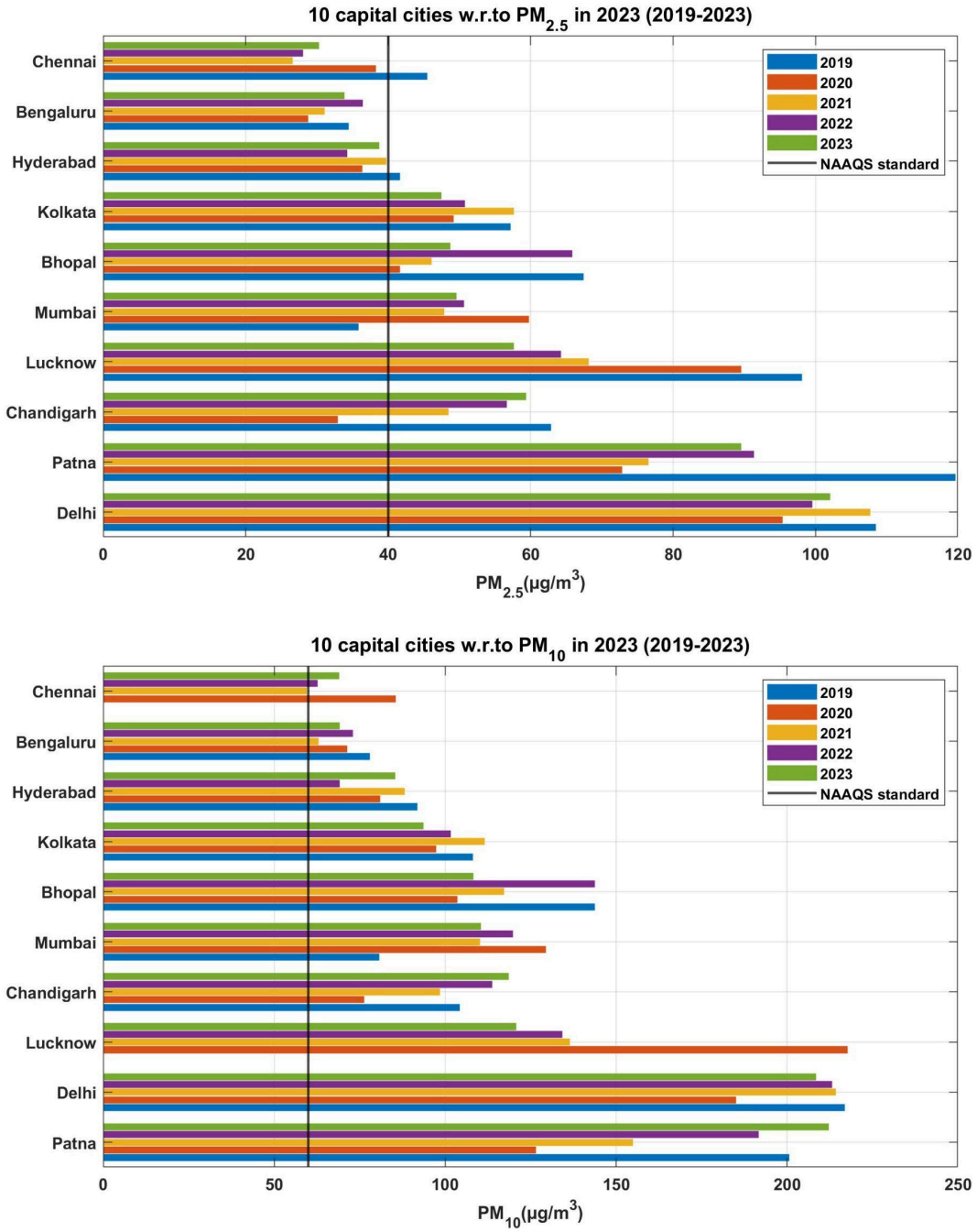

Figure 1.5. *Five-year air quality trends in some capital cities - $PM_{2.5}$ (top panel) and PM_{10} (bottom panel).*

For the report, we also analysed air quality trends in the state capital cities of Patna, Delhi, Lucknow, Chandigarh, Mumbai, Bhopal, Kolkata, Hyderabad, Bengaluru and Chennai. Delhi,

equipped with the highest number of government air quality monitoring stations (37) among Indian cities, witnessed a modest 5.9% decline in $PM_{2.5}$ levels from 2019 to 2023. Reductions in $PM_{2.5}$ levels were observed in other cities like Bengaluru (2%), Hyderabad (7%), Kolkata (16.9%), Patna (25.2%), Chennai (33.4%) and Lucknow (41.2%). Lucknow exhibited a consistent year-on-year decline. Conversely, Mumbai experienced an increase of 38% in $PM_{2.5}$ levels, coinciding with a notable expansion in active monitoring stations, from 9 in 2019 to 22 in 2023. For more details, please refer to the annexure here.

4. Funds and their Use in Non-attainment Cities

In the five years from 2019 to 2023, the union government has disbursed over ₹ 9649.99 crores to the non-attainment cities through the NCAP programme and the Fifteenth Finance Commission. Urban local bodies are the implementing agencies for NCAP, and they are responsible for spending the funds disbursed to them for clean air action plans. These plans outline the work that the cities are required to undertake in the short, medium and long term.

Of the total funds released to the cities, ₹ 5835.03 crores, a little over 60% have been utilised by the urban local bodies. However, some cities have spent more than the others. For instance, Thane has spent ₹ 41.49 crores despite not receiving any funds from the programme. Six other cities – Ulhasnagar, Bhubaneswar, Angul, Navi Mumbai, Howrah and Chennai – have spent more money to clean up their air than has been allotted. On the other hand, cities like Visakhapatnam and Nashik have spent none of the funds disbursed to them.

The disbursement and spending details for all non-attainment cities, along with the change in air quality levels, are available here.

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5. Key Conclusions

The analysis of the air quality in Indian cities based on data from monitors in the CAAQMS network revealed several important features.

1. Air pollution levels are higher than the National Ambient Air Quality Standards (NAAQS) of 40 µg/m³ and 60 µg/m³ for $PM_{2.5}$ and $PM_{10,}$ respectively in most cities.

2. $PM_{2.5}$ and PM_{10} levels are higher than the World Health Organization's air quality guidelines for both pollutants in all cities where on-ground monitoring is being done through the CAAQMS network.

3. As cities added CAAQMS in different years, continuous data is not available for all five years (2019-2023). With such data gaps, it is difficult to do a robust trend analysis. Although the non-attainment cities are expanding their air quality monitoring networks, the current density may not yet provide a truly representative picture of a city's air quality.

4. The variations in $PM_{2.5}$ and PM_{10} observed in the CAAQMS data can also be partly attributed to the geographical locations of the cities analysed, the diverse sources of emissions and meteorological influences, among other factors. The contribution of these factors, particularly the influence of emissions versus meteorology, requires further study.

Information contained in the report can be found in the tables document here.
Additional information about all NCAP cities can be found in the annexure here.

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About Climate Trends

Climate Trends is a research-based consulting and capacity building initiative that aims to bring greater focus on issues of environment, climate change and sustainable development. We specialise in developing comprehensive analyses of complex issues to enable effective decision making in the private and public sectors.

About Respirer Living Sciences

Respirer Living Sciences, Pune, is a pioneer in Make-in-India emissions monitoring and reporting technologies. Between 2017 and 2023, its deployed air quality monitors went from ~150 to over 2,500. It has partnered with prominent institutions like the IITs, governments, think tanks, corporates and civil society organisations in India and abroad. Respirer's emission monitors are low-cost, its solutions high-tech, AI-driven. They measure both greenhouse gases as well as the most prominent air pollutants – $PM_{2.5}$ (fine particulate matter), nitrogen dioxide, ozone, carbon monoxide, volatile organic compounds, carbon dioxide and methane.