PAVANA · POLICY BRIEF

Centre for Air Pollution & Environmental Health · Pahle India Foundation

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

Uttar Pradesh has 17 NCAP non-attainment cities - more than any other state in the Indo-Gangetic Plain, and home to some of India's most acutely polluted cities by annual $PM_{2.5}$ concentration. The evidence of health harm is strongest where the pollution burden is highest. The opportunity to lead is UP's.

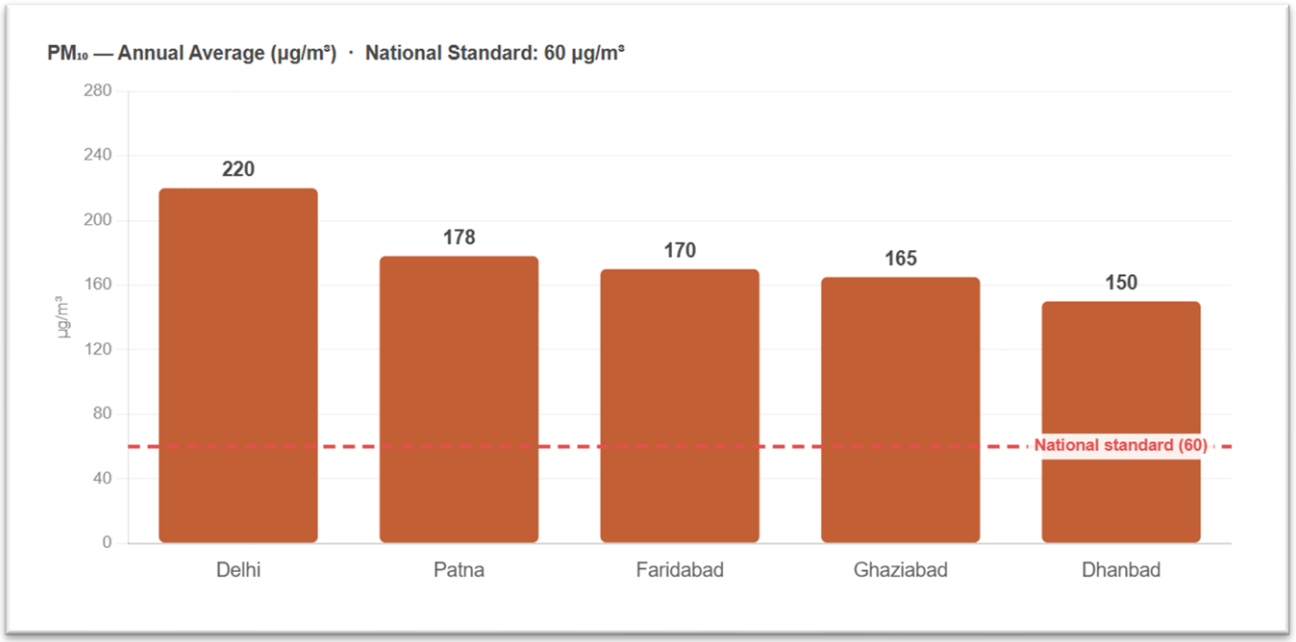
This policy brief responds to a felt and recognized gap in India's clean air policy discourse: the absence of a synthesis of India's own evidence on the health consequences of air pollution. Every study, dataset, and institutional source cited in this brief is India-generated - drawn from Indian cohorts, 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 Uttar Pradesh that air pollution is not only an environment compliance challenge - it is a health burden that UP's health system is already carrying, without formally knowing its cause.

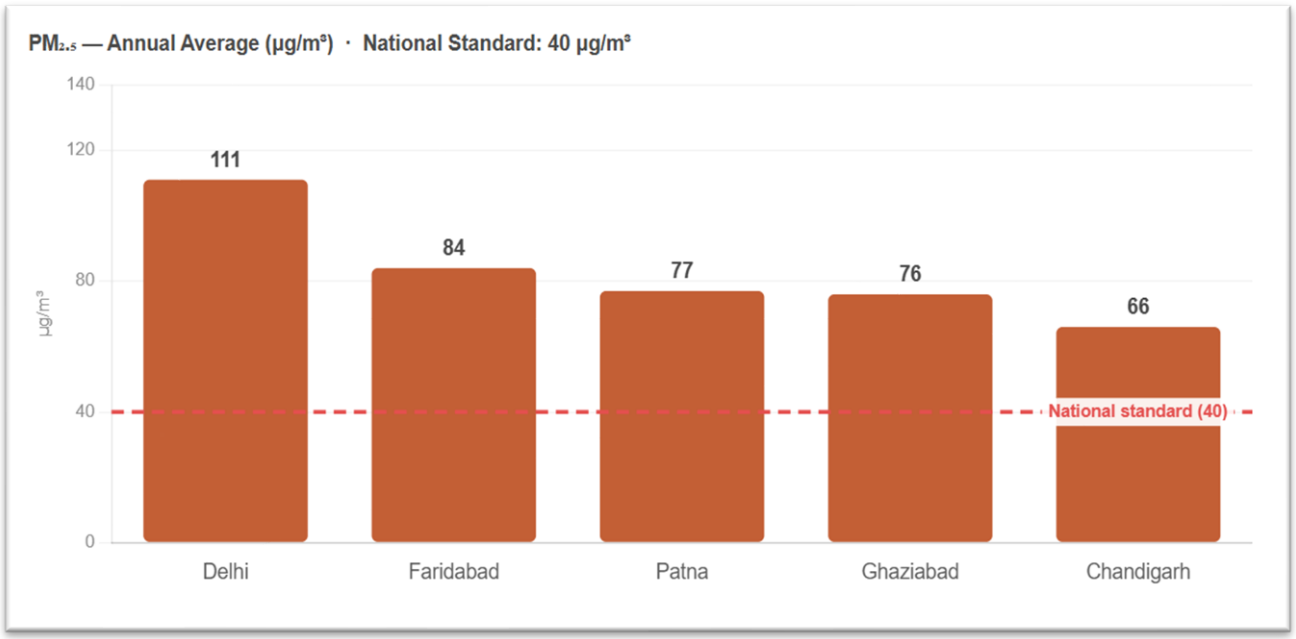
1 India's Clean Air Progress - and the Health Opportunity Ahead

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 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 Uttar Pradesh is not whether its cities carry India's highest pollution-health burden. They do. The question is whether UP will be the first state to formally connect that burden to its health data - making cities like Noida, Lucknow and Kanpur 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 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 µg/m³ 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. 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 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; categorized 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.*** 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 needed is the Government of UP's formal connection between its pollution monitoring and health burden data.**

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 ischemic 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 UP's Institutional Architecture - State with Most to Gain from Health-Linked NCAP Reform

UP's institutional architecture for responding to this challenge is substantial. The Uttar Pradesh Pollution Control Board (UPPCB) operates continuous ambient air quality monitoring stations across UP's major NCAP cities. UP's Directorate of Medical and Health Services and National Health Mission-UP operate district hospitals, community health centres, and disease surveillance infrastructure across all 75 districts. SGPGI Lucknow and King George's Medical University are among India's leading medical research institutions and are already generating pollution-health research for UP's cities.

But UP's architecture has the same structural gap as the national system: UPPCB's $PM_{2.5}$ monitoring data has never been formally linked to UP's health burden data. UP's district hospitals record cardiorespiratory admissions and ARI cases but no UPPCB report, UP Health Department analysis, or Planning document formally connects these disease trends to the ambient $PM_{2.5}$ levels that UPPCB continuously measures. UP 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.

UP already has the foundation for India's most powerful proof of concept in health-linked clean air governance. UPPCB's CAAQMS network in Lucknow and Kanpur provides continuous $PM_{2.5}$ data for two major cities with strong health infrastructure. National Health Mission-UP's HMIS generates district-level health reporting. SGPGI and KGMC generate some of India's strongest pollution-health research outside Delhi. What is missing is a formal Chief Secretary-level directive connecting these systems. A single cross-departmental order directing UPPCB and the UP-Health Department to co-produce quarterly pollution-health correlation reports for NCAP cities would make UP the first state in India to formally link ambient $PM_{2.5}$ to health outcomes, establishing the proof of concept that national policy needs.

5 Specific Asks for the Government of Uttar Pradesh

01 Issue a Cross-Departmental Directive: UPPCB and UP Health to Co-Produce Quarterly Pollution-Health Reports

A Chief Secretary-level directive to establish a formal data-sharing protocol between UPPCB and UP's Directorate of Medical and Health Services - starting with Lucknow and Kanpur. Protocol to include: (i) quarterly reports correlating UPPCB district-level $PM_{2.5}$ averages with HMIS cardiorespiratory admissions and ARI case counts from government hospitals in NCAP cities; (ii) public reporting through UP's State Health Management Information System; (iii) formal designation of Lucknow and Kanpur as UP's health-linked clean air pilot cities under the next phase of NCAP. PAVANA will provide technical protocol support at no cost to the state government.

Immediate · CS Office + UPPCB + UP DMHS + NHM-UP

02 Commission UP's First Official Air Pollution Health Burden Report through SGPGI and KGMC

A CS-commissioned report - mandated under NCAP's state action plan framework - led jointly by SGPGI Lucknow and King George's Medical University would: (i) compile ICMR-NCDIR National Cancer Registry data for UP's most polluted districts to document lung cancer incidence trends against UPPCB $PM_{2.5}$; (ii) aggregate HMIS cardiorespiratory admission data from NCAP cities against pollution levels; (iii) produce UP's first official pollution-health burden estimate. This report gives UP the evidence base to negotiate stronger central resources under the next phase of NCAP.

Short term · CS Office + SGPGI + KGMC + UPPCB + ICMR-NCDIR

03 Compute Population-Weighted $PM_{2.5}$ Baselines for All 17 UP NCAP Cities

Population-Weighted Exposure (PWE) to $PM_{2.5}$ - adjusting pollution levels by the number of people actually exposed - is the most policy-relevant measure of whether a city's NCAP progress is reducing health harm. With 17 NCAP cities, UP has India's largest state-level NCAP platform. PAVANA proposes to compute PWE-$PM_{2.5}$ baselines for all 17 UP NCAP cities using UPPCB CAAQMS data and Census population

04 Request MoEFCC to Designate UP as the National Pilot State for Health-Outcome-Linked NCAP Reform

UP's scale, institutional capacity, and pollution burden make it the ideal national pilot for health-linked NCAP governance. A Chief Secretary-level request to Union government - citing UP's willingness to establish the UPPCB-Health Department co-reporting framework, commission the SGPGI–KGMC health burden report, and co-develop the inter-ministerial data linkage protocol -

data, and to make the methodology and outputs available to UPPCB for formal adoption as UP's official NCAP baseline. This would position UP as India's standard-setter for health-accountable NCAP performance measurement.

Short-medium term · PAVANA + UPPCB + UP Planning Commission

positions UP as India's first state-level proof of concept. Success in UP provides the template that India's other states with NCAP non-attainment cities need.

The next phase of NCAP design window · CS Office + MoEFCC + CPCB + MoHFW

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 the existing institutional mandates of UPPCB, UP's Health Department, and the Chief Secretary's office, require no new legislation, and carry no foreign technical dependence.

PAVANA offers three specific forms of technical support to the Government of Uttar Pradesh, at no cost to the state: (1) Computing PWE-$PM_{2.5}$ baselines for all 17 UP NCAP cities using UPPCB CAAQMS and Census data, co-published under UPPCB authority; (2) Designing the UPPCB-UP Health Department data linkage protocol for the Lucknow-Kanpur pilot; (3) Technical support for the SGPGI-KGMC-led UP air pollution health burden report. All three are executable within existing UPPCB and NCAP mandates.

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