Respirer Living Sciences

INDIA'S AIR QUALITY IN FOCUS

An in-depth analysis of PM10 Trends from 2021 to 2024

Photo: Unsplash | Johan Mouchet

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EXECUTIVE SUMMARY

This report offers a comprehensive analysis of **PM10 concentration trends across 11 major Indian cities between 2021 and 2024**, based on data from **AtlasAQ** by **Respirer Living Sciences.** The findings reveal that all cities consistently breached the National Ambient Air Quality Standards **(NAAQS) of 60 µg/m³**, with several northern cities—including **Bhiwadi, Delhi, and Ghaziabad—recording annual averages well over 150 µg/m³**.

In contrast, southern cities like **Bengaluru and Chennai** registered comparatively lower concentrations, typically ranging between **70–90 µg/m³**, yet still exceeding the permissible limit of 60 µg/m³. The data highlights clear **regional disparities and strong seasonal variation**, with **PM10 levels peaking in the winter months**, particularly in **northern India**, due to factors such as crop residue burning, vehicular emissions, and unfavorable meteorological conditions.

Importantly, despite various air quality interventions at the national and city levels, the report finds **no consistent downward trend in PM10 concentrations across the years**, raising concerns about the effectiveness and enforcement of existing mitigation strategies. These insights call for more nuanced, **data-driven responses** tailored aligned with **local conditions**. The report provides actionable recommendations aimed at strengthening air quality management frameworks, enhancing public awareness, and guiding sustainable urban planning and regulatory reform.


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INTRODUCTION

Particulate matter (PM10) pollution remains a pressing environmental and public health challenge in India. **PM10** refers to **airborne particles with a diameter of 10 micrometers or less**, which can penetrate deep into the respiratory system, leading to severe health issues, including respiratory diseases, cardiovascular problems, and premature mortality.

This report examines **PM10 concentration trends over four years**, providing insights into **spatial and temporal variations**. This analysis aims to identify the most critically affected regions, understand contributing factors, and propose data-backed solutions. Given the rapid urbanization and industrialization in India, assessing **PM10 trends is essential for sustainable urban planning and effective environmental governance**.

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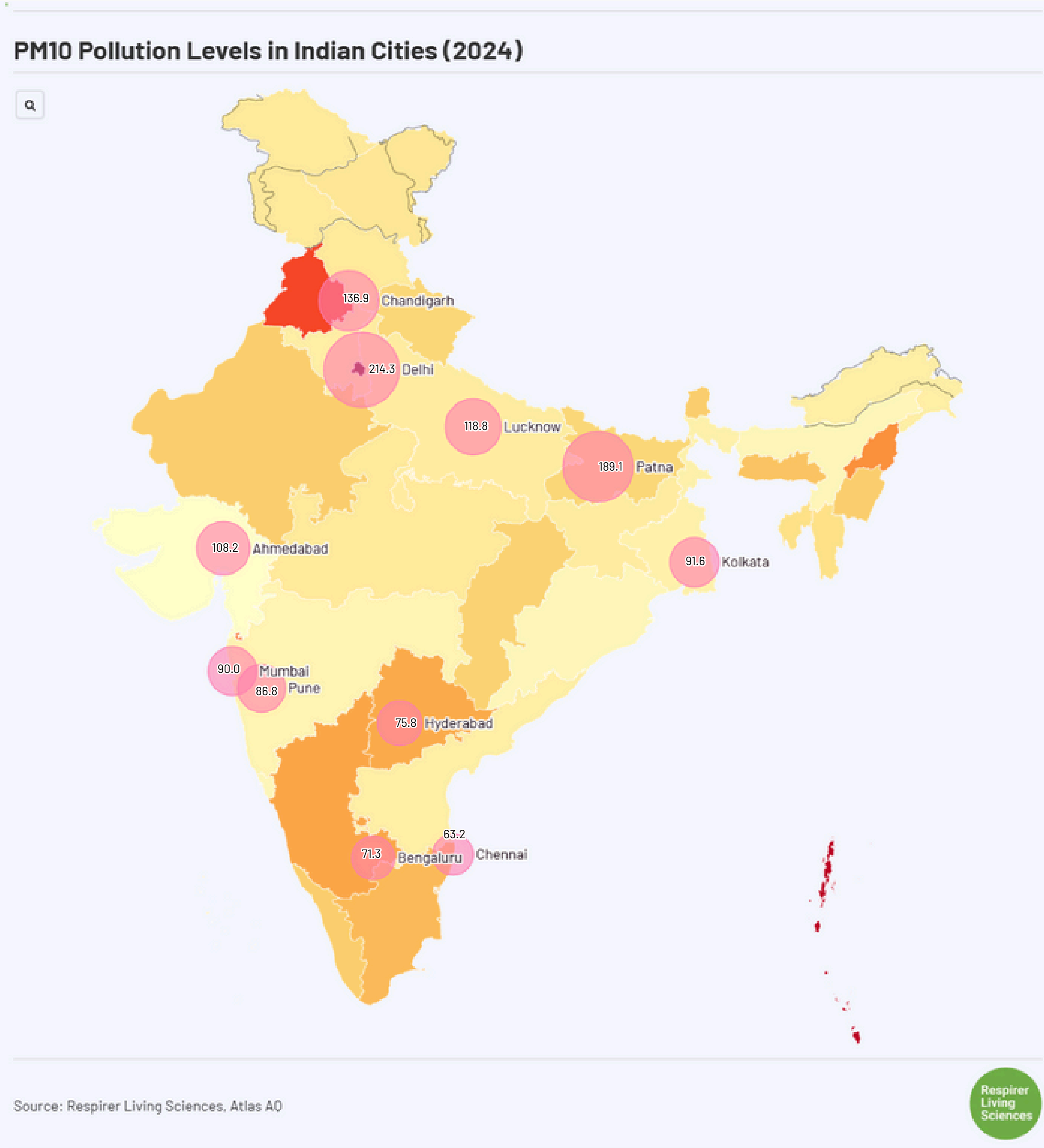
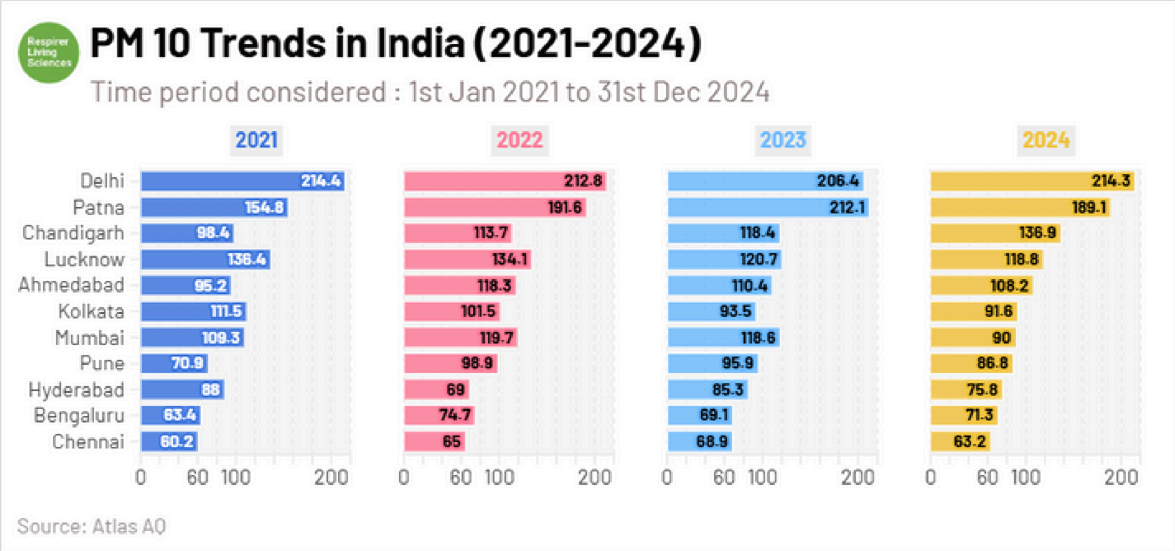
NATIONAL AIR QUALITY TRENDS (2021-2024)

The national air quality analysis reveals persistent PM10 pollution across Indian cities, with levels consistently exceeding the **safe threshold defined by NAAQS.**



This map illustrates PM10 pollution levels across major Indian cities in 2024. The data visualisation draws from AtlasAQ, highlighting regions with concerning particulate matter concentrations.



This map illustrates PM10 pollution levels across major Indian cities from 2021-2024. The data visualisation draws from AtlasAQ, highlighting regions with concerning particulate matter concentrations.

- **Overall Trends:** All analyzed cities recorded PM10 levels **surpassing 60 µg/m³**, indicating widespread air quality concerns. Several cities exhibited an upward trend in pollution levels, while a few showed slight improvements due to localized interventions.

- **Worst-Affected Cities:** Delhi consistently reported the highest PM10 concentrations, averaging **above 200 µg/m³** across all years. Other highly polluted cities include Patna, Chandigarh, and Lucknow, where PM10 levels fluctuated significantly.

- **Temporal Variations:** Seasonal variations played a crucial role in PM10 concentration, with winter months experiencing a spike in pollution levels due to temperature inversions and increased biomass burning. Summer months generally saw a reduction in PM10 levels due to improved atmospheric dispersion.

- **Declining Trends in Select Cities:** Kolkata, Mumbai, and Hyderabad showed a gradual decline in PM10 levels, likely due to enhanced air quality monitoring efforts and implementation of pollution control measures such as emission regulations, public transport enhancements, and greening initiatives.

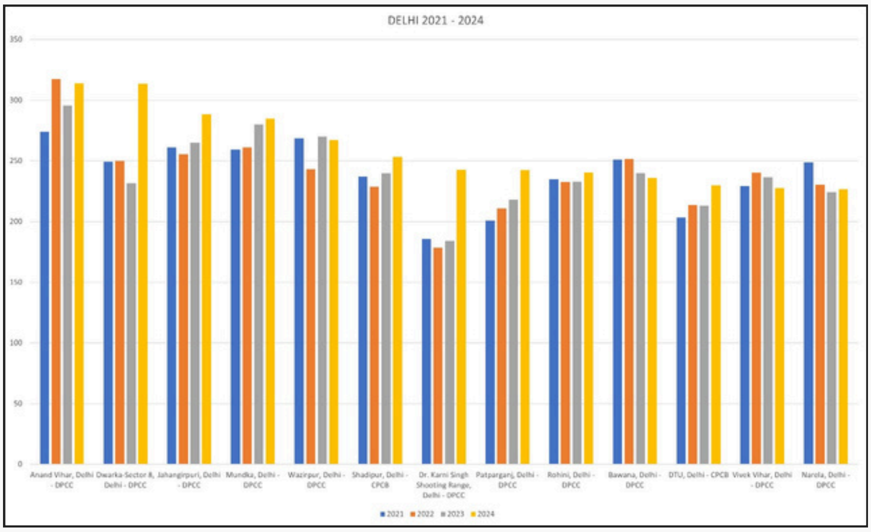
CITY-SPECIFIC ANALYSIS

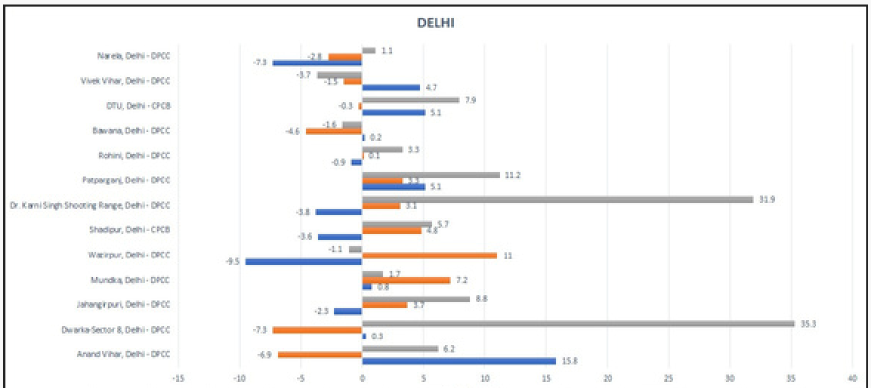
1. DELHI

Delhi continues to **record the highest PM10 levels** with consistently extreme concentrations. **Anand Vihar** remains the most polluted site, registering PM10 levels ranging from **283.7 µg/m³ in 2021 to 272.0 µg/m³ in 2024**, showing no significant improvement.Other stations showed **minor fluctuations**, but overall air quality remains **alarmingly poor** with **no discernible downward trend** over the **4 year period.**

Key Contributing Factors:

- Extreme vehicular emissions, including diesel-run transport
- High industrial activity in surrounding NCR regions
- Winter smog due to crop burning in neighbouring states
- Dust storms and construction dust





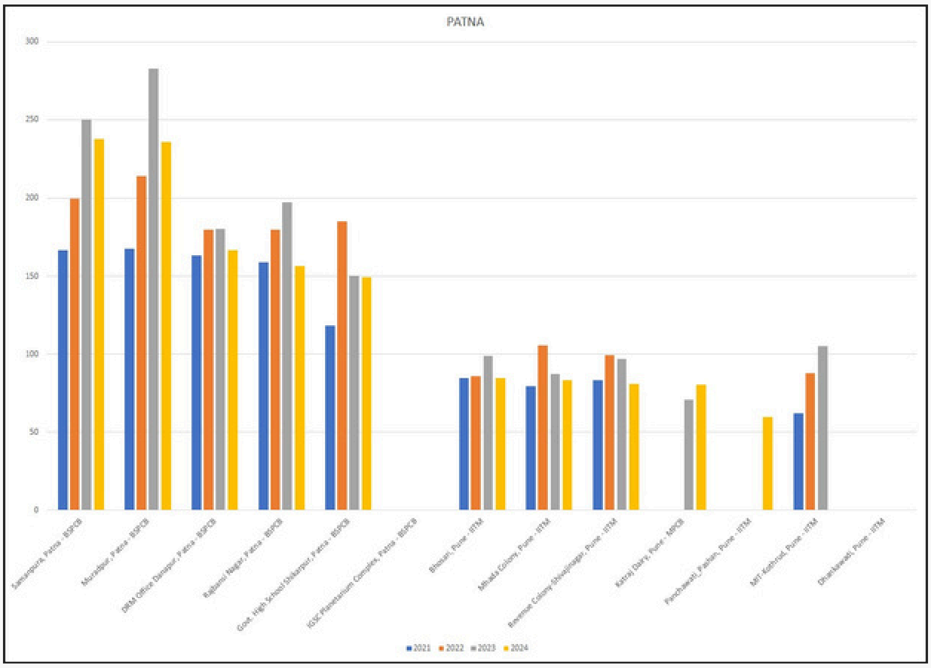
	Anand Vihar, Delhi - DPCC	Dwarka-Sector 8, Delhi - DPCC	Jahangirpuri, Delhi - DPCC	Mundka, Delhi - DPCC	Wazirpur, Delhi - DPCC	Shadipur, Delhi - CPCB	Dr. Karni Singh Shooting Range, Delhi - DPCC	Patparganj, Delhi - DPCC	Rohini, Delhi - DPCC	Bawana, Delhi - DPCC	DTU, Delhi - CPCB	Vivek Vihar, Delhi - DPCC	Narela, Delhi - DPCC
%inc (2023-2024)	6.2	35.3	8.8	1.7	-1.1	5.7	31.9	11.2	3.3	-1.6	7.9	-3.7	1.1
%inc (2022-2023)	-6.9	-7.3	3.7	7.2	11	4.8	3.1	3.3	0.1	-4.6	-0.3	-1.5	-2.8
%inc (2021-2022)	15.8	0.3	-2.3	0.8	-9.5	-3.6	-3.8	5.1	-0.9	0.2	5.1	4.7	-7.3

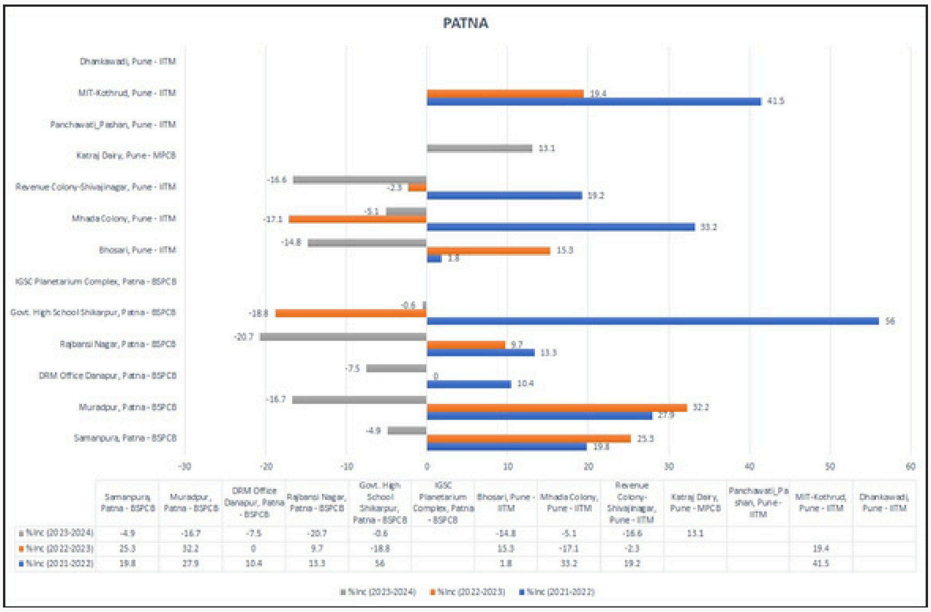
2. PATNA

Patna has **consistently high PM10 levels**. Samanpura recorded a steady rise from **166.6 µg/m³ in 2021** to **250.0 µg/m³ in 2023**, before slightly declining to **237.7 µg/m³** in **2024**. Muradpur peaked at **283.0 µg/m³ in 2023**, showing extreme pollution levels.

Key Contributing Factors:

- High vehicle density and diesel-run public transport
- Brick kilns around the city contributing to particulate pollution
- Unpaved roads and dust resuspension
- Open waste burning





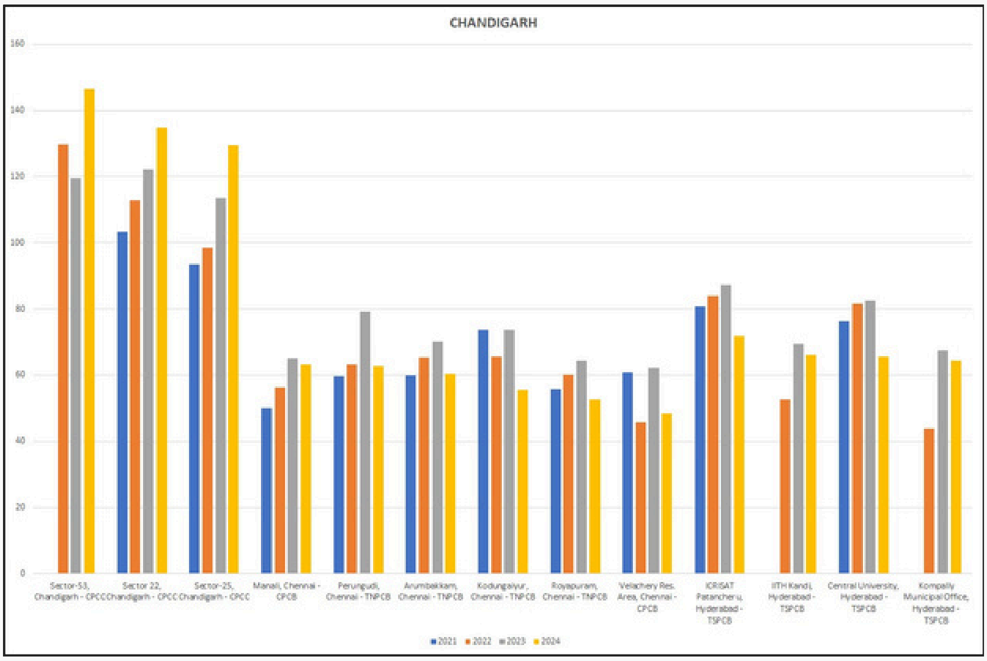
	Samanpura, Patna - BSPCB	Muradpur, Patna - BSPCB	DRM Office Danapur, Patna - BSPCB	Rajbansi Nagar, Patna - BSPCB	Govt. High School Shikarpur, Patna - BSPCB	IGSC Planetarium Complex, Patna - BSPCB	Bhosari, Pune - IITM	Mhada Colony, Pune - IITM	Revenue Colony-Shivajinagar, Pune - IITM	Katraj Dairy, Pune - MPCB	Panchawati_Pashan, Pune - IITM	MIT-Kothrud, Pune - IITM	Dhankawadi, Pune - IITM
%inc (2023-2024)	-4.9	-16.7	-7.5	-20.7	-0.6		-14.8	-5.1	-16.6	13.1			
%inc (2022-2023)	25.3	32.2	0	9.7	-18.8		15.3	-17.1	-2.3			19.4	
%inc (2021-2022)	19.8	27.9	10.4	13.3	56		1.8	33.2	19.2			41.5	

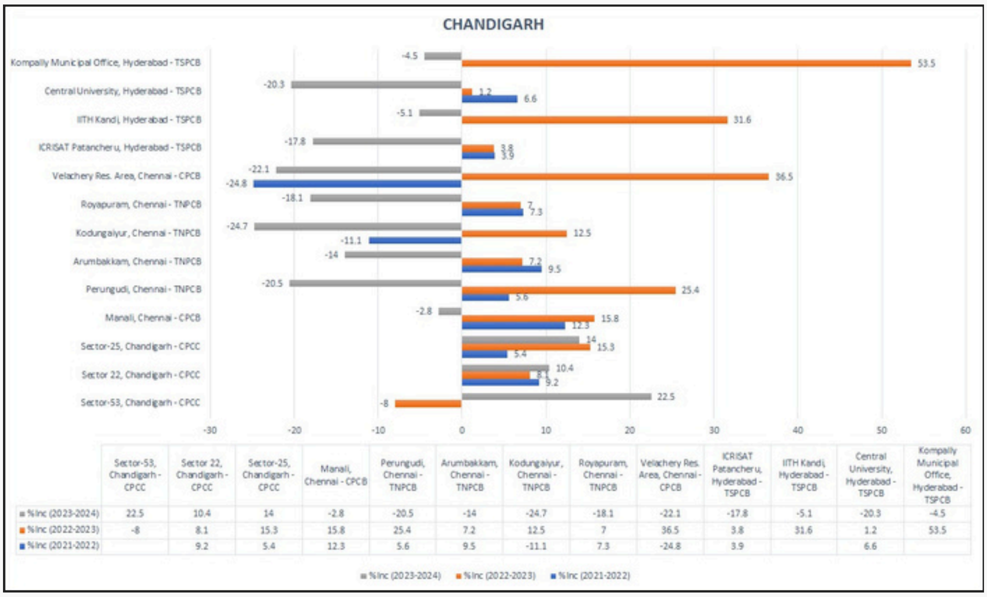
3. CHANDIGARH

All Chandigarh stations showed an **increasing trend** in PM10 levels. Sector-25 station recorded a rise from **93.5 µg/m³ in 2021** to **129.5 µg/m³ in 2024**, indicating worsening air quality.

Key Contributing Factors:

- Increasing vehicular population
- Construction activity
- Agricultural residue burning from nearby states
- Dust from unpaved roads





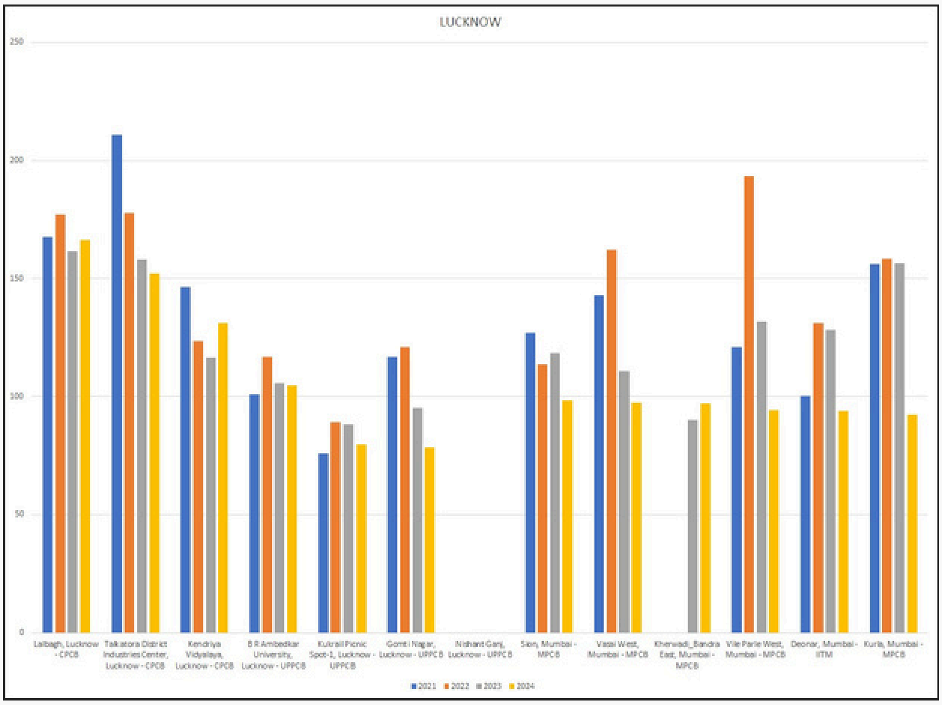
	Sector-53, Chandigarh - CPCC	Sector 22, Chandigarh - CPCC	Sector-25, Chandigarh - CPCC	Manali, Chennai - CPCB	Perungudi, Chennai - TNPCB	Arumbakkam, Chennai - TNPCB	Kodungaiyur, Chennai - TNPCB	Royapuram, Chennai - TNPCB	Velachery Res. Area, Chennai - CPCB	ICRISAT Patancheru, Hyderabad - TSPCB	IITH Kandi, Hyderabad - TSPCB	Central University, Hyderabad - TSPCB	Kompally Municipal Office, Hyderabad - TSPCB
%Inc (2023-2024)	22.5	10.4	14	-2.8	-20.5	-14	-24.7	-18.1	-22.1	-17.8	-5.1	-20.3	-4.5
%Inc (2022-2023)	-8	8.1	15.3	15.8	25.4	7.2	12.5	7	36.5	3.8	31.6	1.2	53.5
%Inc (2021-2022)		9.2	5.4	12.3	5.6	9.5	-11.1	7.3	-24.8	3.9		6.6	

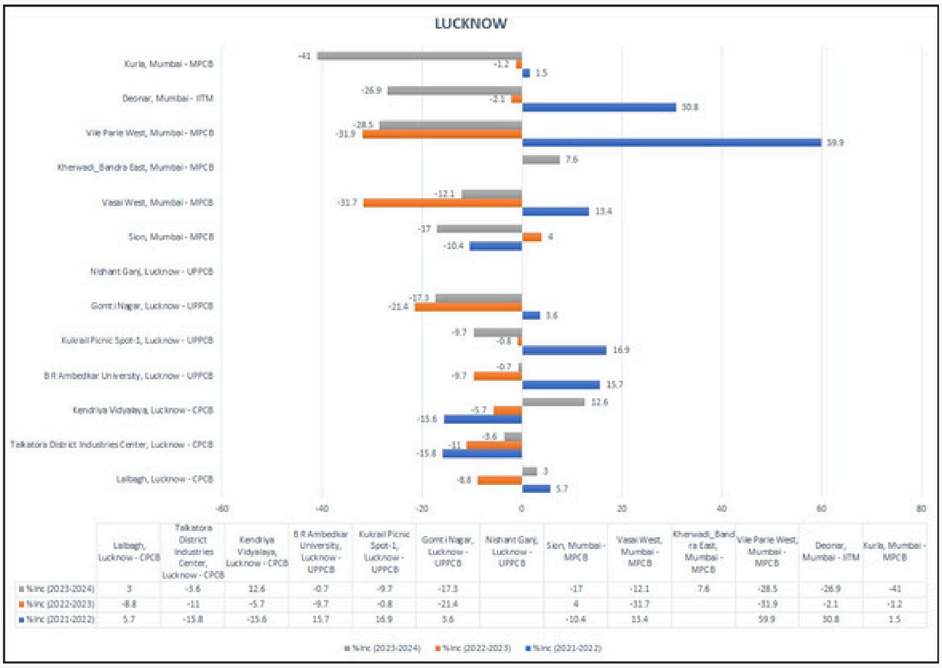
4. LUCKNOW

PM10 levels in Lucknow **remain well above NAAQS**. Lalbagh recorded **consistently high values over 160 µg/m³**. Talkatora station showed a **decreasing trend** from **211.0 µg/m³ in 2021** to **152.3 µg/m³ in 2024**, but air quality remains poor.

Key Contributing Factors:

- Unregulated construction dust
- Burning of waste and biomass
- Traffic congestion in old city areas
- Industrial emissions from nearby regions





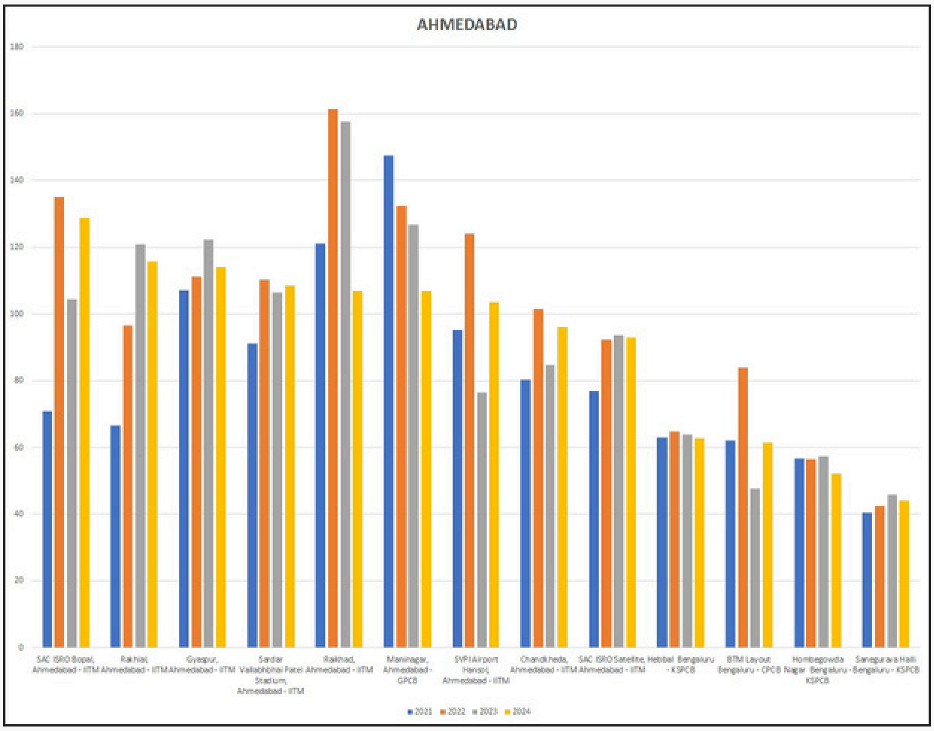
	Lalbagh, Lucknow - CPCB	Talkatora District Industries Center, Lucknow - CPCB	Kendriya Vidyalaya, Lucknow - CPCB	B R Ambedkar University, Lucknow - UPPCB	Kukrail Picnic Spot-1, Lucknow - UPPCB	Gomti Nagar, Lucknow - UPPCB	Nishant Ganj, Lucknow - UPPCB	Sion, Mumbai - MPCB	Vasai West, Mumbai - MPCB	Kherwadi_Bandra East, Mumbai - MPCB	Vile Parle West, Mumbai - MPCB	Deonar, Mumbai - IITM	Kurla, Mumbai - MPCB
%Inc (2023-2024)	3	-3.6	12.6	-0.7	-9.7	-17.3		-17	-12.1	7.6	-28.5	-26.9	-41
%Inc (2022-2023)	-8.8	-11	-5.7	-9.7	-0.8	-21.4		4	-31.7		-31.9	-2.1	-1.2
%Inc (2021-2022)	5.7	-15.8	-15.6	15.7	16.9	3.6		-10.4	13.4		59.9	30.8	1.5

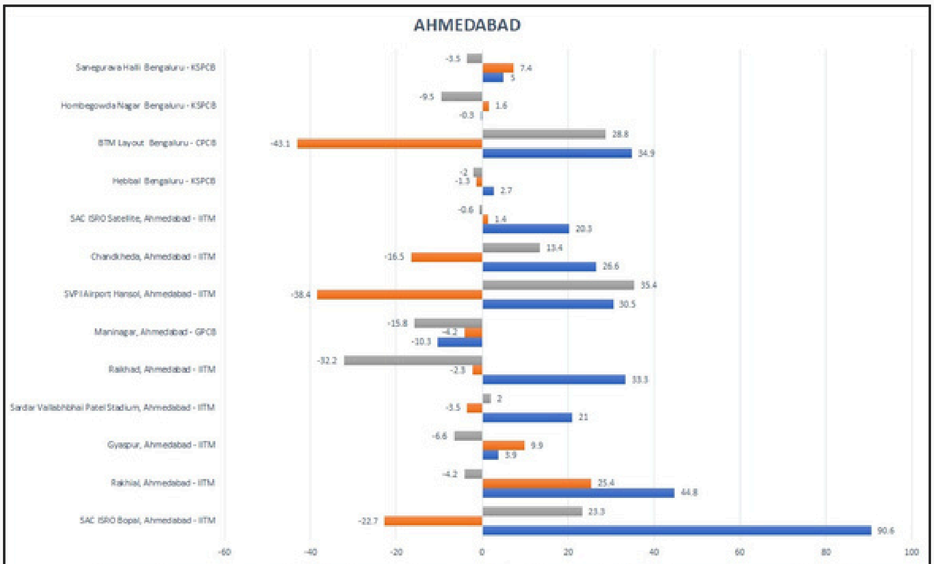
5. AHMEDABAD

Ahmedabad's PM10 levels **remain high**. SAC ISRO Bopal saw a **rise in 2022**, while Raikhad station had a **substantial drop in 2024** after previous highs.

Key Contributing Factors:

- High industrial emissions
- Road dust from heavy traffic areas
- Desert dust contribution from nearby regions
- Poor waste management and burning





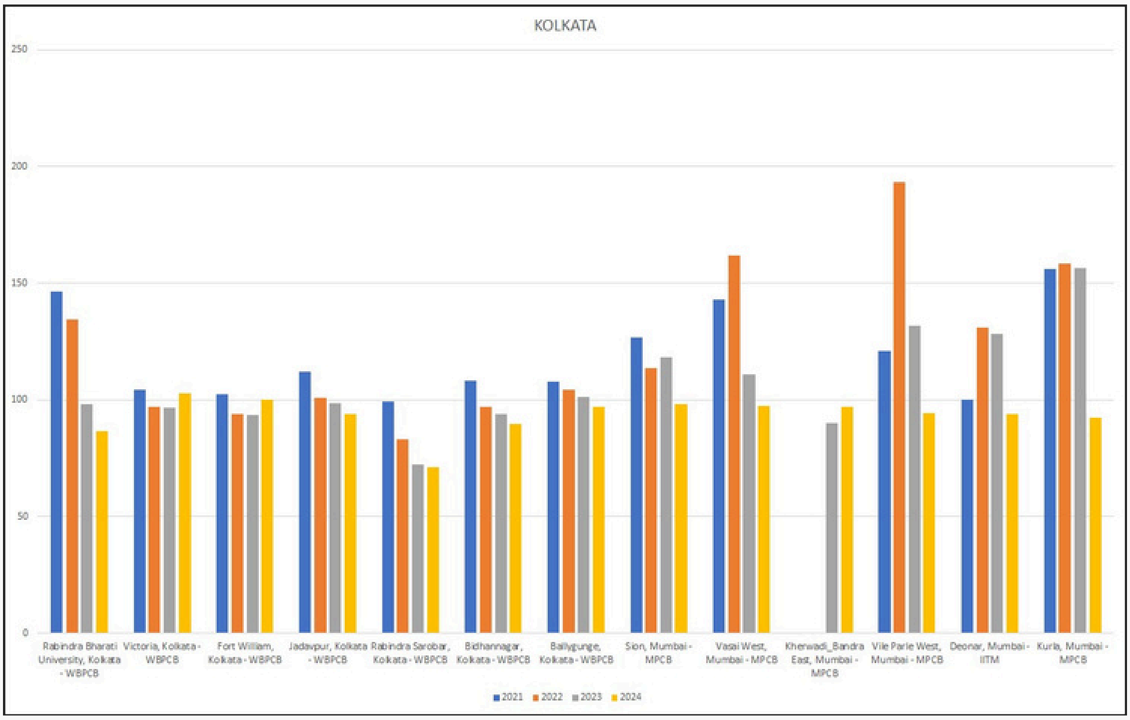
	SAC ISRO Bopal, Ahmedabad - IITM	Rakhial, Ahmedabad - IITM	Gyaspur, Ahmedabad - IITM	Sardar Vallabhbhai Patel Stadium, Ahmedabad - IITM	Raikhad, Ahmedabad - IITM	Maninagar, Ahmedabad - GPCB	SVP I Airport Hansol, Ahmedabad - IITM	Chandkheda, Ahmedabad - IITM	SAC ISRO Satellite, Ahmedabad - IITM	Hebbal Bengaluru - KSPCB	BTM Layout Bengaluru - CPCB	Hombegowda Nagar Bengaluru - KSPCB	Saneguravahalli Bengaluru - KSPCB
%inc (2023-2024)	23.3	-4.2	-6.6	2	-32.2	-15.8	35.4	13.4	-0.6	-2	28.8	-9.5	-3.5
%inc (2022-2023)	-22.7	25.4	9.9	-3.5	-2.5	-4.2	-38.4	-16.5	1.4	-1.3	-43.1	1.6	7.4
%inc (2021-2022)	90.6	44.8	3.9	21	33.3	-10.3	30.5	26.6	20.3	2.7	34.9	-0.3	5

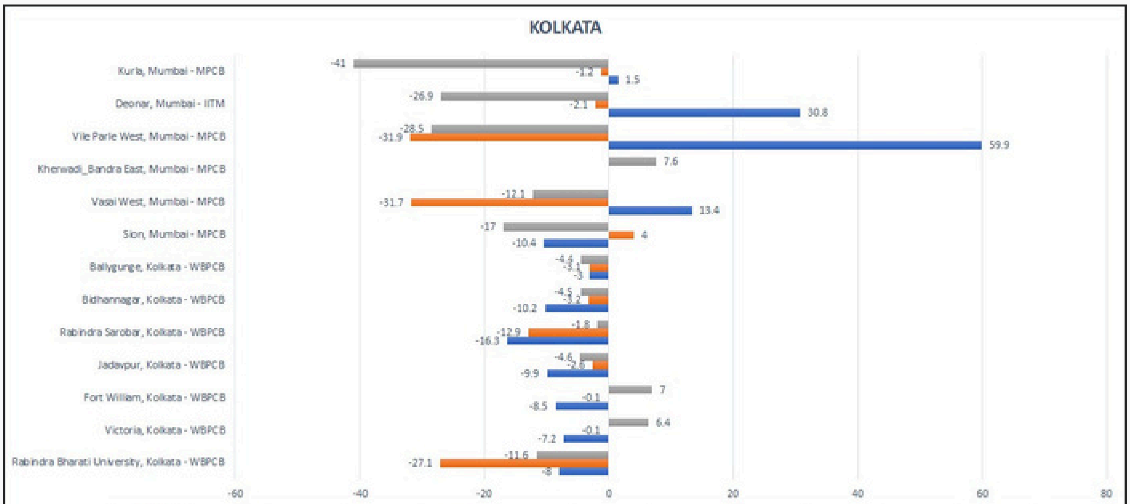
6. KOLKATA

Kolkata's **PM10 levels show an overall decline** but still exceed safe limits. Rabindra Bharati University recorded a drop from **146.4 µg/m³ in 2021** to **86.7 µg/m³ in 2024**.

Key Contributing Factors:

- High traffic and vehicular emissions
- Industrial pollution in suburban areas
- Seasonal variation due to temperature inversion
- Riverbank construction dust





	Rabindra Bharati University, Kolkata - WBPCB	Victoria, Kolkata - WBPCB	Fort William, Kolkata - WBPCB	Jadavpur, Kolkata - WBPCB	Rabindra Sarobar, Kolkata - WBPCB	Bidhannagar, Kolkata - WBPCB	Ballygunge, Kolkata - WBPCB	Sion, Mumbai - MPCB	Vasai West, Mumbai - MPCB	Kherwadi_Bandra East, Mumbai - MPCB	Vile Parle West, Mumbai - MPCB	Deonar, Mumbai - IITM	Kurla, Mumbai - MPCB
%Inc (2023-2024)	-11.6	6.4	7	-4.6	-1.8	-4.5	-4.4	-17	-12.1	7.6	-28.5	-26.9	-41
%Inc (2022-2023)	-27.1	-0.1	-0.1	-2.6	-12.9	-3.2	-3.1	4	-31.7		-31.9	-2.1	-1.2
%Inc (2021-2022)	-8	-7.2	-8.5	-9.9	-16.3	-10.2	-3	-10.4	13.4		59.9	30.8	1.5

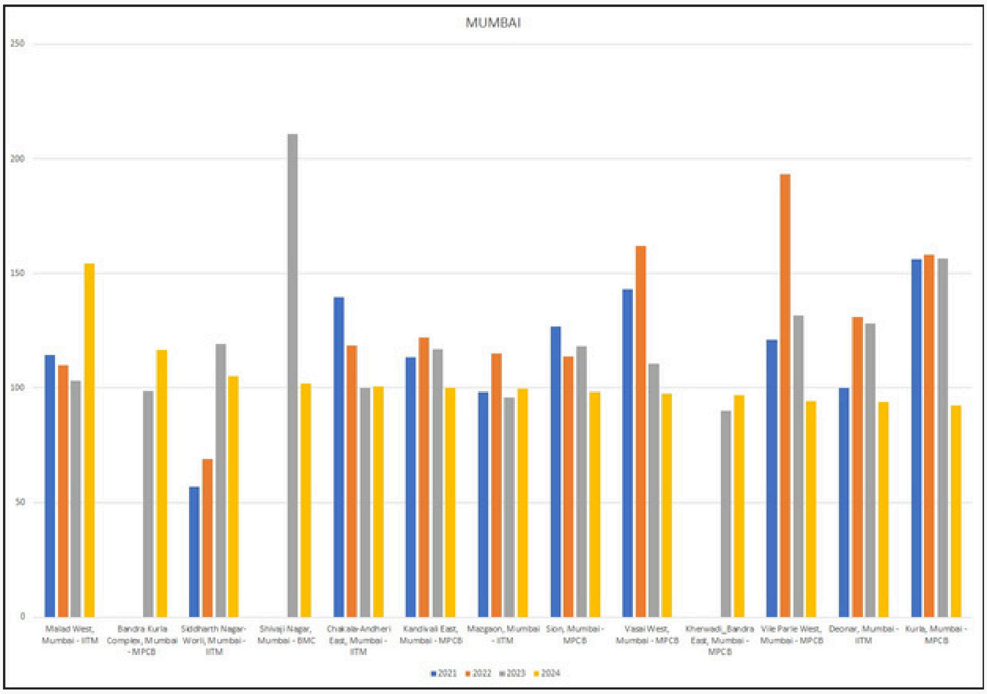
%Inc (2023-2024) %Inc (2022-2023) %Inc (2021-2022)

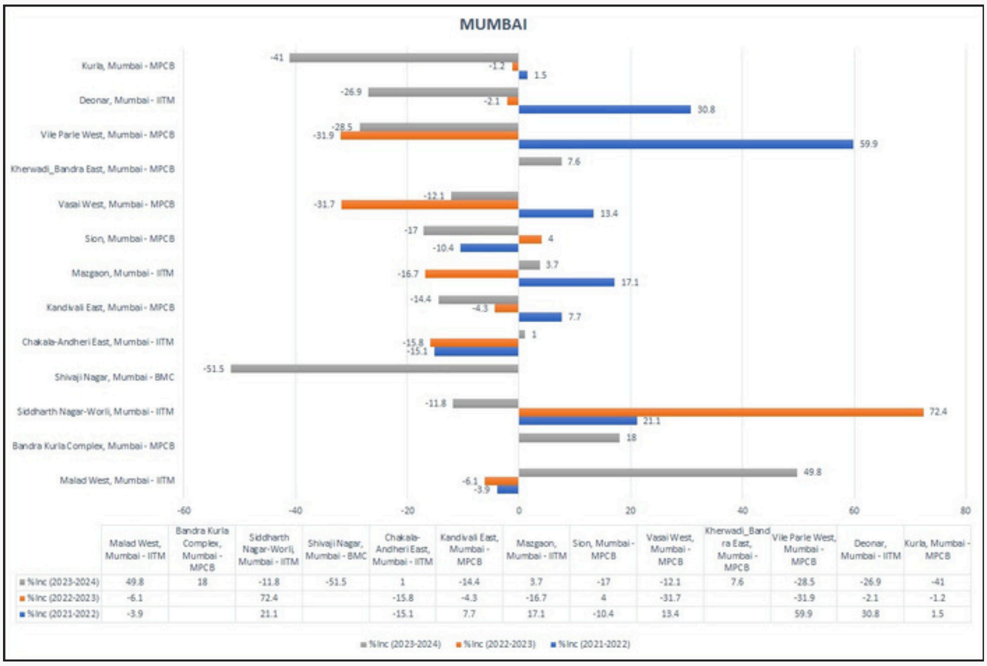
7. MUMBAI

Mumbai's PM10 levels vary by location. Shivaji Nagar recorded **211.0 µg/m³ in 2021**, but levels dropped in later years. However, Malad West station saw a **substantial increase in 2024**, reaching **154.5 µg/m³**.

Key Contributing Factors:

- Heavy traffic emissions and congestion
- Industrial and port-related pollution
- Coastal humidity affecting particulate suspension
- High construction activity





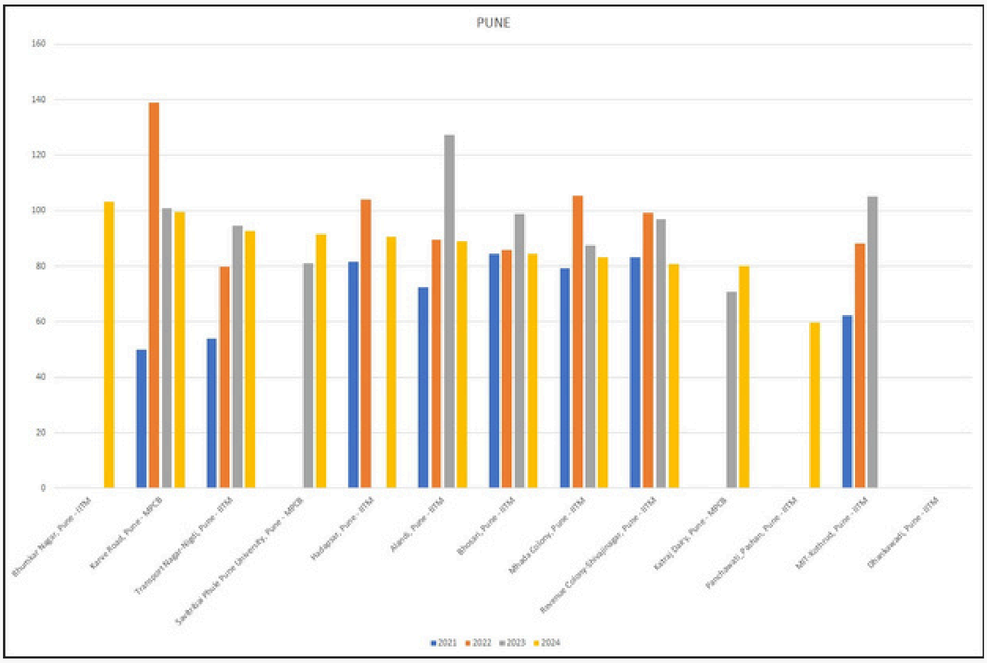
	Malad West, Mumbai - IITM	Bandra Kurla Complex, Mumbai - MPCB	Siddharth Nagar-Worli, Mumbai - IITM	Shivaji Nagar, Mumbai - BMC	Chakala-Andheri East, Mumbai - IITM	Kandivali East, Mumbai - MPCB	Mazgaon, Mumbai - IITM	Sion, Mumbai - MPCB	Vasai West, Mumbai - MPCB	Kherwadi_Bandra East, Mumbai - MPCB	Vile Parle West, Mumbai - MPCB	Deonar, Mumbai - IITM	Kurla, Mumbai - MPCB
%Inc (2023-2024)	49.8	18	-11.8	-51.5	1	-14.4	3.7	-17	-12.1	7.6	-28.5	-26.9	-41
%Inc (2022-2023)	-6.1		72.4		-15.8	-4.3	-16.7	4	-31.7		-31.9	-2.1	-1.2
%Inc (2021-2022)	-3.9		21.1		-15.1	7.7	17.1	-10.4	13.4		59.9	30.8	1.5

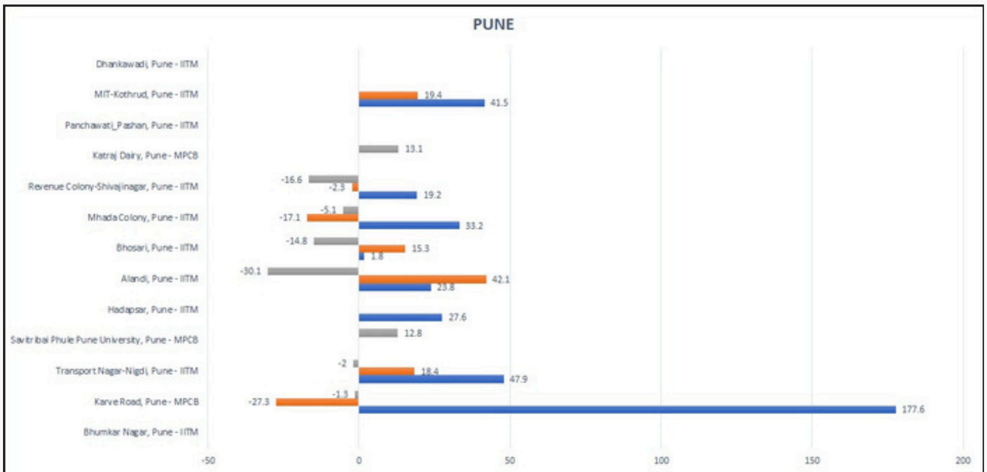
8. PUNE

Pune exhibits **significant variations** in PM10 levels across monitoring stations. Karve Road saw a **177.6% increase** from **50.0 µg/m³ in 2021** to **138.9 µg/m³ in 2022**, before dropping to 99.6 µg/m³ in 2024. Alandi station had a **42.1% increase in PM10 from 2022 to 2023**, followed by a **30.1% decline in 2024**, highlighting high spatial and temporal variability.

Key Contributing Factors:

- Traffic congestion and vehicular emissions
- Road dust and construction activities
- Industrial emissions
- Seasonal variations affecting air quality





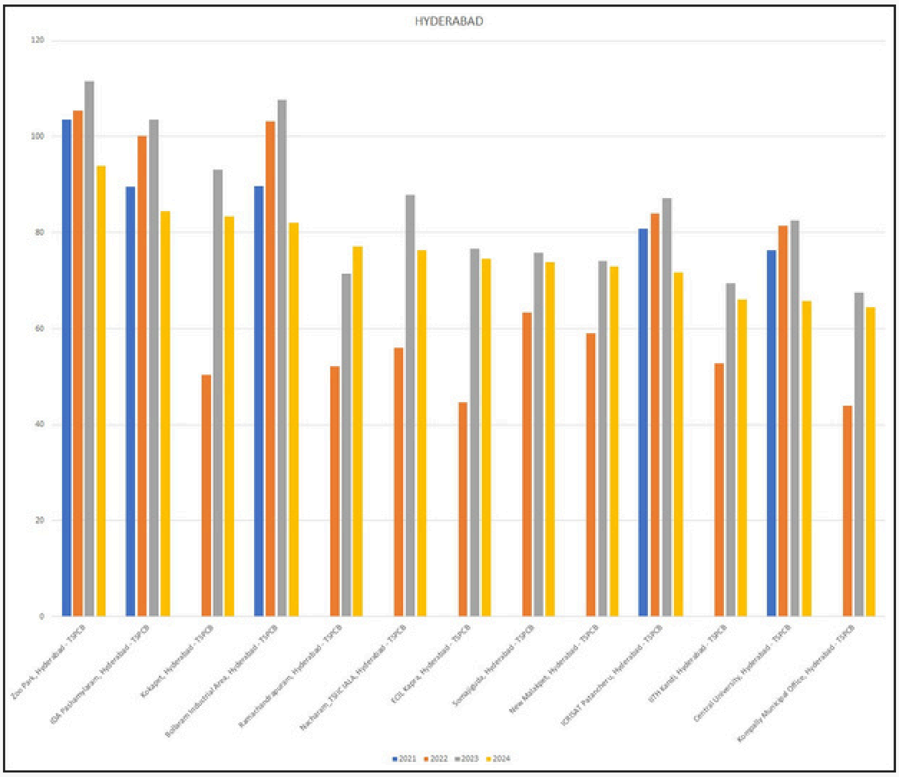
	Bhumkar Nagar, Pune - IITM	Karve Road, Pune - MPCB	Transport Nagar-Nigdi, Pune - IITM	Savitribai Phule Pune University, Pune - MPCB	Hadapsar, Pune - IITM	Alandi, Pune - IITM	Bhosari, Pune - IITM	Mhada Colony, Pune - IITM	Revenue Colony-Shivajinagar, Pune - IITM	Katraj Dairy, Pune - MPCB	Panchawati_Pashan, Pune - IITM	MIT-Kothrud, Pune - IITM	Dhankawadi, Pune - IITM
%Inc (2023-2024)		-1.3	-2	12.8		-30.1	-14.8	-5.1	-16.6	13.1			
%Inc (2022-2023)		-27.3	18.4			42.1	15.3	-17.1	-2.3			19.4	
%Inc (2021-2022)		177.6	47.9		27.6	23.8	1.8	33.2	19.2			41.5	

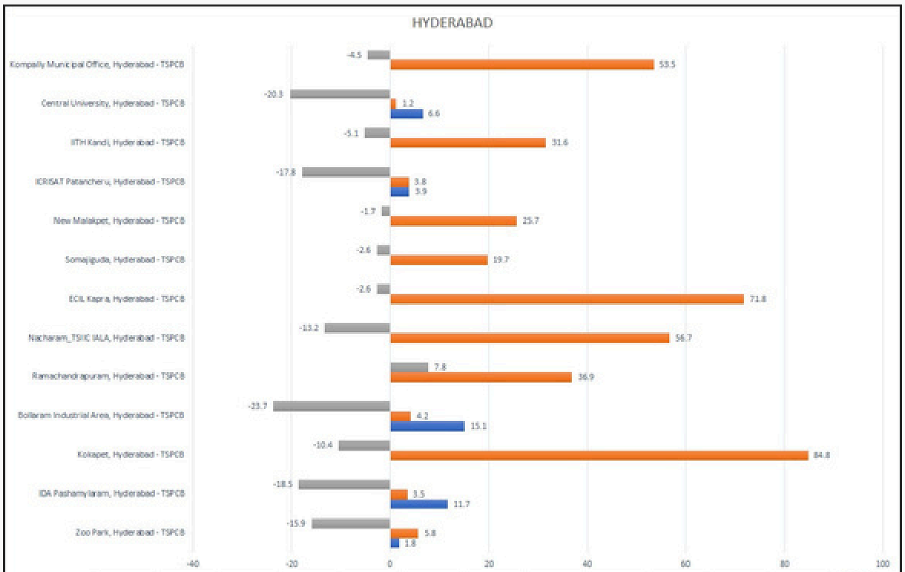
9. HYDERABAD

Hyderabad's stations display **mixed trends**. Kokapet saw a **rise from 50.4 µg/m³ in 2021** to **84.8 µg/m³ in 2024**, whereas Central University showed a **decline in 2024**.

Key Contributing Factors:

- High-tech industry emissions
- Traffic congestion around commercial hubs
- Urbanization and construction projects
- Dust storms from surrounding arid regions





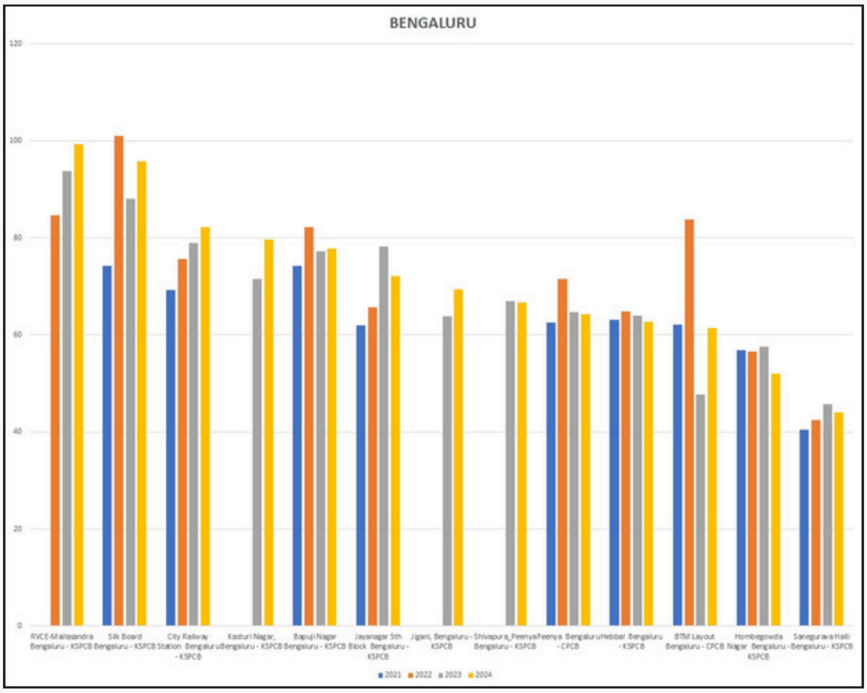
	Zoo Park, Hyderabad - TSPCB	IDA Pashamylaram, Hyderabad - TSPCB	Kokapet, Hyderabad - TSPCB	Bollaram Industrial Area, Hyderabad - TSPCB	Ramachandrapuram, Hyderabad - TSPCB	Nacharam_TSIIC IALA, Hyderabad - TSPCB	ECIL Kapra, Hyderabad - TSPCB	Somajiguda, Hyderabad - TSPCB	New Malakpet, Hyderabad - TSPCB	ICRISAT Patancheru, Hyderabad - TSPCB	IITH Kandi, Hyderabad - TSPCB	Central University, Hyderabad - TSPCB	Kompally Municipal Office, Hyderabad - TSPCB
%Inc (2023-2024)	-15.9	-18.5	-10.4	-23.7	7.8	-13.2	-2.6	-2.6	-1.7	-17.8	-5.1	-20.3	-4.5
%Inc (2022-2023)	5.8	3.5	84.8	4.2	36.9	56.7	71.8	19.7	25.7	3.8	31.6	1.2	53.5
%Inc (2021-2022)	1.8	11.7		15.1						3.9		6.6	

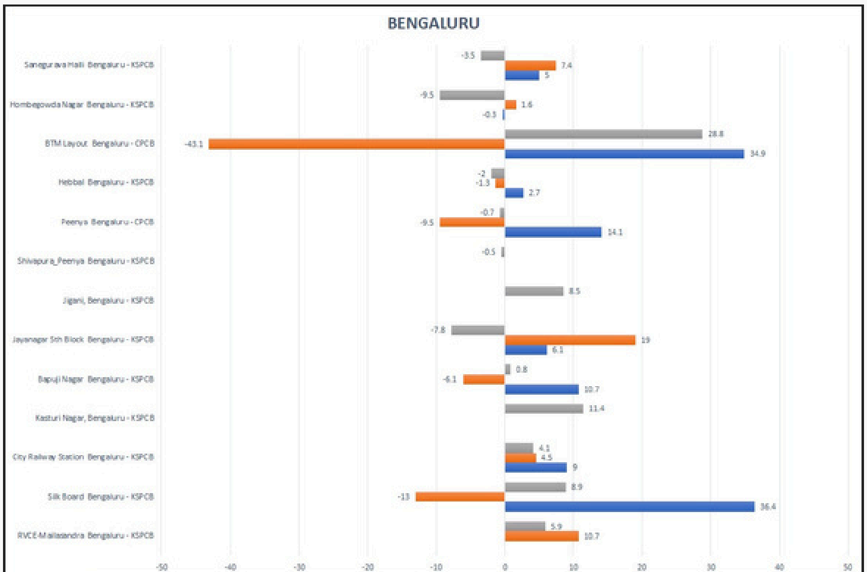
10. BENGALURU

Bengaluru's PM10 levels **varied across stations**. Silk Board saw a **sharp increase in 2022**, while Hombegowda Nagar recorded **lower levels compared to other cities**, though still **above NAAQS**.

Key Contributing Factors:

- IT corridor traffic congestion
- High construction activity in expanding urban zones
- Open waste burning
- Dry weather conditions worsening dust suspension





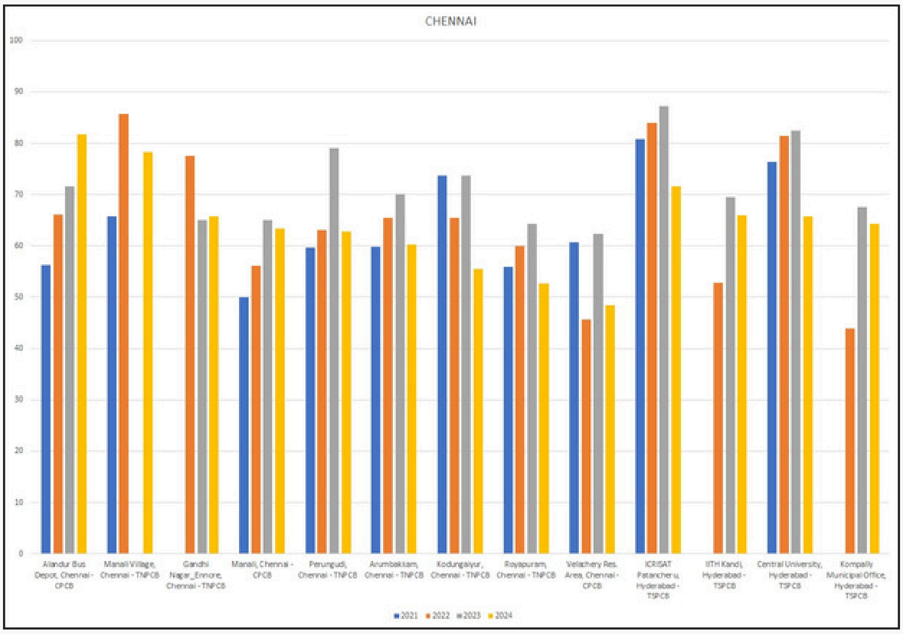
	RVCE-Mailasandra Bengaluru - KSPCB	Silk Board Bengaluru - KSPCB	City Railway Station Bengaluru - KSPCB	Kasturi Nagar, Bengaluru - KSPCB	Bapuji Nagar Bengaluru - KSPCB	Jayanagar 5th Block Bengaluru - KSPCB	Jigani, Bengaluru - KSPCB	Shivapura_Peenya Bengaluru - KSPCB	Peenya Bengaluru - CPCB	Hebbal Bengaluru - KSPCB	BTM Layout Bengaluru - CPCB	Hombegowda Nagar Bengaluru - KSPCB	Sanegurava Halli Bengaluru - KSPCB
%inc (2023-2024)	5.9	8.9	4.1	11.4	0.8	-7.8	8.5	-0.5	-0.7	-2	28.8	-9.5	-3.5
%inc (2022-2023)	10.7	-13	4.5		-6.1	19			-9.5	-1.3	-43.1	1.6	7.4
%inc (2021-2022)		36.4	9		10.7	6.1			14.1	2.7	34.9	-0.3	5

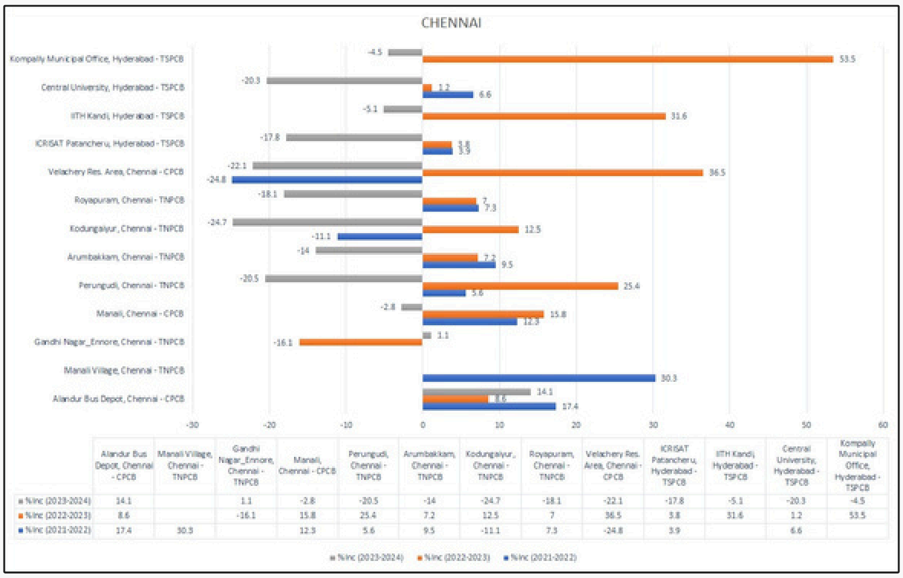
11. CHENNAI

Chennai had **relatively lower PM10 levels**, but most stations still exceeded NAAQS. Alandur Bus Depot saw an increase from **56.3 µg/m³ in 2021** to **81.8 µg/m³ in 2024**.

Key Contributing Factors:

- Vehicular emissions from congested areas
- Shipping and port-related pollution
- Industrial emissions in nearby areas
- Sea salt aerosols affecting PM10 concentration





	Alandur Bus Depot, Chennai - CPCB	Manali Village, Chennai - TNPCB	Gandhi Nagar_Ennore, Chennai - TNPCB	Manali, Chennai - CPCB	Perungudi, Chennai - TNPCB	Arumbakkam, Chennai - TNPCB	Kodungaiyur, Chennai - TNPCB	Royapuram, Chennai - TNPCB	Velachery Res. Area, Chennai - CPCB	ICRISAT Patancheru, Hyderabad - TSPCB	IITH Kandi, Hyderabad - TSPCB	Central University, Hyderabad - TSPCB	Kompally Municipal Office, Hyderabad - TSPCB
%inc (2023-2024)	14.1		1.1	-2.8	-20.5	-14	-24.7	-18.1	-22.1	-17.8	-5.1	-20.3	-4.5
%inc (2022-2023)	8.6		-16.1	15.8	25.4	7.2	12.5	7	36.5	3.8	31.6	1.2	53.5
%inc (2021-2022)	17.4	30.3		12.3	5.6	9.5	-11.1	7.3	-24.8	3.9		6.6	

RECOMMENDATIONS

Based on the observed trends, targeted interventions are necessary to combat PM10 pollution effectively:

01 Strengthening Emission Controls

Enforce stringent emission norms for industries and vehicles, focusing on high-pollution zones like Delhi, Patna, and Lucknow.

02 Expanding Green Infrastructure

Promote urban afforestation, rooftop gardens, and green corridors to act as natural air filters.

03 Improving Public Transport

Develop efficient and affordable mass transit systems to reduce private vehicle dependency and associated emissions.

04 Enhanced Monitoring & Data Transparency

Increase the number of real-time air quality monitoring stations and ensure public accessibility to air quality data.

05 Targeted Policy Interventions

Implement location-specific air pollution control strategies, considering regional meteorological conditions and major pollution sources.

06 Regulating Construction Activities

Mandate dust control measures, use of cleaner construction materials, and restrictions on site operations during peak pollution periods.

CONCLUSION

The findings from this **PM10 trend analysis** highlight the **persistent air pollution challenges across Indian cities**. While certain regions have shown marginal improvements, air quality remains a major concern, with significant implications for **public health and urban sustainability.**

Addressing PM10 pollution demands a **collaborative approach** involving government agencies, industries, urban planners, and the public. **Stricter enforcement of pollution control regulations, technological advancements, and community-driven initiatives** can contribute to long-term improvements in air quality.

This report underscores the urgent need for **data-driven policy actions** to create sustainable urban environments and protect public health. The insights provided should serve as a roadmap for stakeholders committed to reducing air pollution and ensuring a **healthier future for Indian cities**.

Photo: Unsplash | Carolina Avinceta

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.**

For more details visit our website: Respirer.in

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