

Realizing NCAP's Health Promise: Indian Evidence and Recommendations for National Clean Air Programme Reform

Maharashtra carries India's highest NCAP non-attainment city count. The evidence of health harm is concentrated where the pollution burden is highest across India's most industrialised and urbanised state. The opportunity to lead is Maharashtra's.

This policy brief responds to a felt and recognized gap in India's clean air policy discourse: the absence of a synthesis of India's own evidence on the health consequences of air pollution. Every study, dataset, and institutional source cited in this brief is India-generated - drawn from Indian cohorts, Indian registries, Indian surveillance systems, and Indian research institutions. India has produced substantial primary evidence on air pollution and health; what is needed is a formal recognition within the Government of Maharashtra that air pollution is not only an environment compliance challenge - it is a health burden that Maharashtra's health system is already carrying, without formally knowing its cause.

1 India's Clean Air Progress - and the Health Opportunity Ahead

India is home to some of the most polluted cities on earth. Many cities in the Indo-Gangetic Plain including Delhi, Siwan, Greater Noida, Patna, and Lucknow rank among the world's most polluted¹. Yet the air pollution challenge is not confined to large cities alone. Annual PM_{2.5} concentrations across Indian cities consistently exceed India's own Central Pollution Control Board (CPCB) standard (40 µg/m³)². In 2024, annual average concentrations of PM₁₀ and PM_{2.5} exceeded national ambient air quality standards (NAAQS), among cities with continuous CPCB monitoring stations, in 43 and 23 cities respectively³. A programme designed to protect Indian lives should also include places where most of those lives, and most of that burden, is actually located. It is against this backdrop that India's own research institutions have spent two decades documenting what this pollution does to Indian bodies and that evidence now demands a policy response.

108 of 130

NCAP cities fall short of India's NAAQS PM₁₀ standard in FY 2024-25 after six years and ₹13,000+ crore of the programme

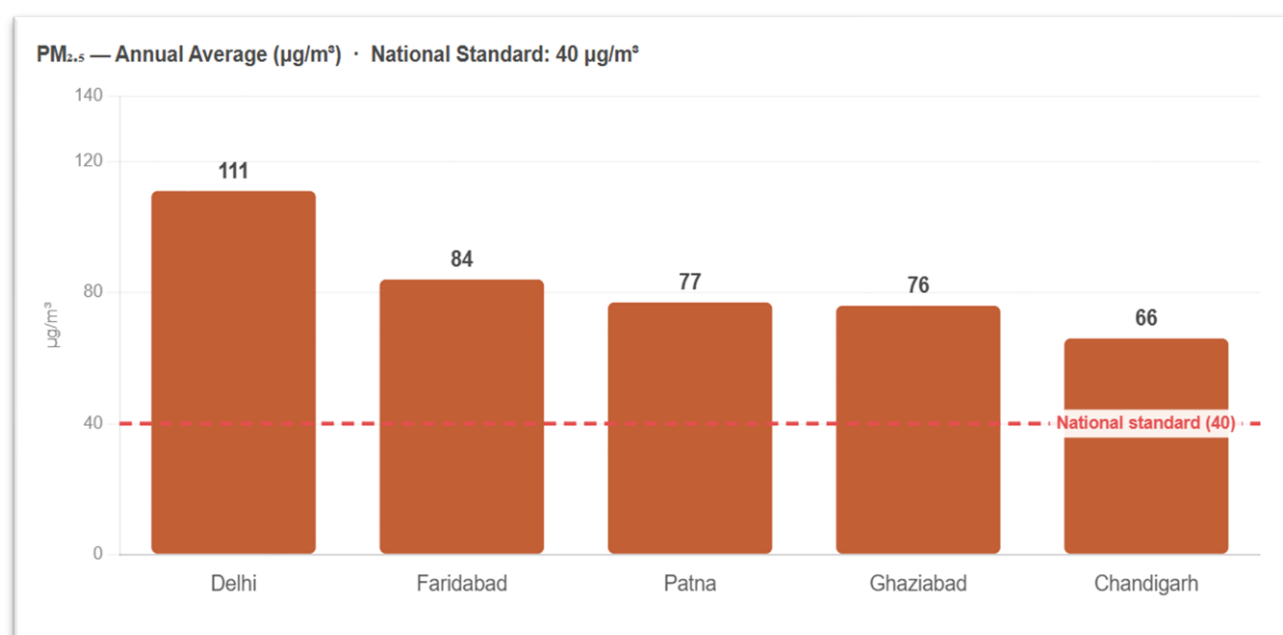
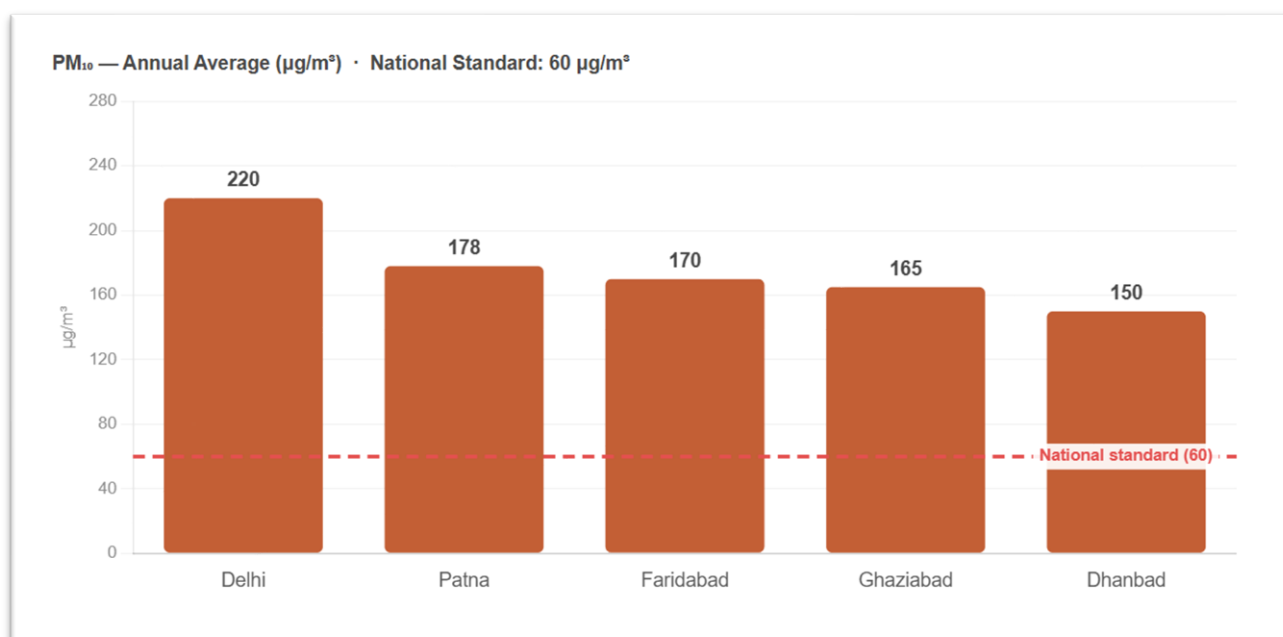
MoEFCC, Lok Sabha, December 2025⁴

51%

of released NCAP funds utilized by 82 MoEFCC-funded cities (₹831 cr of ₹1,616 cr released) - a utilization challenge alongside the health challenge

CSE, An Agenda for Reform, July 2024⁵

Top 5 polluted cities in India by PM₁₀ & PM_{2.5} concentration (2024)



Source: Central Pollution Control Board (CPCB), Annual Report 2024-25, MoEFCC, Government of India³

Within this broader challenge, NCAP's own performance data tells a partial but important story. In FY 2024-25, 103 of 130 NCAP cities showed improvement in PM₁₀ concentrations compared to the 2017-18 baseline, yet only 22 cities actually conform to India's own NAAQS⁴. While the trend is improving, 108 cities still do not meet India's own standard. More critically, NCAP targets remain pegged to PM₁₀, not PM_{2.5}, the finer particulate that penetrates deeper into lung tissue and carries stronger dose-response links to cardiovascular mortality. PM_{2.5} penetrates the blood-brain barrier, and has documented impacts on neurological health as well. **A programme benchmarked against the less health-relevant pollutant, and scoped only to cities, is misaligned with the burden it was actually designed to address. The health consequences of this pollution are not confined to the lungs.**

Evidence generated through Government of India surveillance and research systems consistently demonstrates that air pollution affects multiple organ systems and disease categories across the life course.

The question before Maharashtra is not whether its cities carry a serious pollution-health burden. They do. The question is whether Maharashtra will be the first state to formally connect that burden to its health data - making Pune and Nagpur the proof of concept for health-accountable clean air governance that India needs at national scale.

2 The Evidence: What Indian Research Has Established

A substantial and growing body of primary research, generated by the very institutions that underpin India's tobacco control policy, non-communicable disease (NCD) burden estimates, and maternal health guidelines, documents the health consequences of air pollution across multiple outcomes and populations. The stakes extend beyond domestic health policy. Meeting Sustainable Development Goals (SDG) is not achievable in India without substantially reducing the health burden of air pollution⁶. Air pollution is not a parallel agenda to NCDs; it is one of its primary drivers.

The Government of India routinely relies on evidence in public health generated by institutions such as All India Institute of Medical Sciences, Indian Council of Medical Research, Public Health Foundation of India, the Indian Institutes of Technology, and Sri Ramachandra Institute of Higher Education and Research. These same institutions generate evidence on air pollution and health; hence its integration into clean air policy would be consistent with established evidence-based governance processes.

Evidence by Health Outcome and Intervention Response

Health Outcome	Key Indian Findings and Institution	Study / Source
Cardiovascular - Hypertension	PM _{2.5} exposure associated with elevated systolic blood pressure and significantly higher incidence of hypertension in urban Delhi adults. Prospective cohort design; 5,342 participants. <i>PHFI / AIIMS-CARRS Cohort, Delhi</i>	Prabhakaran D et al. (2020) ⁷
Metabolic - Type 2 Diabetes	22% higher incidence of type 2 diabetes per 10 µg/m ³ increase in annual average PM _{2.5} (HR 1.22; 95% CI 1.09-1.36) among 12,064 participants in Delhi and Chennai. Among the first prospective cohort evidence on PM _{2.5} and diabetes from Indian urban populations. <i>PHFI - CARRS Cohort, Delhi & Chennai</i>	Mandal S et al. (2023) ⁸

Respiratory - Children	Indoor PM _{2.5} and NO ₂ significantly elevated in homes of children with respiratory illness in an industrial area of Delhi. Lung function impairment documented in Ashok Vihar children; exposure- response relationship demonstrated. <i>Delhi-based research group</i>	Kumar R et al. (2007, 2008) ^{9,10}
Health Outcome	Key Indian Findings and Institution	Study / Source
Respiratory - Urban Slums	Indoor PM and Respirable Suspended Particulate Matter (RSPM) levels in Nizamuddin slum households in Delhi significantly elevated above reference levels; associated respiratory health effects documented among residents in poorly ventilated housing. <i>IIT Delhi / Delhi University</i>	Kulshreshtha P et al. (2008) ¹¹
Respiratory - Rural Women	Both obstructive and restrictive lung defects documented in women and children exposed to biomass cookstove emissions in rural Tamil Nadu. PM _{2.5} identified as the primary driver. <i>Multi-institutional, rural Tamil Nadu</i>	Patel et al. (2018) ¹²
Cancer - Lung	ICMR-NCDIR documents higher lung cancer incidence in India's most polluted metro cities. Lung cancer incidence has shown a significant upward trend in Indian metro cities. <i>National Cancer Registry Programme, Bengaluru</i>	Nath et al. (2022) ¹³
Systemic - Vitamin D	Children aged 9-24 months in high-pollution locality in Delhi had mean serum vitamin D of 12.4 ng/ml less than half of the requirement from low-pollution area. (p<0.001). This demonstrates pollution's reach beyond respiratory and cardiovascular systems. <i>St. Stephen's Hospital, Delhi</i>	Agarwal KS et al. (2002) ¹⁴
Intervention - BP & Oxidative Stress	Portable HEPA air filtration in an all-female old-age home in Rohtak, Haryana (29 participants) showed statistically significant improvement in systolic blood pressure (p<0.001) during active vs. sham filtration, with CRP and oxidative DNA damage as secondary outcomes. <i>PGIMS, Rohtak, Haryana</i>	Ahuja A et al. (2025) ¹⁵

Intervention evidence Natural Experiment - Lockdown	COVID-19 lockdown (2020) caused approximately 50% PM _{2.5} reductions across Delhi, Mumbai, and Kolkata documented by CPCB monitoring data and peer-reviewed analysis. This demonstrated that targeted emission controls can achieve rapid, measurable air quality improvements, providing India-specific empirical evidence that policy-driven source reduction works. <i>Multiple Indian universities</i>	Dhaka SK et al. (2020) and Mandal J et al. (2021) ^{16,17}
Mortality	Every 25 µg/m ³ increase in PM _{2.5} associated with 0.8% increase in daily non-accidental mortality in Delhi; 1.5% increase among adults aged 60 and above. Short-term exposure time-series analysis; 700,512 deaths recorded June 2010–December 2016. <i>PHFI / Centre for Policy Research, Delhi</i>	Krishna B et al. (2021) ²¹

The studies presented are drawn from a broader peer-reviewed evidence base. Health Effects Institute's global burden of disease evidence portal lists 647 Indian studies, and approximately 200 peer-reviewed studies document direct human health outcome evidence from air pollution exposure in India, spanning respiratory, cardiovascular, metabolic, maternal, and child health outcomes. Please note that studies mentioned above vary in design; table is indicative of the breadth of Indian literature and is not an exhaustive list.

India's Emerging Primary Evidence Infrastructure

Two ongoing prospective cohort studies led by researchers across AIIMS Delhi, IIT Delhi, IIT Bombay, and St John Research Institute will fill the gap with gold-standard primary evidence:

APiPED - Air Pollution Impact on Pregnancy & Early Childhood Development¹⁸ Enrolling 2,500 pregnant women from urban and rural Delhi NCR; following children to age 2. Directly measures PM _{2.5} and PM ₁₀ using personal portable monitors for a sub-sample. Will generate India's first primary clinical evidence linking measured ambient PM _{2.5} to maternal outcomes and early child development - birthweight, inflammation biomarkers, and neurodevelopment.	APEAL - Longitudinal Effects of Air Pollution on Adolescent Lungs¹⁹ 4,000 adolescents across Delhi, Mumbai, Bengaluru, and Mysuru; categorised by PM _{2.5} exposure level. Uses spirometry and forced oscillation technique alongside blood biomarkers. Will produce India's first age-appropriate lung function reference values in polluted urban settings and establish trajectory of lung development under chronic PM _{2.5} exposure.
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Both studies are at the protocol-stage - results are several years away, but this indicates that India's research institutions are now generating the gold-standard prospective cohort evidence that current policy gaps demand. The next phase of NCAP should be designed to receive and act on these findings as they emerge. Under NCAP, Ministry of Environment, Forest and Climate Change (MoEFCC) has established the National Knowledge Network (NKN) on Air Pollution Management coordinated through IITs and other premier institutions as the technical advisory and capacity-building framework for NCAP implementation, with dedicated technical personnel deployed across NCAP cities. The government has

built the infrastructure. What is missing is the Government of Maharashtra's formal connection between its pollution monitoring and health burden data.

Where the Evidence Is Strongest - and Where It Thins

Well-Studied: Regions

Delhi NCR mainly dominates the primary evidence based followed by Tamil Nadu reflecting the concentration of research infrastructure - AIIMS, PHFI, IIT Delhi, SRIHER in cities where institutional capacity is strongest. Moreover, evidence is also emerging from cities such as Mumbai, Bengaluru and Mysuru.

Under-Studied: Regions

The Indo-Gangetic Plain cities with the worst pollution burden i.e., Patna, Kanpur, Lucknow, Ghaziabad have the least primary research coverage. This is the most critical geographic gap for policy purposes. Additionally, North-Eastern states have no or little evidence on the growing pollution level.

Critical Disease Gaps

India has no prospective cohort study linking ambient PM_{2.5} to COPD incidence. For ischemic heart disease, the Million Death Study - using nationally representative SRS mortality data found a null-to-weak association²⁰ These gaps are significant and must not become a reason for inaction.

3 Maharashtra's Position - State with the Highest NCAP Non-Attainment City Count and the Institutional Capacity to Lead

Maharashtra carries India's highest NCAP non-attainment burden - 19 cities designated under the programme, the most of any Indian state. From the financial capital Mumbai to the industrial corridors of Pune, Nagpur, Nashik, and Aurangabad, Maharashtra's urban centres have consistently ranked among India's most polluted throughout NCAP's operation. The state's pollution burden is both the most industrially driven and the most geographically diverse - from Mumbai's coastal vehicular and industrial emissions to the brick kilns and thermal power plants of Vidarbha.

Maharashtra has institutional capacity that most other states lack. The Maharashtra Pollution Control Board (MPCB) operates one of India's most extensive CAAQMS networks, with continuous ambient air quality monitoring across Maharashtra's major NCAP cities. The state's Directorate of Economics and Statistics (DES) maintains district-level health, economic, and demographic data systems. MITRA - the Maharashtra Institution for Transformation, established by Government Resolution in November 2022 on the lines of NITI Aayog - is mandated to provide strategic and technical direction for Maharashtra's development through private sector and civil society participation. MITRA's functions include data analytics support to districts for local-level planning, outcome-based real-time evaluation, and inter-departmental dialogue across Health and Nutrition, Environment, and other priority sectors. KEM Hospital Research Centre in Mumbai and AIIMS Nagpur are among India's leading medical research institutions generating pollution-health evidence. Pahle India Foundation is an empanelled research partner of the Government of Maharashtra, engaged with the state's DES and MITRA, and is positioned to provide technical protocol support at no cost to the state government.

But Maharashtra's architecture has the same structural gap as the national system: MPCB's PM_{2.5} monitoring data has never been formally linked to the state's health burden data. Maharashtra's district hospitals record cardiorespiratory admissions and ARI cases, and NCRP-affiliated cancer registries

document lung cancer incidence - but no MPCB report, State Health Department analysis, or DES document formally connects these disease trends to the ambient PM_{2.5} levels that MPCB continuously measures. Maharashtra is carrying the health cost of its air pollution burden without formally accounting for it.

4 The Opportunity: Connecting India's Air Quality and Health Data

India does not have an evidence problem. It has an institutional design problem. India generates pollution data and health data in parallel and has no routine system to connect them.

CPCB	PM-JAY	NPCCHH ARI Sentinel Surveillance
Real-time PM _{2.5} from CPCB's nationwide CAAQMS network across NCAP cities- Data collected, published, available	Hospital admissions with ICD-10 disease codes across Ayushman Bharat- Data collected, not linked to pollution	Operational since 2017 across selected sites across states but no public data reports released and no formal PM _{2.5} linkage

These three systems operate in parallel. No formal mechanism connects them.

Maharashtra already has the data foundation for India's most powerful state-level proof of concept in health-linked clean air governance. MPCB's CAAQMS network across Mumbai, Pune, Nagpur, and Nashik provides continuous PM_{2.5} data. The state DES holds district health and economic data. ICMR-NCDIR-affiliated NCRP cancer registries hold data for Maharashtra's most polluted districts. Pahle India Foundation is empanelled with the state government and engaged with DES and MITRA. What is missing is the formal Chief Secretary-level directive that connects these systems - making Maharashtra the first Indian state with an official, systematically documented, government-owned estimate of its PM_{2.5}-associated health burden.

5 Specific Asks for the Chief Secretary, Government of Maharashtra

01 Issue a Government Resolution: MPCB and State DES to Formally Link PM_{2.5} Monitoring to Health Burden Data

A Chief Secretary-level directive establishing a formal data-sharing protocol between the Maharashtra Pollution Control Board (MPCB) and the state Directorate of Economics and Statistics (DES) - starting with Mumbai, Pune, Nagpur, and Nashik. Protocol to include: (i) annual reports correlating MPCB district-level PM_{2.5} averages with HMIS cardiorespiratory admissions and ARI case counts from government hospitals in NCAP cities; (ii) linkage with PM-JAY HMIS data at district level; (iii) public reporting through the state's official DES data platform. PAVANA will provide full technical protocol support at no cost to the state government.

02 Commission Maharashtra's First Official PM_{2.5}-Attributed Disease Burden Estimate

A CS-commissioned study led jointly by KEM Hospital Research Centre Mumbai and AIIMS Nagpur, with IIT Bombay as technical partner - to: (i) compile ICMR-NCDIR National Cancer Registry data for Maharashtra's most polluted districts and document lung cancer incidence trends against MPCB PM_{2.5}; (ii) aggregate HMIS cardiorespiratory admission data from all 19 NCAP non-attainment cities against district-level pollution levels; (iii) produce Maharashtra's first official, government-commissioned estimate of PM_{2.5}-attributed disease burden. This report establishes Maharashtra's evidence base for negotiating stronger central resources in the next phase of NCAP and is directly publishable as a

Immediate · CS Office + MPCB + State DES + NHM-Maharashtra

03 Task MITRA to Lead Maharashtra's Cross-Departmental PM_{2.5}-Health Data Analytics Framework

MITRA's Government Resolution mandate includes: data analytics support to districts for local-level planning; outcome-based real-time evaluation and concurrent feedback to implementing agencies; and facilitation of inter-departmental dialogue across Maharashtra's Health and Nutrition and Environment priority sectors. This is precisely the institutional function that Maharashtra's PM_{2.5}-to-health data linkage requires. MITRA to: (i) lead the analytical framework for linking MPCB district-level PM_{2.5} data with state DES health data across all 19 NCAP non-attainment cities; (ii) serve as the inter-departmental coordination body bringing MPCB, the State Health Department, and DES under a formal cross-departmental PM_{2.5}-health burden reporting protocol; (iii) include PM_{2.5}-associated health burden as an explicit outcome indicator in MITRA's Health and Nutrition sector evaluation framework. PAVANA, as a civil society research partner engaged with MITRA, will provide the technical analytical protocol at no cost to the state government.

Short-Medium term · MITRA + MPCB + State DES + Department of Health

state health burden reference document.

Short term · CS Office + KEM Hospital Research Centre + AIIMS Nagpur + IIT Bombay + MPCB + ICMR-NCDIR

04 Designate Maharashtra as India's First State-Level Pilot for Health-Outcome-Linked NCAP Reform

Maharashtra's scale - 19 non-attainment cities, India's most extensive state CAAQMS network, and the strongest industrial-research-health institutional density outside Delhi - makes it the ideal national pilot for health-linked NCAP governance. A Chief Secretary-level communication to MoEFCC and CPCB, citing Maharashtra's willingness to establish the MPCB-DES co-reporting framework, commission the KEM-AIIMS Nagpur health burden study, and integrate clean air metrics into MITRA's competitiveness framework, positions Maharashtra as India's state-level proof of concept. Success in Maharashtra provides the replicable template that India's other high-burden states need.

Next phase of NCAP design window · CS Office + MoEFCC + CPCB + MPCB

6 Conclusion

India's challenge in addressing air pollution is not a shortage of evidence, but rather one of institutional design and policy translation. NFHS data traces its footprint in child respiratory health. ICMR-NCDIR cancer registries show its signature in lung cancer incidence in India's most polluted cities. CPCB's own monitoring network confirms that virtually all 130 NCAP cities exceed the PM_{2.5} NAAQS of 40 µg/m³ and 108 cities still fall short of even the less stringent PM₁₀ standard. Primary studies from AIIMS, PHFI, IIT Delhi, and other institutes independently document what this exposure does to Indian lungs, hearts, and metabolic health. ***The science is Indian. The data is Indian. The conclusion is unambiguous.***

The window to embed health outcome metrics into the next phase of NCAP is open now - and it will not

remain open indefinitely. Programme architecture, inter-ministerial data protocols, and surveillance mandates are set at the design stage. A programme that launches without formal PM_{2.5} to health linkage will spend years trying to retrofit what could have been built in from the start. The four asks in this brief are executable within the existing institutional mandates of MPCB, the state DES, and the Chief Secretary's office, require no new legislation, and carry no foreign technical dependence.

The question before the Chief Secretary is not whether to act. Maharashtra's 19 NCAP cities, its MPCB monitoring network, KEM Hospital Research Centre, AIIMS Nagpur, and the state DES are already in place. Pahle India Foundation is empanelled with the state government and engaged with DES and MITRA. The question is whether the Chief Secretary's office will issue the formal directives that make Maharashtra the first Indian state to officially know what its air is doing to its people - and the first to hold its clean air programme accountable for reducing it.

PAVANA offers technical support to the Government of Maharashtra: (1) Computing PWE-PM_{2.5} baselines for all 19 Maharashtra NCAP non-attainment cities using MPCB CAAQMS and Census data; (2) Supporting MITRA in designing the cross-departmental PM_{2.5}-health data analytics framework; (3) Providing the analytical methodology for Maharashtra's first official PM_{2.5}-attributed disease burden estimate. All three are executable within existing MPCB, MITRA, and Department of Health mandates.

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