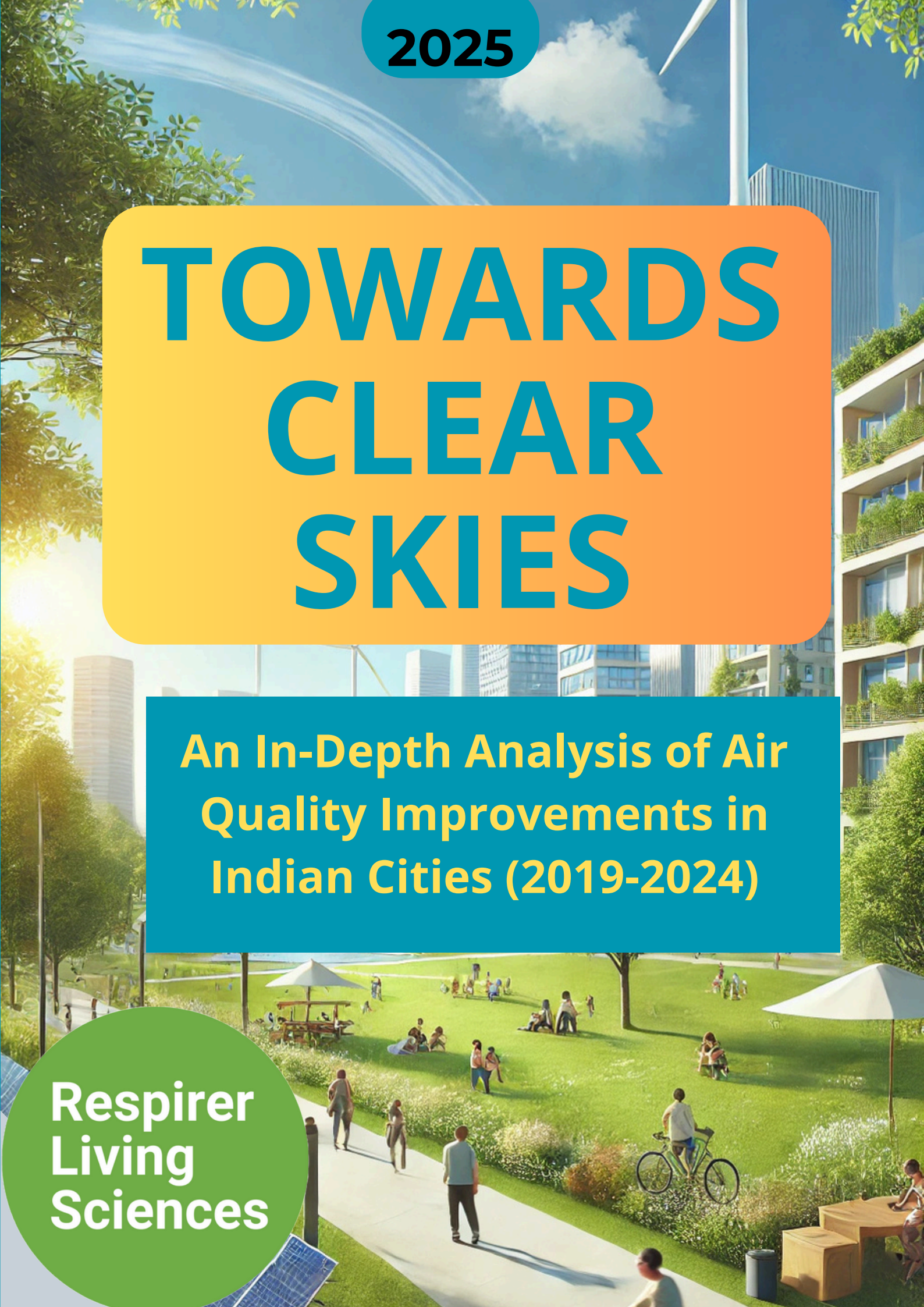
2025

TOWARDS CLEAR SKIES

An In-Depth Analysis of Air Quality Improvements in Indian Cities (2019-2024)



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Executive Summary

This report by Respirer Living Sciences evaluates air quality improvements across 130 Indian cities from 2019 to 2024, focusing on 82 cities under the National Clean Air Programme (NCAP). Utilizing the AtlasAQ platform, the study highlights a 24.45% reduction in PM levels in NCAP cities and a 26.84% reduction nationwide, reflecting notable progress. Exceptional successes include Varanasi (-76.4%) and Moradabad (-58%), while cities like Delhi and Faridabad remain among the most polluted, underscoring persistent challenges.

The report provides insights into metropolitan regions: Delhi showed minor improvements despite significant policy efforts, Mumbai performed better but faces localized challenges, while Kolkata and Bengaluru achieved more consistent progress through enhanced public transport and emission controls. Regional disparities highlight the need for targeted strategies, with northern and central cities faring worse than southern counterparts.

Temporary air quality improvements during COVID-19 emphasized the impact of behavioral changes and policy. The NCAP, originally targeting a 20-30% reduction by 2024, revised its goal to 40% by 2026, necessitating sustained efforts. However, gaps in implementation, infrastructure, and governance pose barriers.

This report aims to guide policymakers, researchers, and advocates with detailed analyses of trends, challenges, and opportunities for sustainable air quality management.

Ronak Sutaria, CEO and Founder, Respirer Living Sciences

"The path to cleaner air requires more than technological fixes; it demands systemic changes in governance, public behavior, and infrastructure planning. This report captures both the strides made and the roadblocks ahead."

Introduction

TRANSFORMING INDIA'S AIR QUALITY: PROGRESS, CHALLENGES, AND THE PATH AHEAD.

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India has achieved progress in reducing particulate matter (PM) levels, with a **nationwide average reduction of 26.84% from 2019 to 2024**, but persistent challenges in heavily polluted cities such as Delhi and Faridabad highlight the need for more cohesive and localised strategies to accelerate this progress.

Air pollution is a critical public health and environmental issue in India, causing over a million premature deaths annually and significant economic losses. The National Clean Air Programme (NCAP), launched in 2019, targets a 40% reduction in PM levels by 2026 after revising its initial goal of 20-30% by 2024. Covering 131 cities, including 82 NCAP-designated ones, the program focuses on reducing particulate matter (PM10 and PM2.5) concentrations through multi-sectoral interventions.

This report by **Respirer Living Sciences** assesses air quality trends across 130 cities, leveraging the advanced **AtlasAQ platform** for real-time data integration. Key successes include significant reductions in cities like Varanasi and Moradabad, alongside ongoing challenges in cities such as Delhi and Faridabad. Regional disparities reveal northern and central cities lagging behind their southern counterparts, underscoring the need for targeted policies.

By presenting actionable insights into metropolitan regions, policy gaps, and emerging opportunities, this report serves as a resource for stakeholders committed to sustainable air quality improvement in India.

Methodology

This analysis integrates data from authoritative sources, including the Central Pollution Control Board (CPCB) and the AtlasAQ platform, to provide a comprehensive evaluation of air quality trends from 2019 to 2024. The CPCB's National Air Quality Monitoring Programme (NAMP) provided foundational datasets, while AtlasAQ, developed by Respirer Living Sciences, processed and visualized this data to identify granular trends and anomalies.

Colour Codes for PM2.5

AQI (US)	PM2.5 (µg/m3)	Remark	NAQI	PM2.5 (µg/m3)	Remark
0-50	0-12	Good	0-50	0-30	Good
51-100	12-35	Moderate	51-100	30-60	Satisfactory
101-150	35-55	Unhealthy for Sensitive Individuals	101-200	60-90	Moderate
151-200	55-150	Unhealthy			
201-300	150-250	Very Unhealthy	201-300	90-120	Poor
>300	>250	Hazardous	301-400	120-250	Very Poor
			401-500	>250	Severe

Key Aspects

The study encompasses 130 cities, including 82 NCAP cities, over six years from January 1, 2019, to December 31, 2024. Data was integrated into the AtlasAQ platform, ensuring consistency and addressing gaps through statistical validation methods.

Trends in PM10 and PM2.5 concentrations were analyzed to evaluate year-over-year improvements, with additional focus on city rankings and specific metropolitan challenges. The methodology also accounts for temporary anomalies, such as the impact of COVID-19 lockdowns.

The methodology ensures an accurate and actionable evaluation of India's air quality trends by combining rigorous data collection, advanced analytics, and contextual insights.

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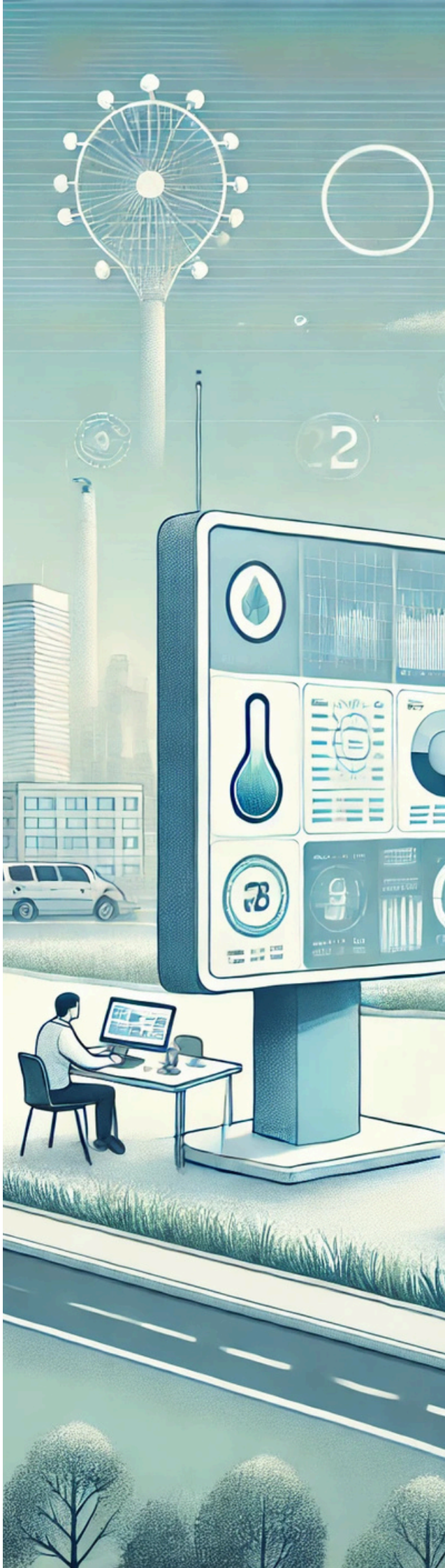

Top 10 Most Polluted Cities in 2024

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In 2024, air pollution remained a pressing challenge in several Indian cities, with PM2.5 levels indicating hazardous conditions in various regions. The cities listed below represent the top 10 most polluted urban centers in the country, highlighting the regions that require urgent interventions to combat deteriorating air quality. These cities, spanning northern, central, and eastern India, are predominantly affected by a combination of industrial activity, vehicular emissions, and poor regulatory enforcement.

Despite nationwide improvements in air quality, the data for 2024 reveals that some cities, like Byrnihat, Assam, and Delhi, continue to face alarmingly high PM2.5 levels, making them hotspots for pollution management. Addressing the challenges in these cities will necessitate targeted efforts, including stricter enforcement of pollution control norms, cleaner technologies, and enhanced public awareness.

Rank (2024)	City	State	PM2.5 (µg/m³) in 2024
1	**Byrnihat**	Assam	127.3
2	**Delhi**	Delhi	107.0
3	**Gurugram**	Haryana	96.7
4	**Faridabad**	Haryana	87.1
5	**Sri Ganganagar**	Rajasthan	85.5
6	**Greater Noida**	Uttar Pradesh	83.9
7	**Muzaffarnagar**	Uttar Pradesh	83.2
8	**Durgapur**	West Bengal	82.0
9	**Asansol**	West Bengal	80.3
10	**Ghaziabad**	Uttar Pradesh	79.9

This ranking serves as a crucial indicator for policymakers and environmentalists to focus their efforts on these cities. Targeted interventions, such as controlling industrial emissions, improving public transport, and strengthening air quality monitoring, are vital to bring these cities into compliance with national air quality standards.

NCAP Analysis (2019-2024)

Between 2019 and 2024, air quality monitoring data was analyzed for 130 cities across India, of which 82 cities were part of the National Clean Air Programme (NCAP). While the NCAP officially targets 131 cities, some cities were excluded from this analysis due to the absence or inadequacy of air quality monitoring stations. **NCAP cities demonstrated a 24.45% improvement in average particulate matter (PM) levels, with reductions from 62.57 µg/m³ in 2019 to 47.27 µg/m³ in 2024**.

In comparison, the average PM levels across all monitored cities in India dropped by 26.84%, from 60.87 µg/m³ to 44.53 µg/m³ over the same period. This indicates substantial progress in mitigating air pollution nationwide, with NCAP cities showing targeted improvements due to focused interventions.

NCAP Targets for 2026

The NCAP, launched in 2019, initially aimed for a 20-30% reduction in PM concentrations by 2024 using 2017 as the baseline. However, recognizing the escalating air pollution crisis, the program revised its target in 2022 to a more ambitious 40% reduction by 2026. To achieve this, city-specific action plans have been implemented, including enhancing air quality monitoring networks, reducing industrial and vehicular emissions, promoting public transportation, and raising public awareness. Annual reduction targets ranging from 3% to 15% for PM10 levels have been outlined to align with the overall goal.

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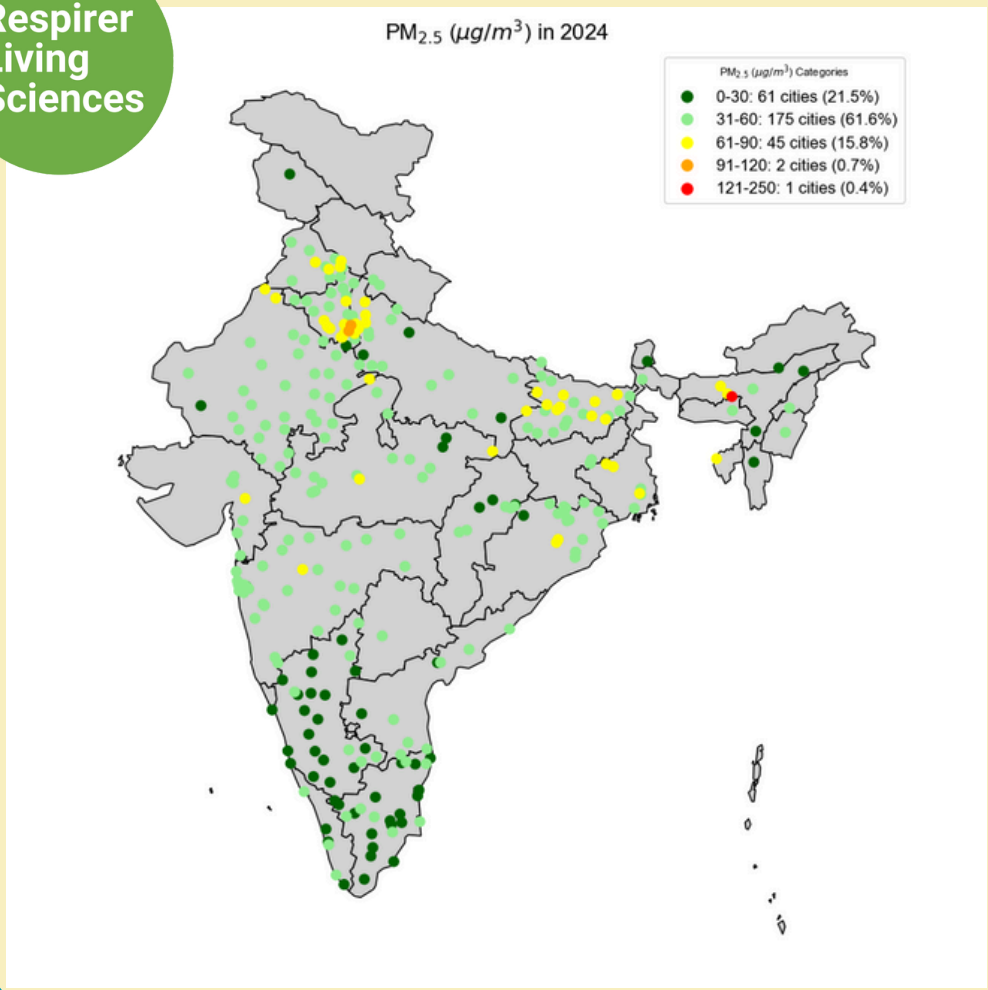

Drivers for Air Quality Improvement

A combination of policy initiatives, technological advancements, and societal shifts has driven improvements in air quality across Indian cities. Adopting BS-VI fuel standards, promoting electric vehicles under schemes like FAME-II, and stricter industrial emission regulations have significantly curbed pollution levels. Measures such as relocating polluting industries and installing advanced emission control systems have also reduced particulate matter emissions. The COVID-19 pandemic lockdowns provided a unique opportunity to observe reductions in pollution due to temporary decreases in industrial activities, vehicular traffic, and construction. These changes, although short-lived, underscored the substantial impact of reduced human activity on air quality. Public awareness campaigns have also played a pivotal role, encouraging the use of cleaner cooking fuels, increased tree planting, and the reduction of waste burning. However, achieving the ambitious 40% reduction target under NCAP by 2026 will require sustained commitment, enhanced technological adoption, and stronger coordination among stakeholders at both local and national levels.

Air Quality Trends: Top Performers and Challenging Cities

Air quality trends across Indian cities from 2019 to 2024 reveal a compelling narrative of progress and challenges. Cities such as Varanasi and Moradabad have emerged as standout performers, showcasing the impact of targeted interventions, while other cities like Aurangabad and Mandideep highlight areas where pollution levels have increased significantly. Below, we analyze two critical tables to understand the dynamics driving these changes.

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Table 1: Top 10 Cities with the Largest Reduction in PM Levels (2019-2024)

Cities like Varanasi (-76.4%), Moradabad (-58%), and Kalaburagi (-57.2%) lead the way in PM reduction, with significant declines attributed to a combination of policy-driven initiatives and localized actions. For instance, Varanasi's success stems from stricter vehicular emission controls and enhanced public transport systems.

City	State	NCAP City	Zone	Year_2019	Year_2024	% Change
Varanasi	Uttar Pradesh	Yes	Central	96.0	22.6	-76.4%
Palwal	Haryana	No	Northern	91.3	37.2	-59.3%
Moradabad	Uttar Pradesh	Yes	Central	99.7	41.8	-58.0%
Kalaburagi	Karnataka	Yes	Southern	47.1	20.1	-57.2%
Meerut	Uttar Pradesh	Yes	Central	139.9	60.1	-57.1%
Katni	Madhya Pradesh	No	Central	91.6	40.0	-56.3%
Agra	Uttar Pradesh	Yes	Central	73.0	33.5	-54.1%
Baghpat	Uttar Pradesh	No	Central	101.6	47.5	-53.3%
Kanpur	Uttar Pradesh	Yes	Central	96.2	47.0	-51.2%
Jodhpur	Rajasthan	Yes	Northern	81.8	40.5	-50.5%

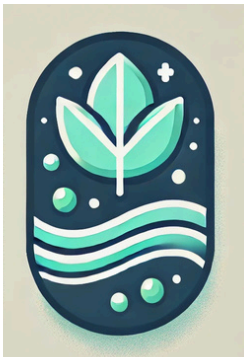

Table 2: Top 10 Cities with Increased Pollution Levels (2019-2024)

In contrast, cities like Aurangabad (52.3%), Mandideep (46.7%), and Tirupati (46%) witnessed notable increases in pollution levels. Rapid urbanization, unregulated industrial activities, and insufficient implementation of air quality measures contribute to these upward trends.

City	State	NCAP City	Zone	Year_2019	Year_2024	% Change
Aurangabad_M	Maharashtra	Yes	Western	39.9	60.8	52.3%
Mandideep	Madhya Pradesh	No	Central	41.4	60.7	46.7%
Tirupati	Andhra Pradesh	No	Southern	23.7	34.6	46.0%
Vijayawada	Andhra Pradesh	Yes	Southern	24.1	34.7	44.0%
Satna	Madhya Pradesh	No	Central	13.6	18.3	34.6%
Talcher	Odisha	Yes	Eastern	49.4	64.6	30.8%
Asansol	West Bengal	Yes	Eastern	61.5	80.3	30.6%
Panchkula	Haryana	No	Northern	44.8	58.4	30.3%
Gandhinagar	Gujarat	No	Western	35.5	46.1	29.9%
Bathinda	Punjab	No	Northern	32.9	41.8	27.1%

Challenging Trends: Cities with Rising Air Pollution (2023-2024)

From 2023 to 2024, **99 cities across India recorded an increase in pollution levels**, reflecting ongoing challenges in air quality management. Among these, **40 cities were NCAP-designated**, while the remaining **59 cities were non-NCAP cities.**

For NCAP cities, the **average percentage increase in pollution was 21.6%**, **slightly above the national average of 21.5%**. This indicates that while interventions under the NCAP have been effective for many cities, some continue to face barriers, such as industrial emissions, vehicular pollution, or ineffective implementation of clean air initiatives.

For non-NCAP cities, the **average percentage increase was consistent with the national trend of 21.5%**. Not being the primary focus of national-level air quality interventions, such cities often lack comprehensive plans to combat pollution, leaving them vulnerable to deteriorations in air quality due to unchecked urbanization and industrial activities.

Observations on rising pollution

- NCAP cities like Delhi and Faridabad struggled to curb increases, highlighting gaps in policy execution and enforcement.
- Non-NCAP cities such as Gurugram and Sri Ganganagar saw notable increases, suggesting a need for inclusion in broader pollution control measures.
- Factors contributing to increased pollution likely include a resurgence in industrial and construction activities post-pandemic, urban sprawl, and localized sources such as waste burning.

Improving Trends: Cities with Better Air Quality (2023-2024)

Conversely, **170 cities reported a reduction in pollution levels**, showcasing progress in air quality management efforts. Of these, **59 cities were NCAP-designated, while 111 cities were non-NCAP cities.**

For NCAP cities, the **average percentage decrease was 14.9%,** slightly lower than the national average of 15.7%. While this reflects overall progress, the marginally lower decrease indicates that more consistent implementation and monitoring are needed in these priority areas.

For non-NCAP cities, the **average percentage decrease was 16.1%,** slightly higher than the national trend. Cities like Varanasi and Moradabad achieved dramatic reductions, recording 76.4% and 58% decreases, respectively. These successes may be attributed to localized interventions, improved public infrastructure, and stricter enforcement of pollution controls.

Observations on decreasing pollution

- Success stories in NCAP cities, such as Varanasi, demonstrate the potential of targeted interventions, including enhanced monitoring and vehicular emission reductions.
- Non-NCAP cities achieving greater reductions, such as Aurangabad and Satna, underline the importance of decentralized efforts, even outside NCAP's formal framework.
- Improvements were also influenced by natural factors, including favorable meteorological conditions, and temporary reductions during COVID-19 lockdowns that still impacted long-term averages.

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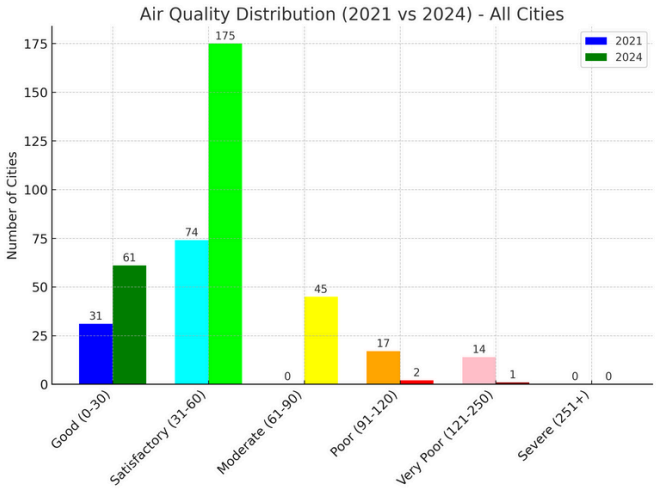
Category-wise Analysis Across Cities (2021-2024)

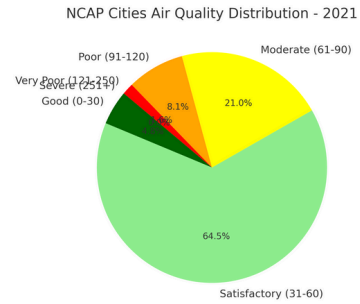
This section analyzes the distribution of cities based on their annual average PM2.5 concentrations across different pollution categories, as defined by the CPCB's AQI framework, from 2021 to 2024. The categories are: 0-30 (Good), 31-60 (Satisfactory), 61-90 (Moderate), 91-120 (Poor), 121-250 (Very Poor), and 251+ (Severe).

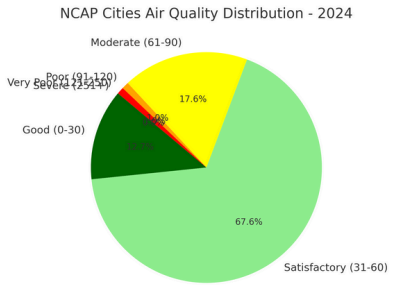
All Cities: Shifts Across Pollution Categories

Between 2021 and 2024, improvements were observed in the distribution of cities across various air quality categories. This shift reflects the impact of nationwide interventions aimed at reducing PM2.5 levels, including stricter industrial emission controls, vehicular regulations, and enhanced monitoring infrastructure. Cities saw a steady migration from higher pollution categories like "Poor" and "Very Poor" to better categories such as "Good" and "Satisfactory." This progress underscores the effectiveness of focused efforts, although continued vigilance is necessary to sustain these trends.



Category	2021	2024
Good (0-30)	31	61
Satisfactory (31-60)	74	175
Moderate (61-90)	0	45
Poor (91-120)	17	2
Very Poor (121-250)	14	1
Severe (251+)	0	0





NCAP Cities: Targeted Progress

NCAP cities demonstrated a more pronounced improvement in air quality compared to non-NCAP cities, reflecting the success of focused interventions under the National Clean Air Programme. By 2024, a significant number of cities transitioned to "Good" and "Satisfactory" categories, driven by localized initiatives, stricter enforcement of emission standards, and active community engagement. Despite these gains, the persistence of some cities in "Very Poor" categories highlights the need for sustained efforts to bridge gaps in implementation and monitoring.

Category	2021	2024
Good (0-30)	3	13
Satisfactory (31-60)	40	69
Moderate (61-90)	13	18
Poor (91-120)	5	1
Very Poor (121-250)	1	1
Severe (251+)	0	0

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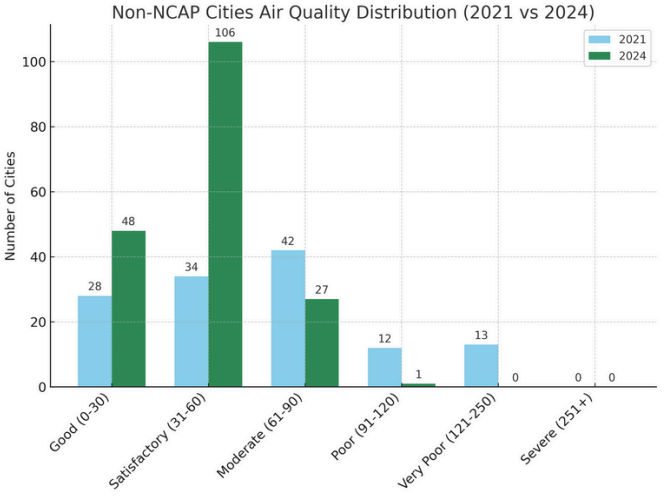
Category-wise Analysis Across Cities (2021-2024)

This section analyzes the distribution of cities based on their annual average PM2.5 concentrations across different pollution categories, as defined by the CPCB's AQI framework, from 2021 to 2024. The categories are: 0-30 (Good), 31-60 (Satisfactory), 61-90 (Moderate), 91-120 (Poor), 121-250 (Very Poor), and 251+ (Severe).

Non-NCAP Cities: Broader Trends in Improvement

While not directly under the program's ambit, non-NCAP cities also exhibited notable improvements, albeit at a slightly slower pace. The increase in cities falling within "Good" and "Satisfactory" categories suggests that broader regulatory measures and state-level policies have had a positive impact. However, challenges such as resource constraints and uneven policy implementation continue to affect the pace of improvement in these areas, underscoring the importance of extending targeted interventions beyond NCAP cities.



Category	2021	2024
Good (0-30)	28	48
Satisfactory (31-60)	34	106
Moderate (61-90)	42	27
Poor (91-120)	12	1
Very Poor (121-250)	13	0
Severe (251+)	0	0

Key Insights

- **National Progress:** The number of cities in the "Good" and "Satisfactory" categories has consistently grown, while cities in "Poor" and "Very Poor" categories have drastically declined, reflecting the collective impact of interventions.
- **NCAP Success:** NCAP cities performed slightly better, with significant shifts toward lower pollution categories, underscoring the effectiveness of targeted strategies.
- **Remaining Challenges:** The presence of cities in the "Very Poor" category indicates areas where interventions need further enhancement, particularly in NCAP cities.
- **Non-NCAP Contributions:** The progress in non-NCAP cities highlights the positive impact of regional and state-level measures, even in the absence of national program focus.

Increase in Air Quality Levels: Top 10 Cities (2023-2024)

CITIES WITH THE HIGHEST INCREASE IN PM2.5 LEVELS

The following cities recorded the most significant increases in PM2.5 concentrations between 2023 and 2024. These changes underscore localized challenges that demand urgent interventions to address air pollution sources, including industrial emissions, vehicular activity, and inadequate mitigation measures.

1. **Nandesari, Gujarat** – PM2.5 levels surged by 189.6%, rising from 27.0 µg/m³ in 2023 to 78.1 µg/m³ in 2024, marking the steepest increase among all cities.
2. **Silchar, Assam** – Recorded a 140.3% increase, with levels climbing from 9.6 µg/m³ to 23.0 µg/m³, reflecting emerging pollution hotspots.
3. **Damoh, Madhya Pradesh** – Observed a sharp rise of 94.5%, as PM2.5 levels escalated from 16.2 µg/m³ to 31.5 µg/m³.
4. **Durgapur, West Bengal** – Experienced a 65.2% increase, with concentrations increasing from 49.6 µg/m³ to 82.0 µg/m³, emphasizing the challenges of industrial emissions.
5. **Kunjemura, Chhattisgarh** – PM2.5 levels grew by 64.1%, rising from 18.7 µg/m³ to 30.6 µg/m³.
6. **Panipat, Haryana** – Levels increased by 50.8%, from 42.0 µg/m³ to 63.3 µg/m³, likely driven by industrial activity and vehicular pollution.
7. **Karauli, Rajasthan** – Observed a 50.4% increase, rising from 33.0 µg/m³ to 49.6 µg/m³, reflecting growing pollution in semi-urban areas.
8. **Aurangabad (M), Maharashtra** – PM2.5 levels grew by 45.4%, from 41.8 µg/m³ to 60.8 µg/m³, highlighting worsening air quality trends in western India.
9. **Kolhapur, Maharashtra** – Increased by 43.7%, from 30.1 µg/m³ to 43.2 µg/m³, reflecting a need for more stringent controls.
10. **Malegaon, Maharashtra** – Recorded a 43.2% increase, with levels rising from 36.0 µg/m³ to 51.5 µg/m³, emphasizing localized emissions challenges.

Decrease in Air Quality Levels: Top 10 Cities (2023-2024)

Several cities showcased significant reductions in PM2.5 concentrations during the same period. These results highlight the effectiveness of policy interventions, improved monitoring, and local efforts in mitigating air pollution.

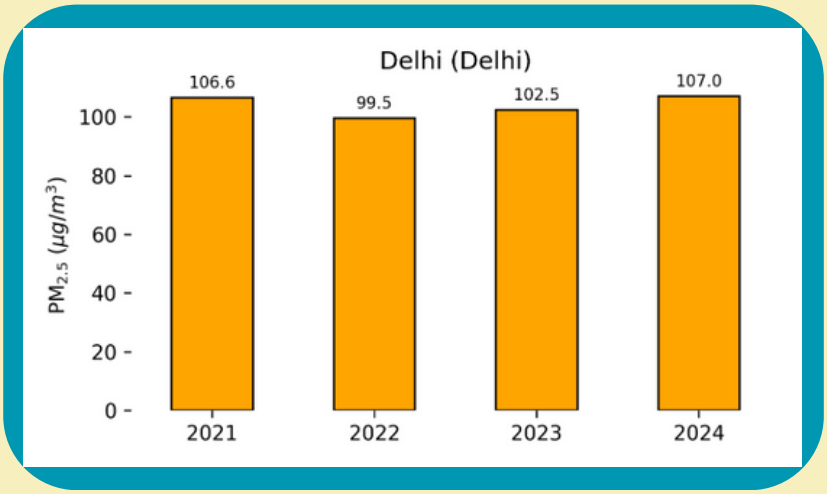
1. **Begusarai, Bihar –** Registered the steepest decline of -62.9%, with PM2.5 levels dropping from 148.3 µg/m³ in 2023 to 55.1 µg/m³ in 2024, showcasing remarkable progress.
2. **Tirupur, Tamil Nadu –** PM2.5 concentrations fell by -59.3%, from 35.2 µg/m³ to 14.3 µg/m³, highlighting effective control measures.
3. **Cuttack, Odisha –** Recorded a significant reduction of -51.6%, with levels decreasing from 93.5 µg/m³ to 45.3 µg/m³.
4. **Bhubaneswar, Odisha –** Observed a decline of -50.9%, as PM2.5 levels fell from 93.1 µg/m³ to 45.7 µg/m³.
5. **Katihar, Bihar –** PM2.5 levels dropped by -44.7%, from 89.6 µg/m³ to 49.5 µg/m³, underscoring significant improvements.
6. **Bettiah, Bihar –** Recorded a decrease of -44.3%, with levels falling from 86.2 µg/m³ to 48.0 µg/m³.
7. **Surat, Gujarat –** PM2.5 concentrations declined by -43.9%, from 57.0 µg/m³ to 32.0 µg/m³, reflecting sustained efforts to reduce emissions.
8. **Angul, Odisha –** Observed a decline of -42.9%, as levels dropped from 118.6 µg/m³ to 67.7 µg/m³, showcasing progress in industrial pollution management.
9. **Balasore, Odisha –** PM2.5 levels fell by -42.3%, from 88.7 µg/m³ to 51.1 µg/m³, highlighting effective policy measures.
10. **Arrah, Bihar –** Recorded a decline of -41.7%, with levels decreasing from 84.5 µg/m³ to 49.2 µg/m³, reflecting progress in pollution reduction efforts.

New Delhi

Delhi saw a marginal improvement of 1.3% in PM2.5 levels from 108.4 µg/m³ in 2019 to 107.0 µg/m³ in 2024, reflecting the persistent challenges in addressing its air quality

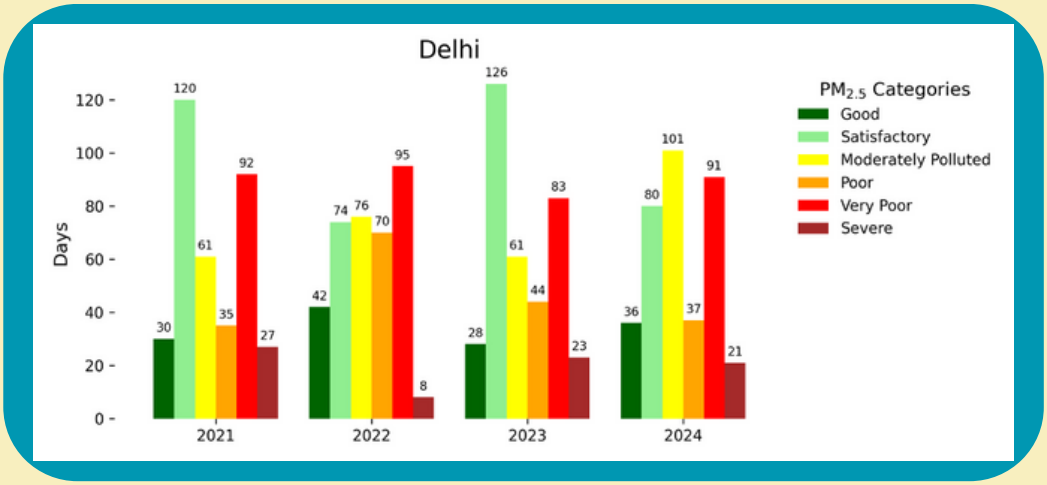
Annual PM2.5 Levels (2021–2024)

This bar chart shows fluctuations in Delhi's annual PM2.5 concentrations, with levels increasing from 99.5 µg/m³ in 2022 to 107.0 µg/m³ in 2024, indicating persistent challenges despite minor improvements in 2022. The rise emphasizes the impact of seasonal pollution and regional factors like stubble burning.



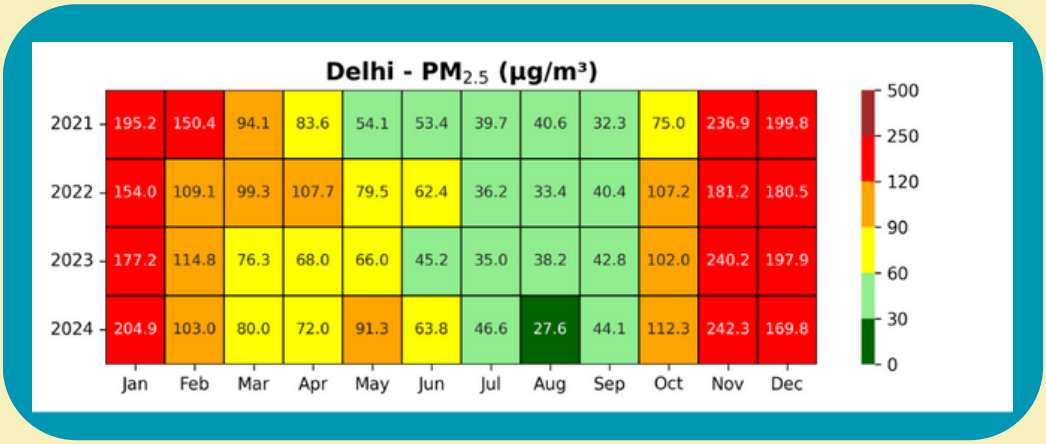
Days Across AQI Categories (2021–2024)

This graph highlights the distribution of days across PM2.5 categories. Notably, the number of "Good" and "Satisfactory" days improved from 30 in 2021 to 36 in 2024, while "Very Poor" and "Severe" days persist. Seasonal spikes in "Severe" days during winter reflect the ongoing influence of temperature inversions and crop residue burning.



Monthly PM2.5 Trends (2021–2024)

This heatmap visualizes monthly PM2.5 levels, showing severe pollution in winter months (November–January), with peaks exceeding 240 µg/m³ in November. The summer months show improvements, with levels dropping below 40 µg/m³, underscoring seasonal variability driven by weather conditions.

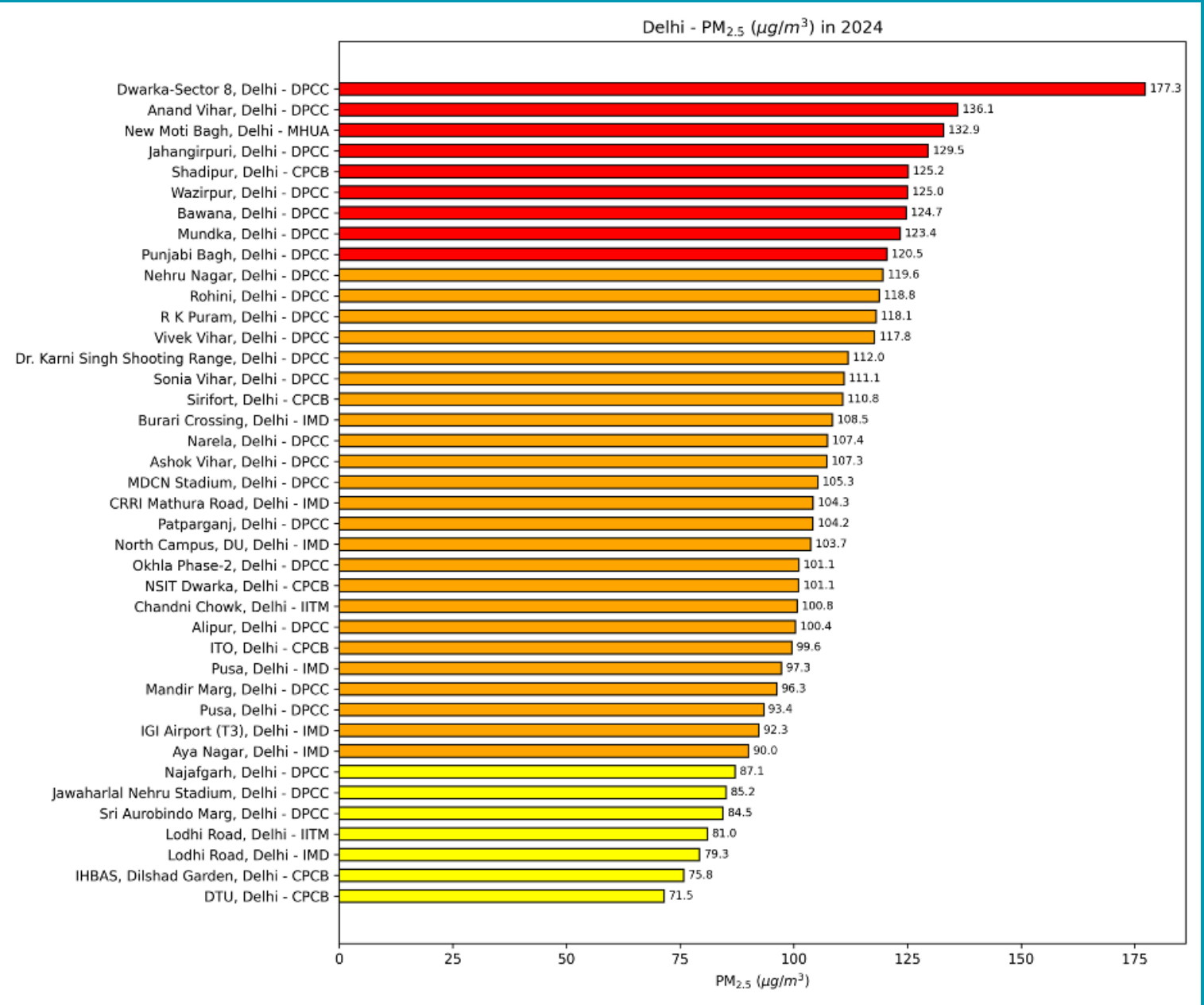


New Delhi

Delhi saw a marginal improvement of 1.3% in PM2.5 levels from 108.4 µg/m³ in 2019 to 107.0 µg/m³ in 2024, reflecting the persistent challenges in addressing its air quality

Monitoring Station Rankings (2024)

This bar chart ranks Delhi's monitoring stations by PM2.5 levels in 2024. Dwarka Sector 8 (177.3 µg/m³) recorded the highest pollution, while DTU (71.5 µg/m³) reported the lowest. The stark disparity reflects the uneven distribution of pollution sources and enforcement measures across the city.

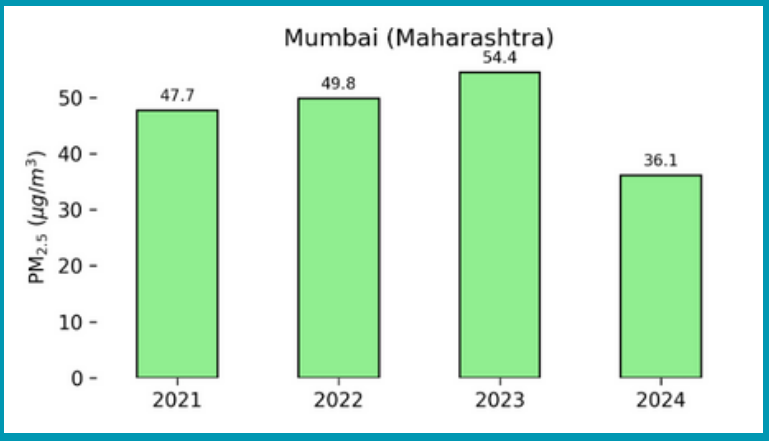


Mumbai

Mumbai saw a 2.6% increase in PM2.5 levels from 35,2 µg/m³ in 2019 to 36.1 µg/m³ in 2024, reflecting a persisting air quality issue for the financial capital

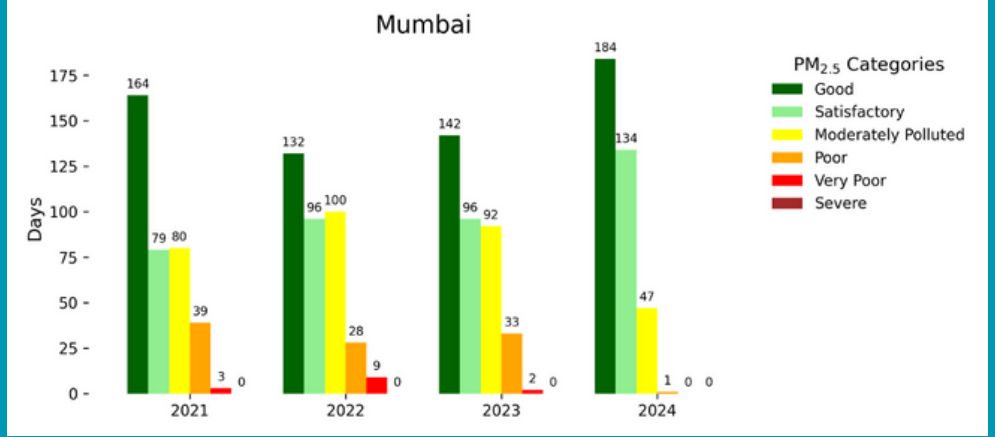
Annual PM2.5 Levels (2021–2024)

The bar chart highlights a slight upward trend in Mumbai's annual PM2.5 levels, increasing from 47.1 µg/m³ in 2021 to 36.1 µg/m³ in 2024. This 2.6% rise reflects localized challenges such as vehicular congestion and industrial emissions in specific areas.



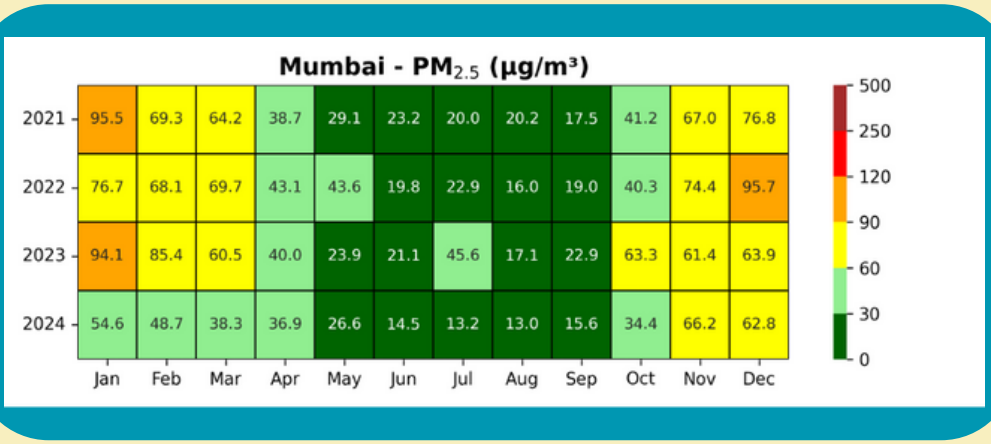
Days Across AQI Categories (2021–2024)

Mumbai witnessed a remarkable improvement in the number of "Good" days, increasing from 164 in 2021 to 184 in 2024. However, the persistence of "Moderate" and "Poor" days in 2022 and 2023 highlights localized pollution sources, particularly during construction-heavy periods.



Monthly PM2.5 Trends (2021–2024)

The heatmap reveals Mumbai's seasonal trends, with PM2.5 levels remaining relatively low during monsoon months (June–August), often falling below 20 µg/m³. However, post-monsoon levels in November consistently rise, reflecting the city's struggles with winter air stagnation and construction-related dust.

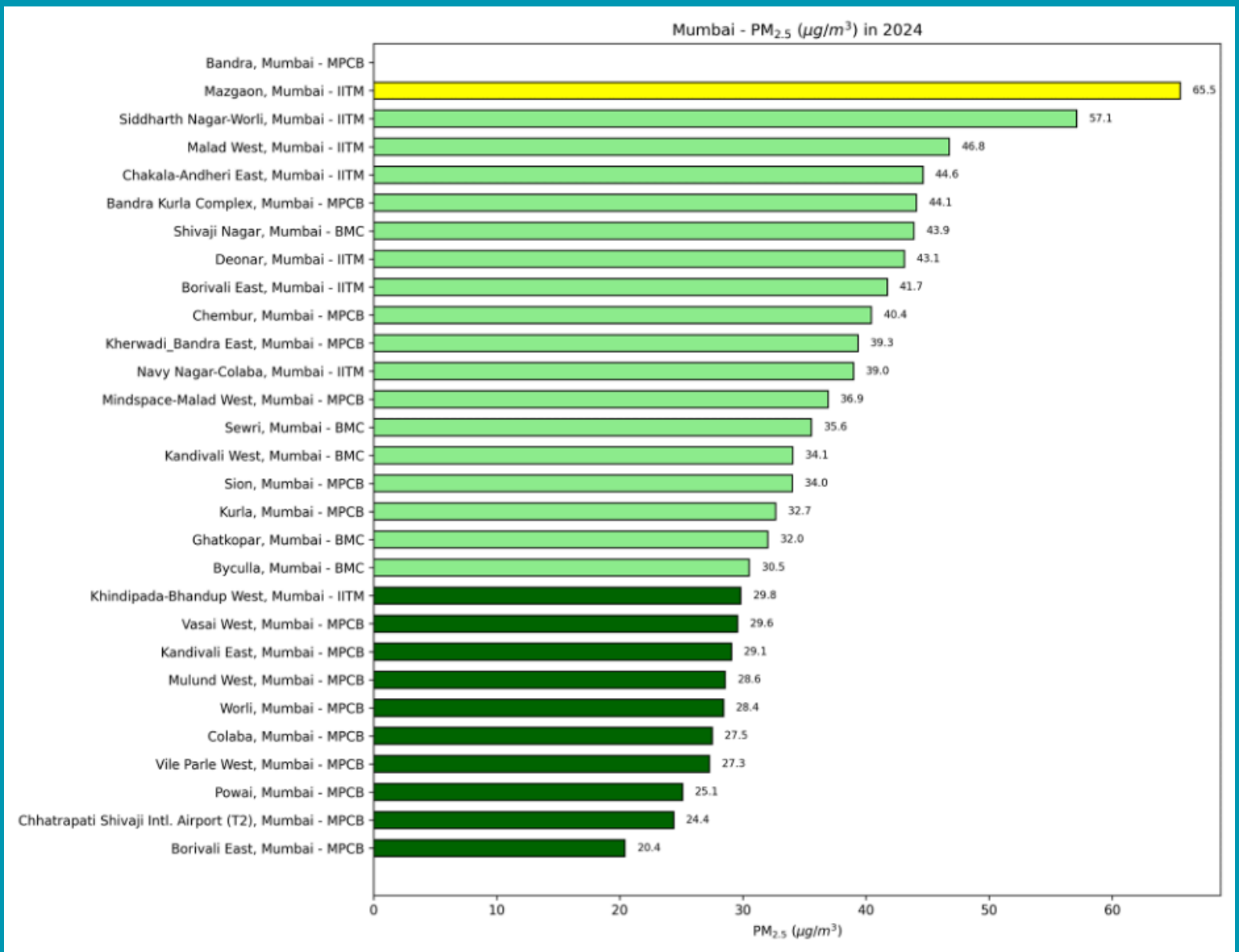


Mumbai

Mumbai saw a 2.6% increase in PM2.5 levels from 35,2 µg/m³ in 2019 to 36.1 µg/m³ in 2024, reflecting a persisting air quality issue for the financial capital

Monitoring Station Rankings (2024)

This chart ranks monitoring stations across Mumbai by PM2.5 levels in 2024. Mazgaon (57.1 µg/m³) was among the most polluted areas, attributed to dense traffic and industrial activity. Conversely, Borivali East (20.4 µg/m³) reported the cleanest air, benefiting from better green cover and lower vehicular density.

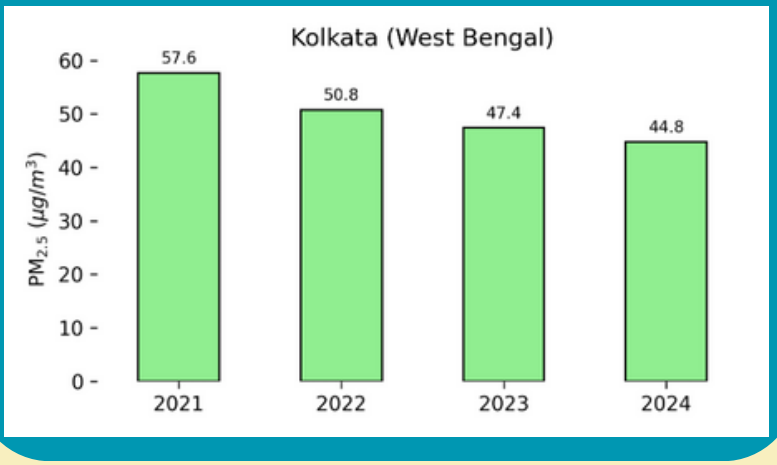


Kolkata

Kolkata saw a 21.5% reduction in PM2.5 levels from 57.1 µg/m³ in 2019 to 44.8 µg/m³ in 2024, reflecting a significant improvement recorded across city monitoring stations

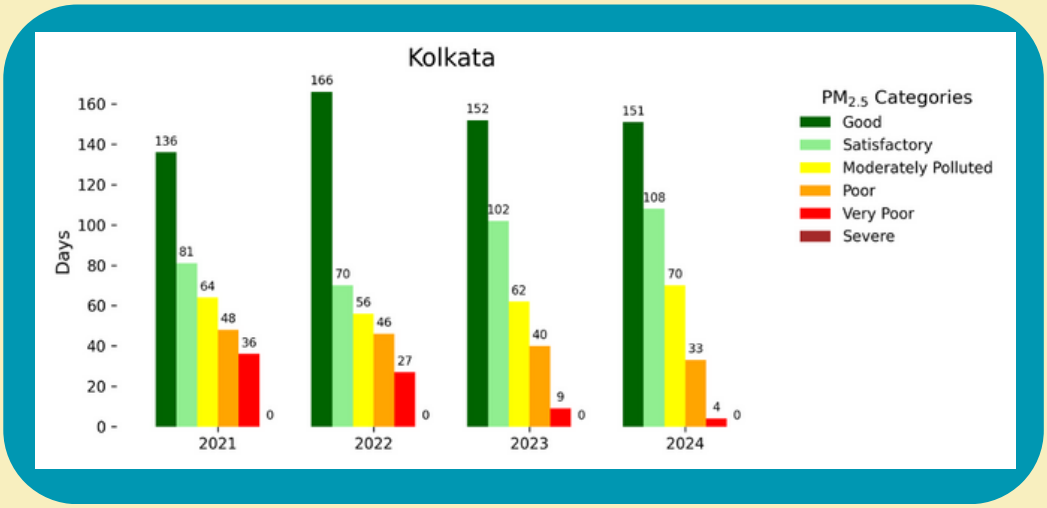
Annual PM2.5 Levels (2021–2024)

Kolkata's annual PM2.5 levels showed steady improvement, decreasing from 57.6 µg/m³ in 2021 to 44.8 µg/m³ in 2024. This reduction reflects a 21.5% drop from 2019, driven by policy interventions and improved industrial emissions control..



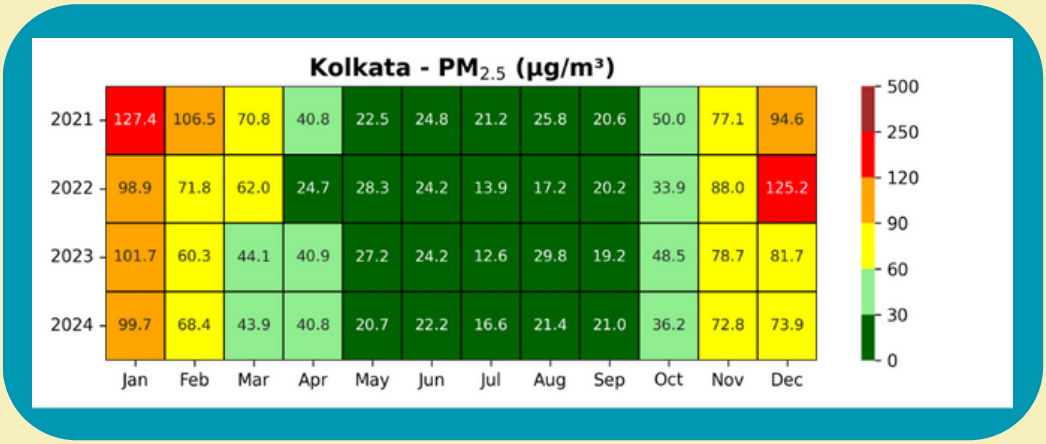
Days Across AQI Categories (2021–2024)

The AQI chart shows a significant increase in "Good" days, rising from 136 in 2021 to 151 in 2024, while "Very Poor" and "Severe" days have reduced to near zero. However, the persistence of "Moderate" and "Poor" days highlights the need for consistent mitigation measures.



Monthly PM2.5 Trends (2021–2024)

Kolkata's heatmap illustrates seasonal trends, with the cleanest air observed in the monsoon months (June–August), where PM2.5 levels fell below 25 µg/m³. Winter months, particularly December, show recurring spikes, with PM2.5 levels exceeding 125 µg/m³, likely due to increased vehicular and heating emissions.

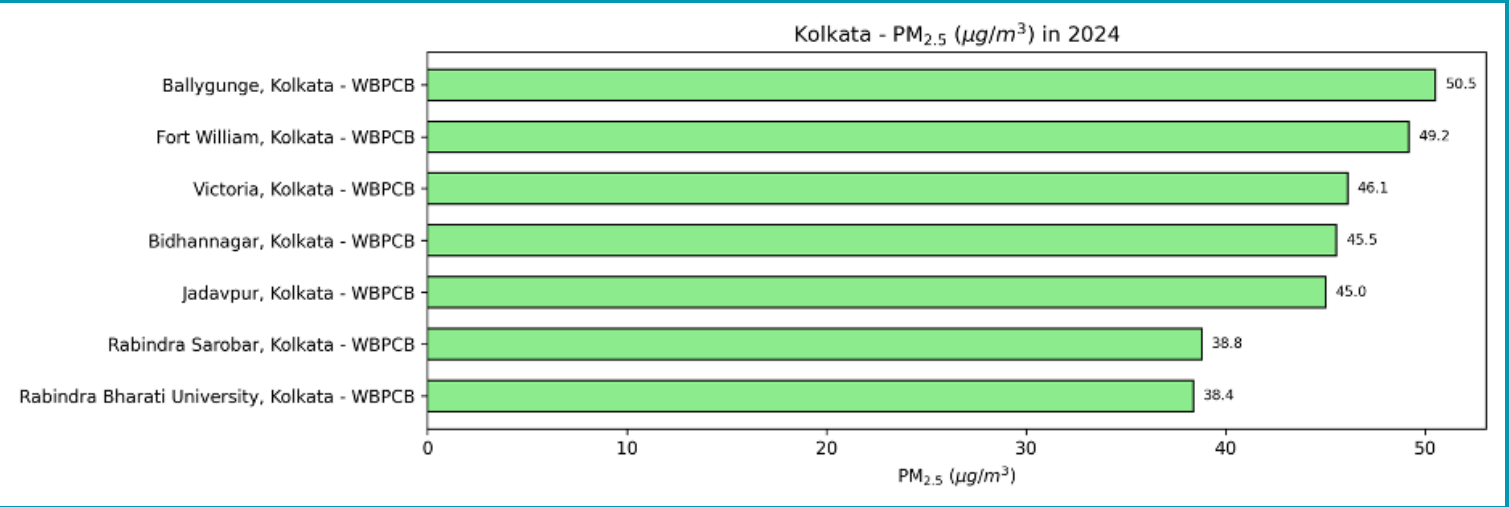


Kolkata

Kolkata saw a 21.5% reduction in PM2.5 levels from 57.1 µg/m³ in 2019 to 44.8 µg/m³ in 2024, reflecting a significant improvement recorded across city monitoring stations

Monitoring Station Rankings (2024)

Monitoring station rankings in 2024 indicate Ballygunge (50.5 µg/m³) and Fort William (49.2 µg/m³) as the most polluted areas, linked to higher vehicular density. In contrast, Rabindra Bharati University (38.4 µg/m³) recorded the cleanest air, benefiting from lower industrial activity and greener surroundings.

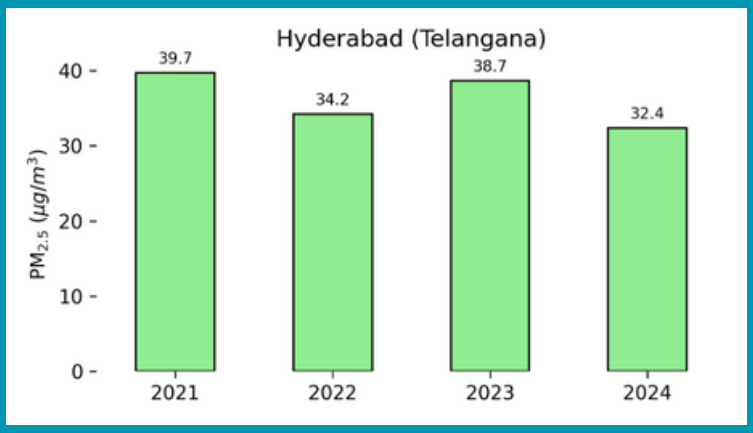


Hyderabad

Achieved a notable improvement in air quality, with a 22.2% reduction in PM2.5 levels, decreasing from 41.6 µg/m³ in 2019 to 32.4 µg/m³ in 2024

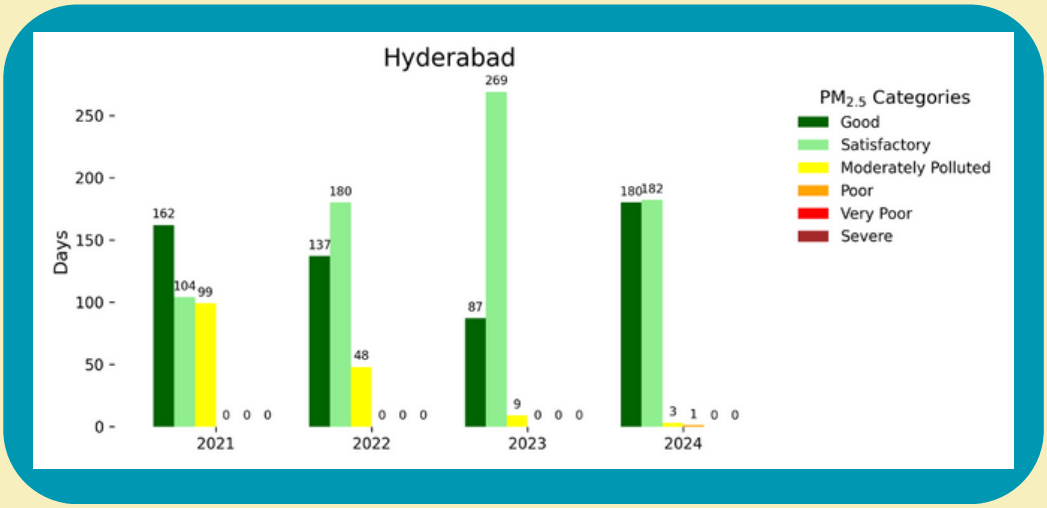
Annual PM2.5 Levels (2021–2024)

Hyderabad's PM2.5 levels have steadily declined, dropping from 39.7 µg/m³ in 2021 to 32.4 µg/m³ in 2024, reflecting a significant 22.2% reduction since 2019. This progress highlights the effectiveness of local policies and improved air quality management strategies.



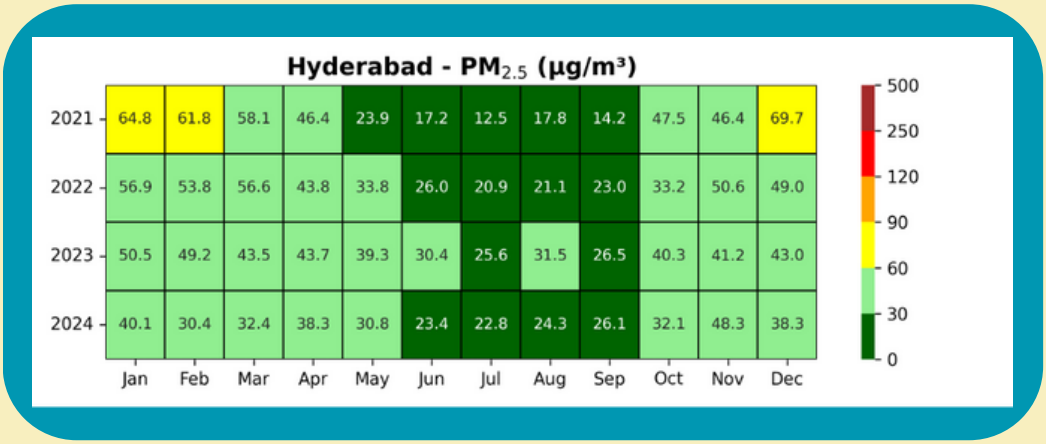
Days Across AQI Categories (2021–2024)

The AQI distribution reveals a substantial increase in "Good" and "Satisfactory" days, with 182 days in these categories in 2024 compared to 162 in 2021. "Moderately Polluted" days, however, persist, indicating scope for further interventions.



Monthly PM2.5 Trends (2021–2024)

The heatmap shows the cleanest air during the monsoon months (July–September), with PM2.5 levels consistently below 20 µg/m³. Winter months, particularly January and December, show moderate spikes due to increased vehicular emissions and urban activity..

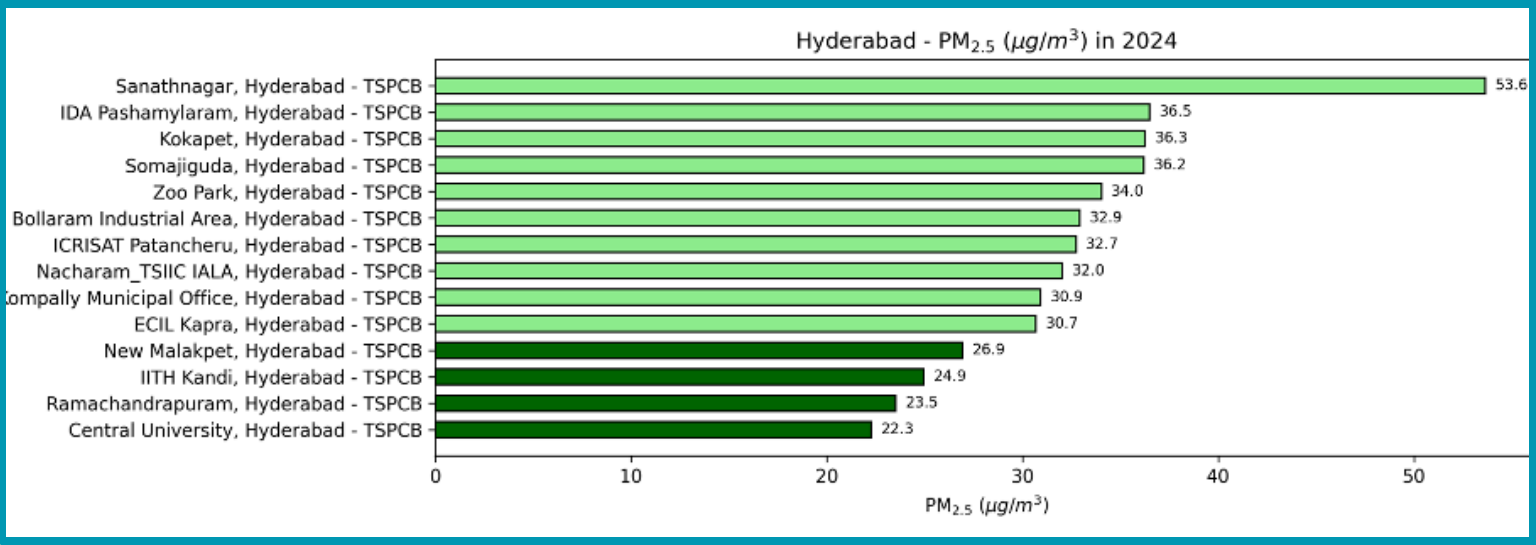


Hyderabad

Achieved a notable improvement in air quality, with a 22.2% reduction in PM2.5 levels, decreasing from 41.6 µg/m³ in 2019 to 32.4 µg/m³ in 2024

Monitoring Station Rankings (2024)

In 2024, Sanathnagar (53.6 µg/m³) recorded the highest PM2.5 levels, attributed to industrial and vehicular activity in the area. Central University (22.3 µg/m³) reported the lowest levels, benefiting from green cover and fewer pollution sources.

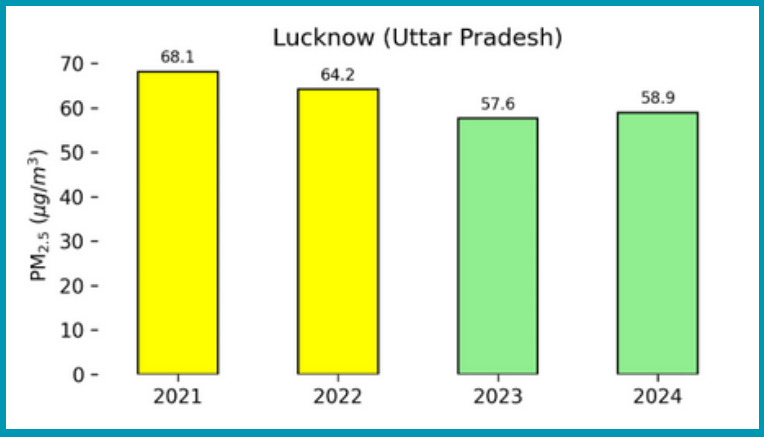


Lucknow

Significant improvement in air quality, with a 39.2% reduction in PM2.5 levels, decreasing from 96.9 µg/m³ in 2019 to 58.9 µg/m³ in 2024.

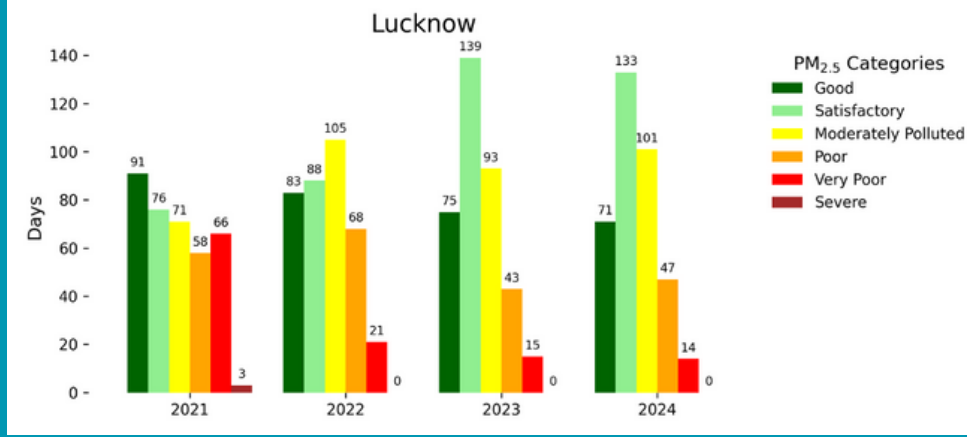
Annual PM2.5 Levels (2021–2024)

Lucknow's PM2.5 levels have shown a notable decline, dropping from 68.1 µg/m³ in 2021 to 58.9 µg/m³ in 2024, representing a significant 39.2% reduction since 2019. This progress highlights the success of targeted interventions and emission control measures.



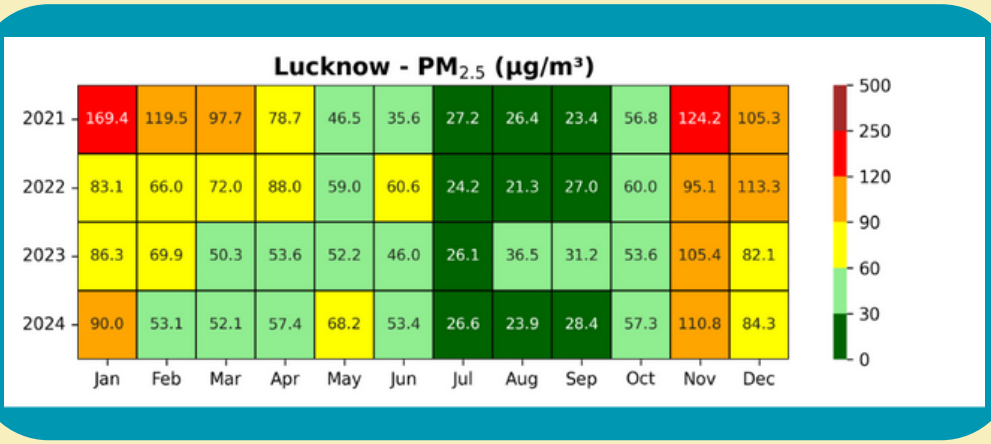
Days Across AQI Categories (2021–2024)

The AQI distribution for Lucknow shows a rise in "Good" and "Satisfactory" days, with 133 days in these categories in 2024 compared to 91 in 2021. However, a significant number of "Moderate" days persist, suggesting room for further policy interventions and enforcement.



Monthly PM2.5 Trends (2021–2024)

The heatmap highlights seasonal variations, with the cleanest months being June and July, where PM2.5 levels drop below 30 µg/m³. In contrast, October and November consistently see spikes exceeding 100 µg/m³, driven by winter pollution and regional crop burning.

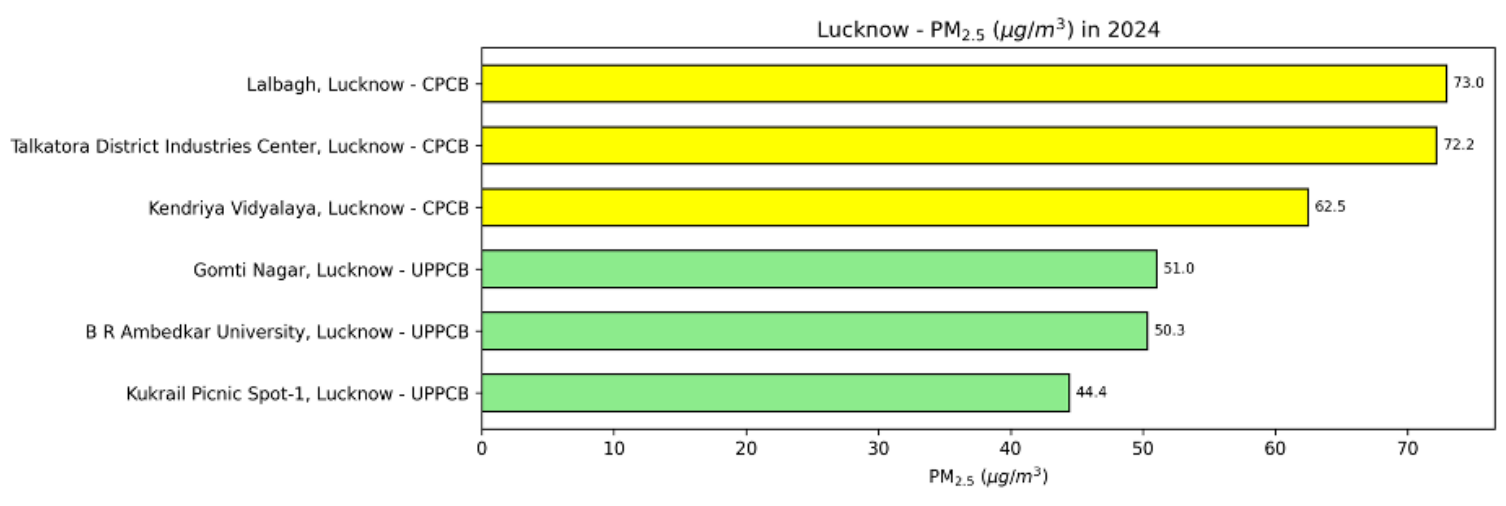


Lucknow

Significant improvement in air quality, with a 39.2% reduction in PM2.5 levels, decreasing from 96.9 µg/m³ in 2019 to 58.9 µg/m³ in 2024.

Monitoring Station Rankings (2024)

Monitoring station data for 2024 indicates Lalbagh (73.0 µg/m³) and Talkatora District Industries Center (72.2 µg/m³) as the most polluted areas due to industrial and traffic emissions. Kukrail Picnic Spot (44.4 µg/m³) reported the lowest levels, benefiting from green cover and reduced industrial activity.

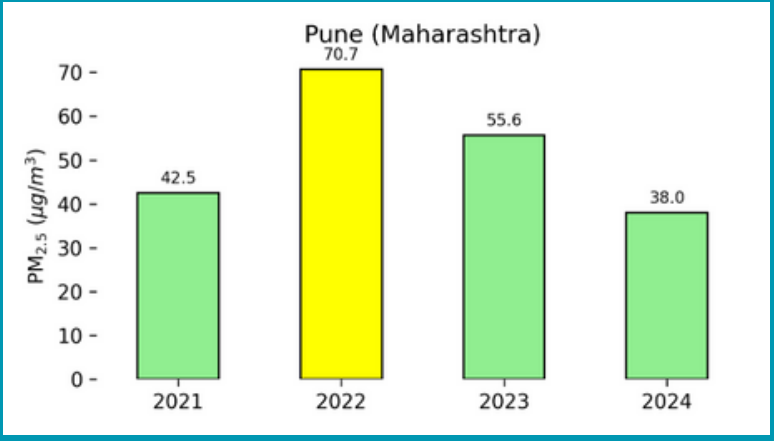


Pune

Pune achieved a notable 20.7% reduction in PM2.5 levels, declining from 47.9 µg/m³ in 2019 to 38.0 µg/m³ in 2024

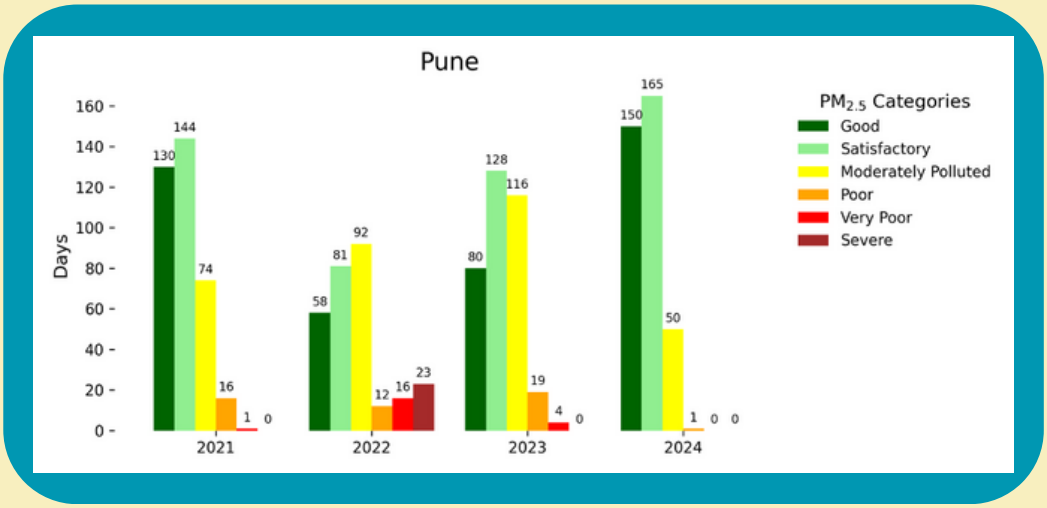
Annual PM2.5 Levels (2021–2024)

Pune's PM2.5 levels demonstrated steady improvement, with levels decreasing from 47.9 µg/m³ in 2019 to 38.0 µg/m³ in 2024, marking a significant 20.7% reduction. Despite spikes in 2022, the city's overall air quality shows consistent progress.



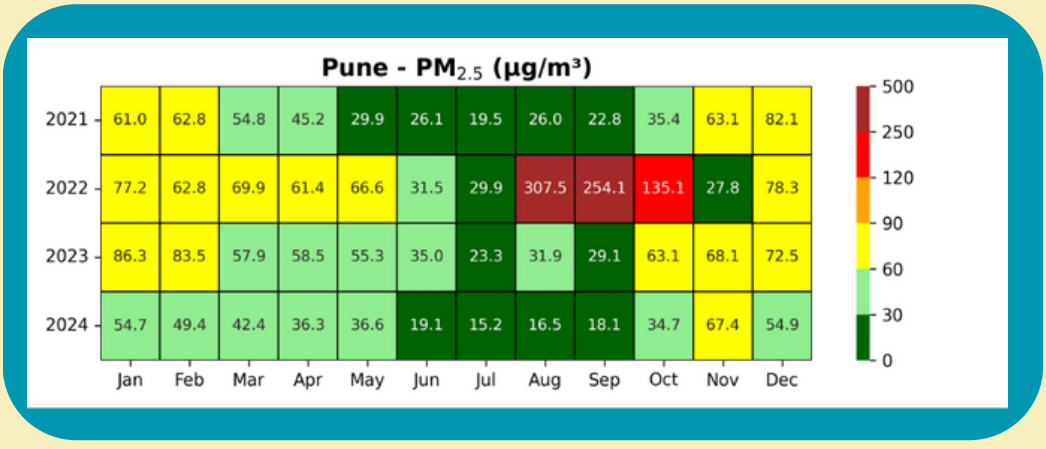
Days Across AQI Categories (2021–2024)

The AQI distribution reveals a positive trend, with Good and Satisfactory days increasing to 215 in 2024 compared to 204 in 2021. However, periodic increases in "Moderate" and "Poor" days in 2022 highlight the effects of localized pollution events.



Monthly PM2.5 Trends (2021–2024)

The heatmap underscores seasonal variations in Pune's air quality, with July to September consistently recording the cleanest months (PM2.5 levels below 20 µg/m³). However, high spikes in August 2022 (307.5 µg/m³) underline the impact of occasional extreme pollution events.

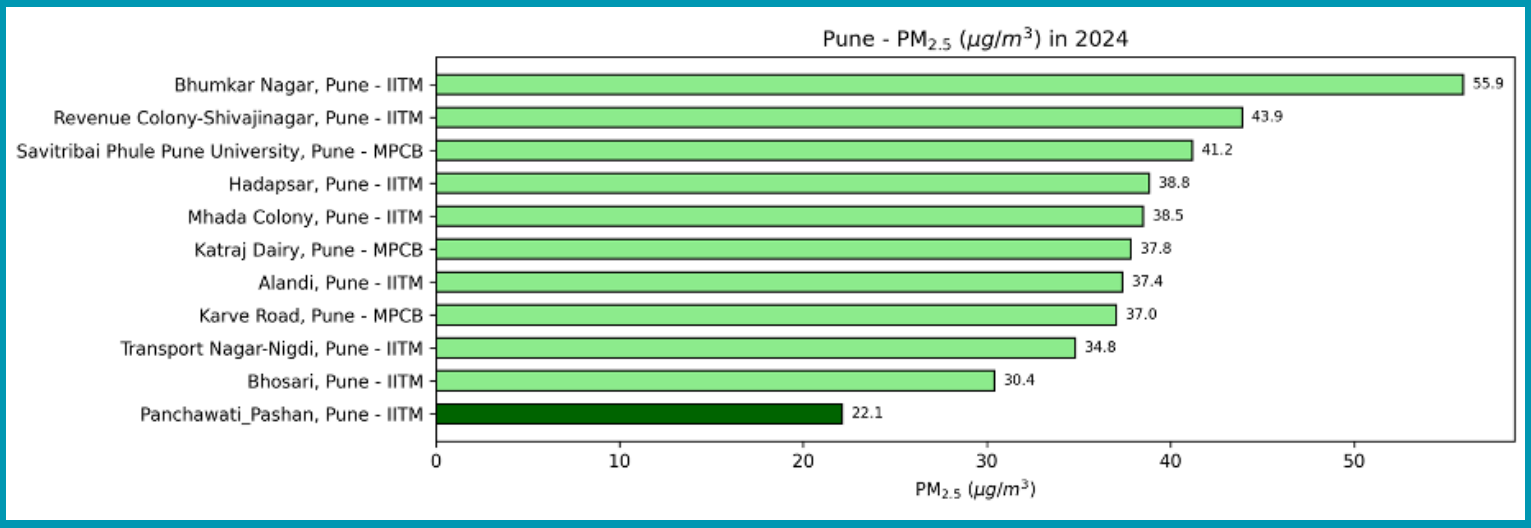


Pune

Pune achieved a notable 20.7% reduction in PM2.5 levels, declining from 47.9 µg/m³ in 2019 to 38.0 µg/m³ in 2024

Monitoring Station Rankings (2024)

In 2024, Bhumkar Nagar (55.9 µg/m³) recorded the highest PM2.5 levels, reflecting pollution hotspots in industrial and vehicular activity zones. Panchawati Pashan (22.1 µg/m³) had the lowest pollution, benefiting from green coverage and fewer emissions sources.

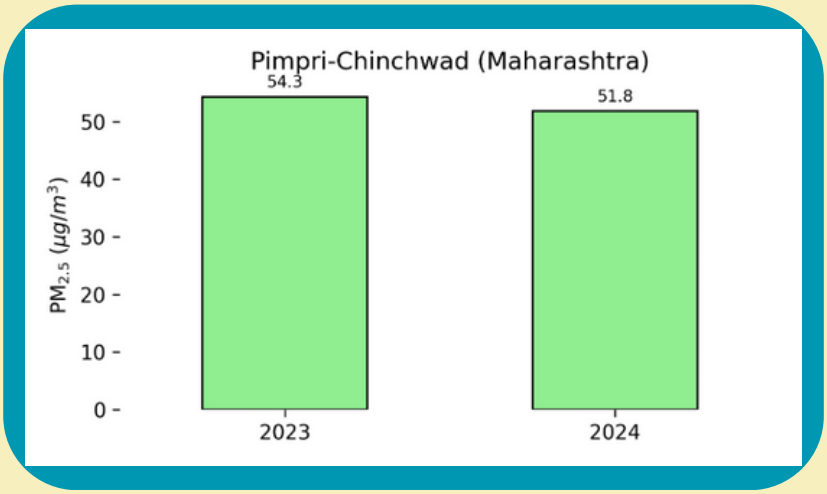


Pimpri Chinchwad

Monitoring in Pimpri-Chinchwad began in April 2023, with the city recording an annual PM2.5 average of 51.8 µg/m³ in 2024, signaling moderate air quality and areas for further improvement.

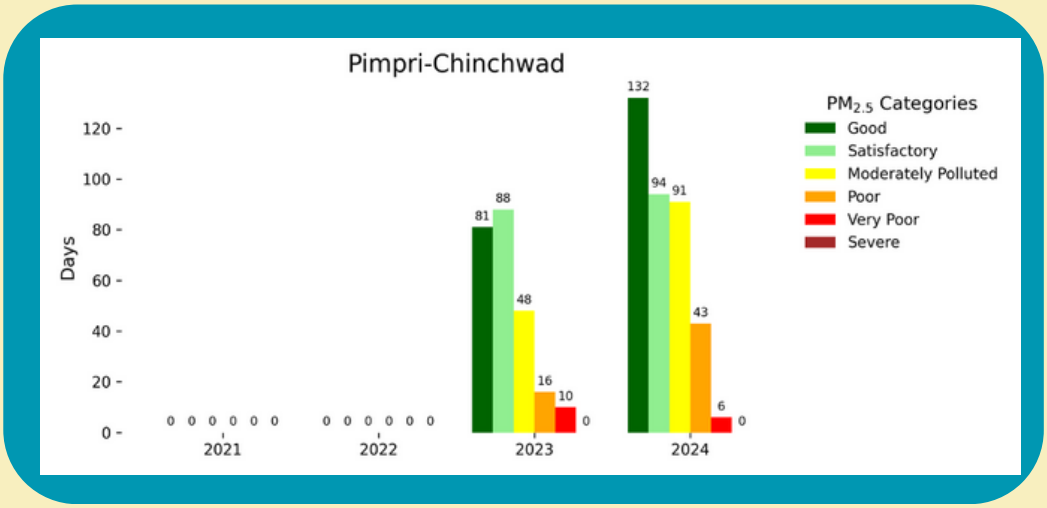
Annual PM2.5 Levels (2021–2024)

Pimpri-Chinchwad's monitoring infrastructure began operations in April 2023, limiting available annual data to 2023 and 2024. The city recorded an average PM2.5 level of 51.8 µg/m³ in 2024, showing a slight improvement from 54.3 µg/m³ in 2023.



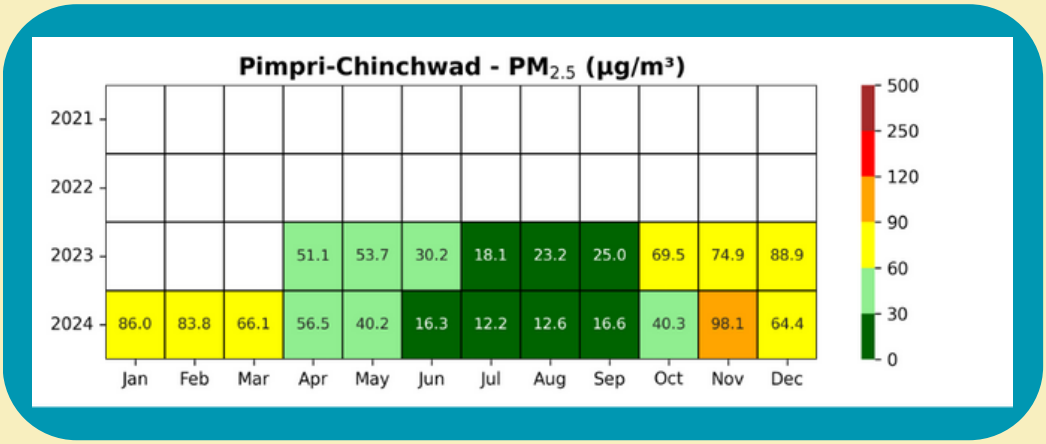
Days Across AQI Categories (2021–2024)

The AQI analysis highlights a growing number of "Good" and "Satisfactory" days in 2024, totaling 225 days, compared to 169 in 2023. However, "Moderate" and "Poor" days still pose challenges, emphasizing the need for sustained interventions.



Monthly PM2.5 Trends (2021–2024)

The heatmap for Pimpri-Chinchwad reveals consistent seasonal variations, with PM2.5 levels significantly improving during the monsoon months of July and August 2024 (levels below 20 µg/m³). Conversely, November shows spikes reaching 98.1 µg/m³, reflecting the impact of winter stagnation and emissions.

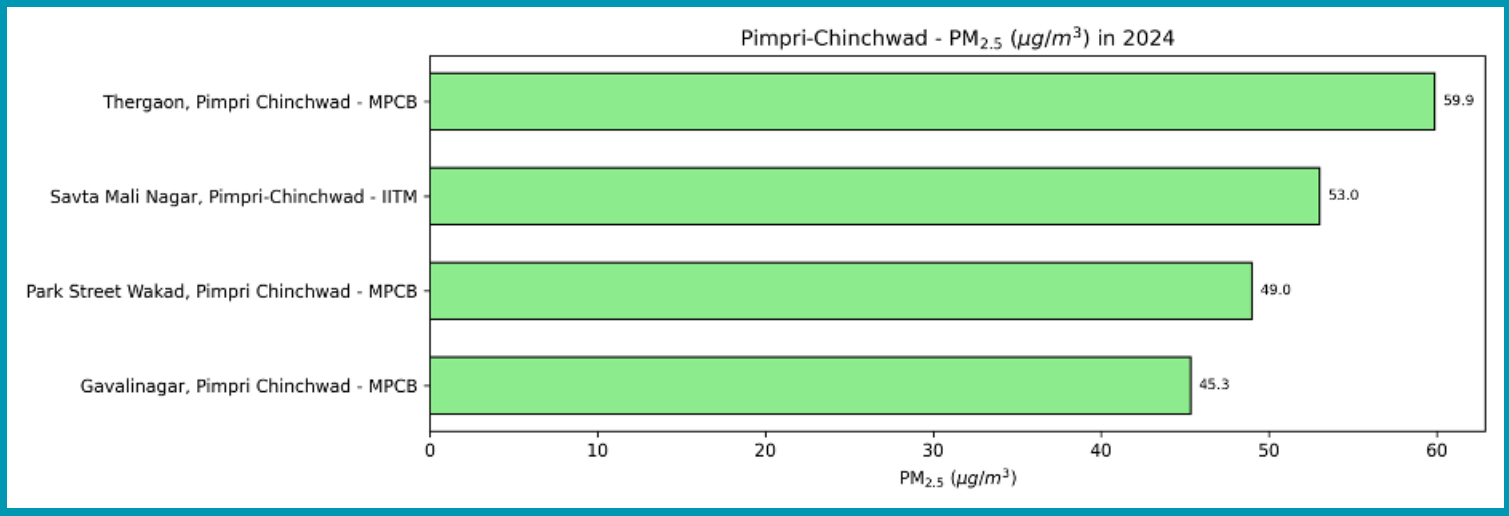


Pimpri Chinchwad

Monitoring in Pimpri-Chinchwad began in April 2023, with the city recording an annual PM2.5 average of 51.8 µg/m³ in 2024, signaling moderate air quality and areas for further improvement.

Monitoring Station Rankings (2024)

Among the monitored locations, Thergaon (59.9 µg/m³) recorded the highest PM2.5 levels in 2024, attributed to industrial and vehicular emissions. Gavalinagar (45.3 µg/m³) had the cleanest air, benefiting from better green cover and lower pollution sources.

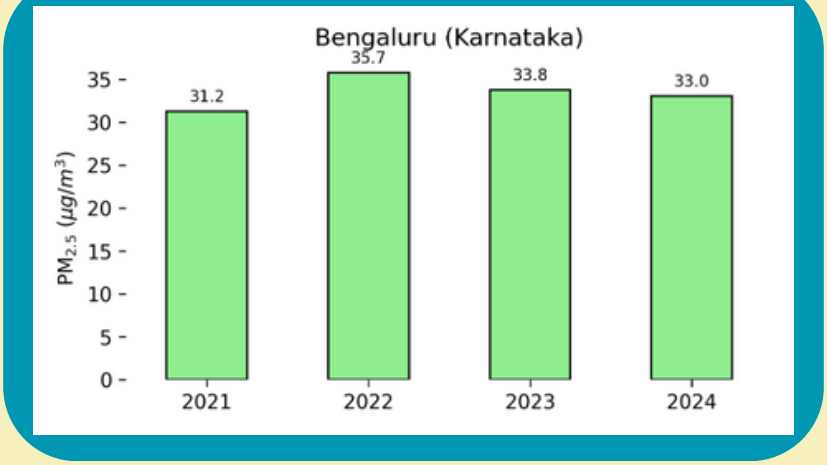


Bengaluru

Bengaluru recorded an 8.0% reduction in PM2.5 levels, decreasing from 35.9 µg/m³ in 2019 to 33.0 µg/m³ in 2024.

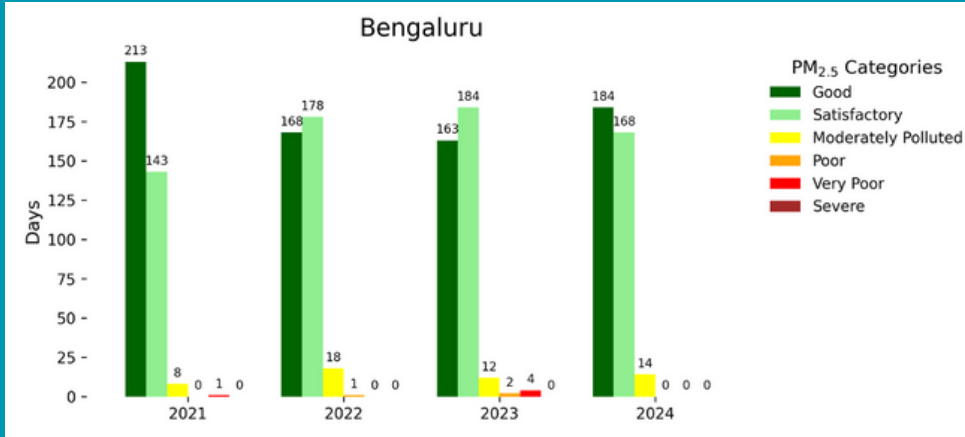
Annual PM2.5 Levels (2021–2024)

Bengaluru's PM2.5 levels have steadily decreased, dropping from 35.9 µg/m³ in 2019 to 33.0 µg/m³ in 2024, reflecting a modest 8.0% reduction. The city's air quality shows stability, benefiting from its relatively lower industrial density compared to other metros.



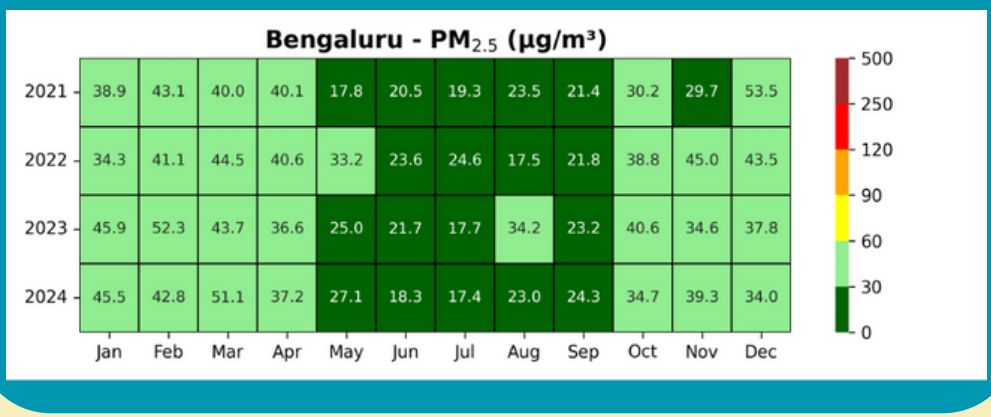
Days Across AQI Categories (2021–2024)

The AQI data highlights that Bengaluru consistently recorded a high number of "Good" and "Satisfactory" days, totaling 352 days in 2024, an improvement over 356 days in 2021. "Moderate" and "Poor" days remained negligible throughout the years.



Monthly PM2.5 Trends (2021–2024)

The heatmap reveals stable monthly PM2.5 levels, with cleaner air during the monsoon months (June–August) and slightly elevated levels in winter (October–December). The city consistently recorded PM2.5 levels below 40 µg/m³, showcasing its controlled emissions.

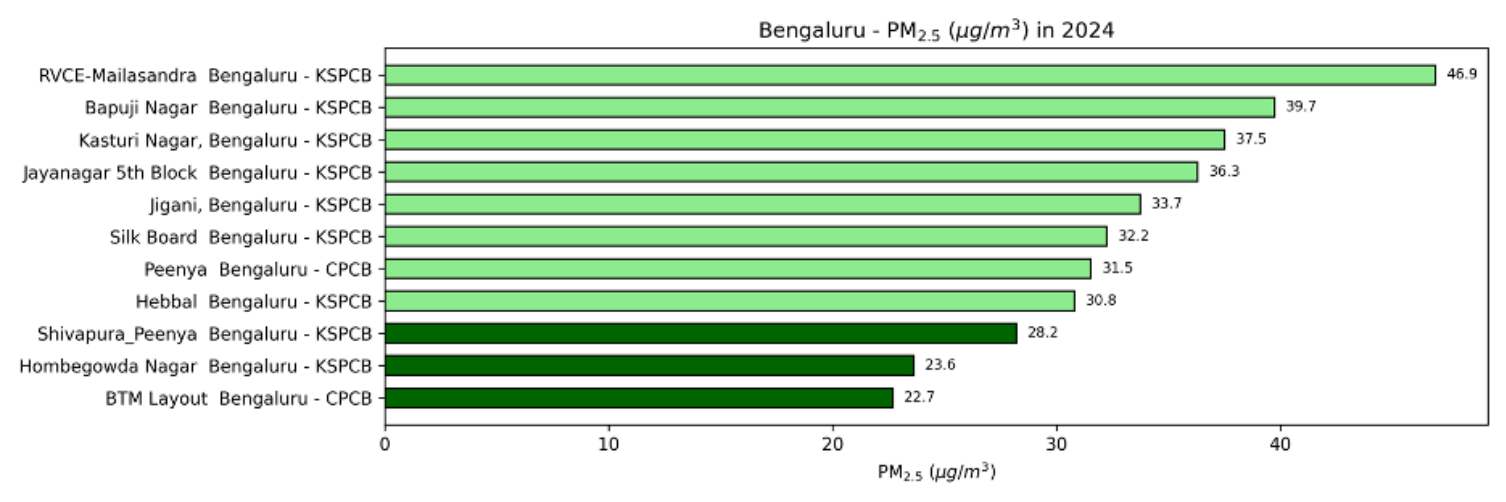


Bengaluru

Achieved a notable improvement in air quality, with a 22.2% reduction in PM2.5 levels, decreasing from 41.6 µg/m³ in 2019 to 32.4 µg/m³ in 2024

Monitoring Station Rankings (2024)

In 2024, RVCE-Mailasandra (46.9 µg/m³) reported the highest PM2.5 levels, primarily due to vehicular emissions and localized construction. BTM Layout (22.7 µg/m³) emerged as the least polluted area, benefiting from better urban planning and green spaces.



Recommendations

Respirer Living Sciences

Strengthening Monitoring Infrastructure

A robust monitoring system is critical for assessing and managing air quality. Expanding the network of air quality monitoring stations, particularly in smaller cities and rural areas, will ensure comprehensive data collection and analysis. Investing in advanced sensor technologies and real-time data integration platforms, such as AtlasAQ, can improve data accuracy and accessibility, enabling informed decision-making.

Enhancing Policy Implementation

Effective policy enforcement is essential for achieving air quality targets. Strengthen mechanisms under the National Clean Air Programme (NCAP) by introducing stricter penalties for industrial and vehicular emissions violations. Region-specific policies should address unique challenges, such as stubble burning in northern India and vehicular congestion in urban areas. Additionally, cross-departmental coordination across urban planning, transport, and environmental agencies must be prioritized.

Promoting Cleaner Technologies

Adopting cleaner technologies can significantly reduce emissions. Accelerate the adoption of electric vehicles (EVs) through incentives under schemes like FAME-II and expand EV infrastructure. Encourage industries to transition to cleaner technologies and relocate polluting units away from densely populated areas. Supporting renewable energy initiatives and phasing out coal-based energy in industrial zones will further contribute to long-term air quality improvement.

Addressing Urban and Regional Disparities

Targeted interventions are needed to address disparities between cities and regions. Develop specific action plans for highly polluted cities such as Delhi, Faridabad, and Lucknow, focusing on customized solutions for vehicular, industrial, and dust pollution. Ensure equitable distribution of funding and resources to smaller NCAP cities and non-NCAP cities that show potential but lack adequate infrastructure.

Seasonal and Emergency Measures

High-pollution seasons demand stringent measures. Implement Graded Response Action Plans (GRAP) during winter months in northern India and subsidize alternatives to stubble burning, such as bio-decomposers and crop residue management tools. Enhance public preparedness through effective communication and health advisories during severe pollution episodes.

Recommendations

Respirer Living Sciences

Strengthening Public Awareness and Participation

Public engagement is pivotal for sustained improvements. Launch extensive awareness campaigns to educate citizens on air pollution and its health impacts, encouraging behavioral changes like reducing vehicle idling and avoiding waste burning. Collaborate with community stakeholders, NGOs, and businesses to foster initiatives such as urban afforestation and waste management programs.

Leveraging Hyperlocal Data for Decision-Making

Data-driven strategies are essential for effective air quality management. Platforms like AtlasAQ can track progress and identify pollution hotspots, enabling timely interventions. Publish transparent, user-friendly reports to keep the public informed and hold policymakers accountable.

Long-Term Urban Planning and Development

Incorporate air quality considerations into urban planning by promoting green spaces, eco-friendly construction practices, and efficient public transportation networks. Enforce stricter building codes and dust control measures during construction activities. Decentralized urban development can also reduce congestion and pollution in metropolitan areas.

Collaboration and International Best Practices

Collaboration among state governments, central agencies, and international organizations is crucial. Exchange knowledge and best practices with global partners to improve air quality strategies. Align India's air quality goals with global climate action commitments to achieve sustainable and synergistic progress.

Revising NCAP Targets and Metrics

Regularly reassess and update NCAP's reduction targets and timelines to reflect ground realities and emerging challenges. Focus on achievable short-term milestones and establish city-specific performance indicators to ensure accountability and progress tracking.

Conclusion

Respirer Living Sciences

The findings of this report underscore a mix of significant achievements and persistent challenges in India's journey toward improved air quality. The 26.84% reduction in particulate matter (PM) levels nationwide, and particularly the 24.45% decrease in NCAP cities, reflects the effectiveness of collaborative efforts under the National Clean Air Programme (NCAP). However, the road ahead requires further commitment, innovation, and cohesive strategies.

Some cities, such as Varanasi and Moradabad, serve as shining examples of what can be achieved through targeted interventions, local governance, and community participation. On the other hand, metropolitan hubs like Delhi and Faridabad highlight the scale and complexity of the challenges that remain. The report's analysis of disparities between northern, central, and southern cities also illustrates the need for regional customization in policy and action plans.

The temporary improvements witnessed during the COVID-19 lockdown period emphasize the potential for behavioral changes to drive air quality enhancements. However, these gains also remind us of the fragility of the progress made and the necessity for structural, long-term solutions.

Achieving the revised NCAP target of a 40% reduction in PM levels by 2026 will require a multi-pronged approach. This involves expanding monitoring networks, enforcing stringent policies, promoting clean technologies, and fostering public awareness. Regional disparities and seasonal pollution spikes must be addressed with equal urgency, alongside stronger collaboration between governmental and non-governmental entities.

ABOUT

RESPIRER LIVING SCIENCES

Respirer Living Sciences is a leading climate-tech startup in India, dedicated to achieving cleaner air and accelerating the transition to cleaner energy. Established in 2017, Respirer provides scientifically validated, scalable air quality monitoring devices and real-time air pollution analytics platforms. These solutions deliver accurate and actionable data to governments, industries, and citizens, empowering them to address air pollution and methane emissions effectively. Respirer's network includes over 2,500 air quality devices deployed across more than 25 Indian cities and several international locations. The company collaborates with prestigious institutions such as IIT Kanpur and Duke University and is part of the Centre of Excellence ATMAN on Clean Air Technologies, supported by the Government of India.

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For More Granular Data on Hotspots across India, please contact: research@respirer.in

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