PAVANA · POLICY BRIEF

Centre for Air Pollution & Environmental Health · Pahle India Foundation

Realizing NCAP's Health Promise:

Evidence and Recommendations for National Clean Air Programme Reform

CPCB has the data. What is needed is the formal connection to health outcomes.

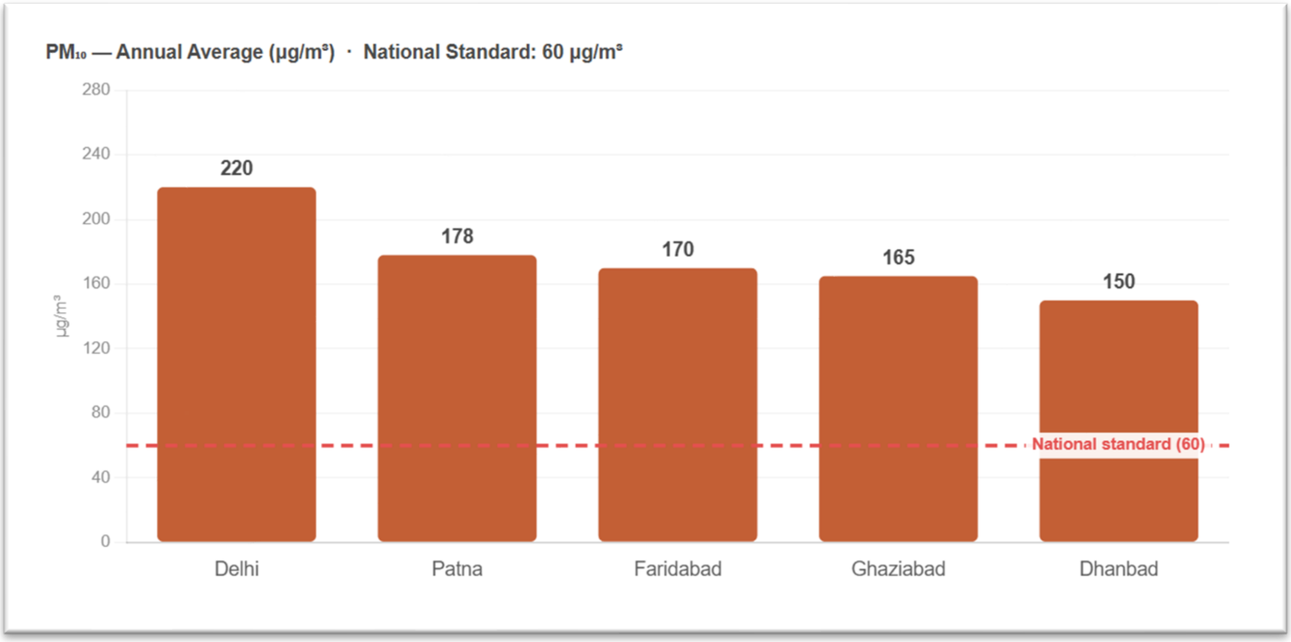
This policy brief responds to a felt and recognized gap in India's clean air policy discourse: the absence of a synthesis of India's own evidence on the health consequences of air pollution. Every study, dataset, and institutional source cited in this brief is India-generated - drawn from Indian cohorts, Indian registries, Indian surveillance systems, and Indian research institutions. India has produced substantial primary evidence on air pollution and health; what has been missing is a formal connection between CPCB's ambient data and India's health outcome datasets.

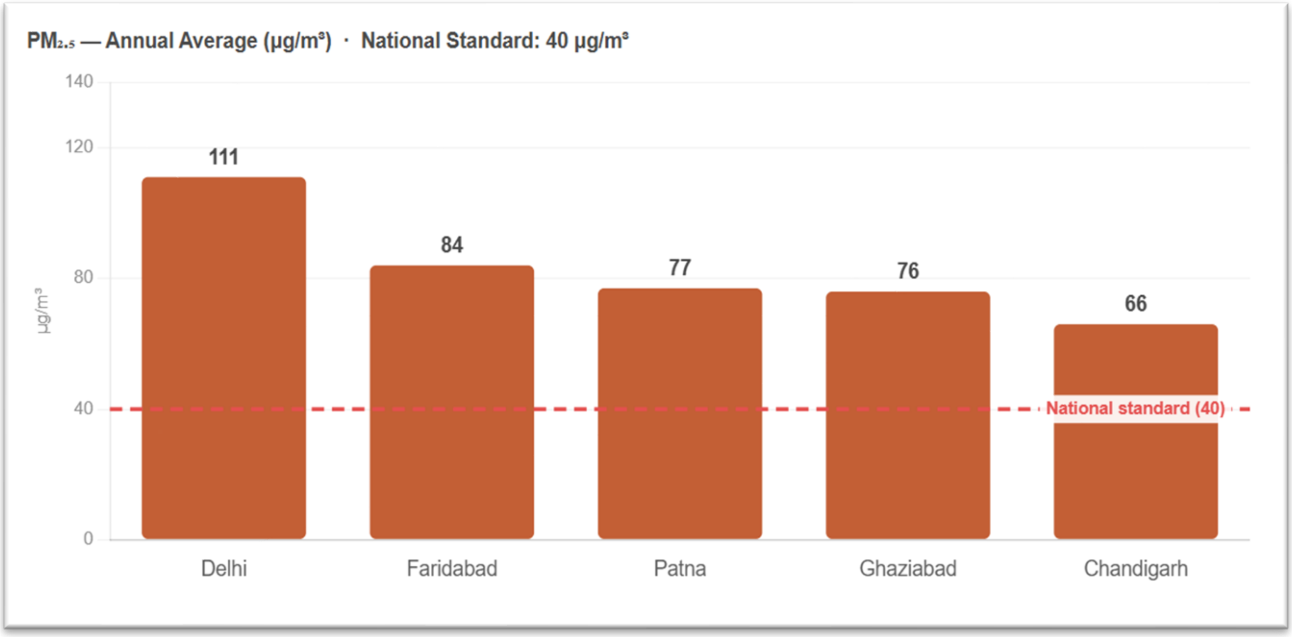
1 India's Clean Air Progress - and the Health Opportunity Ahead

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 polluted[1]. 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 PM_{10} and $PM_{2.5}$ exceeded national ambient air quality standards (NAAQS), among cities with continuous CPCB monitoring stations, in 43 and 23 cities respectively[3]. 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	**51%**
NCAP cities fall short of India's NAAQS PM_{10} standard in FY 2024-25 after six years and ₹13,000+ crore of the programme	of released NCAP funds utilized by 82 MoEFCC-funded cities (₹831 cr of ₹1,616 cr released) - a utilization challenge alongside the health challenge
MoEFCC, Lok Sabha, December 2025[4]	CSE, An Agenda for Reform, July 2024[5]

Top 5 polluted cities in India by PM_{10} & $PM_{2.5}$ concentration (2024)





Source: Central Pollution Control Board (CPCB), Annual Report 2024-25, MoEFCC, Government of India[3]

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 PM_{10} concentrations compared to the 2017-18 baseline, yet only 22 cities actually conform to India's own NAAQS[4]. While the trend is improving, 108 cities still do not meet India's own standard. More critically, NCAP targets remain pegged to PM_{10}, 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 CPCB is not whether air pollution harms health. India's own institutions have answered that. The question is whether CPCB will connect the pollution data it already collects to the health outcomes that data should be informing — and make that connection the basis for how the next phase of NCAP measures success.

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 pollution[6]. 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. *PHFI / AIIMS-CARRS Cohort, Delhi*	Prabhakaran D et al. (2020)[7]
Metabolic- Type 2 Diabetes	22% higher incidence of type 2 diabetes per 10 μg/m³ 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. *PHFI - CARRS Cohort, Delhi & Chennai*	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. *Delhi-based research group*	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. *IIT Delhi / Delhi University*	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. *Multi-institutional, rural Tamil Nadu*	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. *National Cancer Registry Programme, Bengaluru*	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. *St. Stephen's Hospital, Delhi*	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. *PGIMS, Rohtak, Haryana*	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. *Multiple Indian universities*	Dhaka SK et al. (2020) and Mandal J et al. (2021)[16,17]
Mortality	Every 25 $\mu g/m^3$ 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. *PHFI / Centre for Policy Research, Delhi*	Krishna B et al. (2021)[21]

The studies presented are drawn from a broader peer-reviewed evidence base. HEI'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 Development[18]	**APEAL - Longitudinal Effects of Air Pollution on Adolescent Lungs**[19]
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.	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.

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.***

Where the Evidence Is Strongest - and Where It Thins

Well-Studied: Regions	**Under-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.	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 ischaemic heart disease, the Million Death Study - using nationally representative SRS mortality data found a null-to-weak association[20] These gaps are significant and must not become a reason for inaction.

3 CPCB as India's Monitoring Backbone — Data Generated, Not Yet Health-Connected

CPCB is not new to this challenge. Since 2010, CPCB's Continuous Ambient Air Quality Monitoring Stations (CAAQMS) have been India's primary source of real-time $PM_{2.5}$ data. The PRANA portal makes this data publicly accessible. CPCB's Annual Air Quality Status Reports document city-by-city pollution trends across all NCAP cities. The National Knowledge Network (NKN) on Air Pollution Management, established under NCAP and coordinated through IITs, relies on CPCB's monitoring data as its technical backbone.

That infrastructure is real, operational, and the right foundation for India's response to the health burden of air pollution. But it has a critical structural gap: not one of CPCB's systems - CAAQMS, PRANA, the annual reports - is formally linked to any health outcome dataset in India. $PM_{2.5}$ data is collected, analysed, and published. It is never connected to the hospital admissions, cancer registries, or mortality data that would reveal what that pollution is doing to Indian bodies. The next phase of NCAP is the moment to close that gap. CPCB does not need to build new systems. It needs to connect the ones it has and make that connection the basis for how the next phase of NCAP measures success.

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.

5 Specific Asks for CPCB

01 Formally Recommend Shifting NCAP Primary Metric from PM_{10} to $PM_{2.5}$

CPCB already collects real-time $PM_{2.5}$ from CAAQMS stations across NCAP cities with continuous monitoring capability. Shifting the primary disbursement and performance metric from PM_{10} to $PM_{2.5}$ requires no new infrastructure — it is a policy amendment only. CPCB to formally recommend this shift to MoEFCC, providing the technical basis that $PM_{2.5}$ carries stronger dose-response links to

02 Compute PWE-$PM_{2.5}$ Baselines and Publish Annual City Rankings

CPCB to compute Population-Weighted Exposure to $PM_{2.5}$ (PWE-$PM_{2.5}$) baselines for all NCAP cities with CAAQMS data and Census ward-level population (2019–2021 baseline, with 2020 lockdown months corrected per CPCB technical guidance). Publish annual PWE-$PM_{2.5}$ rankings within CPCB's existing Annual Air Quality Report. PWE-$PM_{2.5}$ measures pollution where people actually live, not where monitors cardiovascular and respiratory mortality and is the pollutant fraction most directly linked to health outcomes.

Immediate · CPCB → MoEFCC

03 Upgrade PRANA Portal and Cross-Validate ISRO INSAT-3D Data

Upgrade the PRANA portal to display PWE-$PM_{2.5}$ alongside AQI, building health-relevant exposure into India's regulatory vocabulary without replacing tools policymakers already use. Separately, establish a technical protocol for cross-validating ISRO INSAT-3D aerosol optical depth (AOD) data against CAAQMS ground stations — enabling satellite-based gap-filling for residential wards without continuous monitors, and providing an independent verification layer that cities cannot manipulate.

Short term · CPCB + ISRO

are placed — making it anti-gaming, directly health-relevant, and cross-verifiable against ISRO INSAT-3D satellite data.

Immediate · CPCB

04 Provide the Data-Sharing Protocol for MoEFCC–MoHFW $PM_{2.5}$ Linkage and Strengthen Source Apportionment

CPCB manages the ambient data that makes the MoEFCC–MoHFW data linkage possible. CPCB to define and publish the technical protocol for sharing district-level ambient $PM_{2.5}$ data with MoHFW HMIS — data format, frequency, spatial resolution, and quality standards. In parallel, prioritize commissioning source apportionment studies in Indo-Gangetic Plain cities where pollution burden is highest but source attribution is weakest, ensuring health-linked disbursement reflects where emission reductions matter most.

Immediate + Short term · CPCB + MoEFCC

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 PM_{10} 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 existing institutional mandates, require no new legislation, and carry no foreign technical dependence.

The question before CPCB is not whether it has the data. It does. The question is whether CPCB will use that data to measure, track, and reduce harm - or only to record pollution.

PAVANA offers three specific forms of technical support to CPCB: (1) Computing PWE-$PM_{2.5}$ baselines for NCAP cities with available CAAQMS and Census data; (2) Developing the methodology for the ISRO INSAT-3D cross-validation protocol against CAAQMS ground stations; (3) Drafting the CPCB data-sharing protocol for the MoEFCC–MoHFW $PM_{2.5}$ linkage. All three are executable within the next phase of NCAP architecture.

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