



ENVIRONMENTAL AND HEALTH IMPLICATIONS OF CLIMATE CHANGE AND AIR POLLUTION IN INDIA: A REVIEW OF RECENT EVIDENCE

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DOI: <https://doi.org/10.5281/zenodo.17275137>

Article Received on 14/08/2025

Article Revised on 04/09/2025

Article Accepted on 24/09/2025

ABSTRACT

Climate change and environmental degradation present unprecedented threats to India, home to more than 1.4 billion people. Air pollution, heat waves, and ecological contamination have emerged as leading causes of mortality and morbidity, particularly impacting vulnerable populations such as children, the elderly, and those in poverty. Drawing on ten recent Scopus-indexed studies (2019–2025), this comprehensive review synthesizes evidence on the interlinked health and environmental crises in India, highlighting air pollution, heat stress, combined climatic hazards, and ecosystem contamination. Studies such as the India State-Level Disease Burden Initiative (2021) and de Bont et al. (2024, 2025) reveal that ambient PM_{2.5} and NO₂ exposure contribute to millions of premature deaths annually, while combined heat and pollution exposures exacerbate daily mortality beyond additive risks. Research on heat stress (Lahari et al., 2023; Mehta et al., 2025) indicates a 6–8% increase in mortality risk during heatwaves across climate zones, while Qureshi and colleagues (2022, 2023) demonstrate risks posed by crop residue burning and toxic trace elements in the food chain. This paper synthesizes these findings to identify gaps in research, policy, and action, calling for integrated climate-health frameworks, investment in renewable energy, co-benefit policies, and protective interventions for at-risk populations.

KEYWORDS: Climate change; air pollution; heat stress; public health; PM_{2.5}; India; environmental contamination; climate-health nexus.

1. INTRODUCTION

India's rapid economic development, expanding urban centers, and dependence on fossil fuels have positioned it at the epicenter of global discussions on climate change and public health. The nation accounts for roughly 7% of global CO₂ emissions, ranks among the world's most polluted regions, and faces frequent climate extremes, including severe heatwaves and floods (India State-Level Disease Burden Initiative, 2021). With agriculture employing over 40% of its workforce and much of its population dependent on natural resources, environmental sustainability is inseparable from human health outcomes and economic resilience.

The health effects of climate change in India are multifaceted. Air pollution alone contributes to over 1.6 million premature deaths annually (India State-Level Disease Burden Initiative, 2021). Heatwaves are intensifying, with urban heat islands exacerbating the problem (Lahari et al., 2023). Combined exposures to heat and ambient air pollutants significantly elevate mortality risk beyond individual effects (de Bont et al.,

2025). Additionally, environmental contaminants such as heavy metals in food chains and emissions from stubble burning introduce chronic health risks (Qureshi & Ahire, 2023). This review integrates findings from ten recent peer-reviewed studies to explore these intertwined challenges, aiming to inform evidence-based climate and health policy.

2. METHODOLOGY

A systematic selection process was employed to identify ten Scopus-indexed studies from 2019 to 2025 focusing on environmental exposures and health outcomes in India. Databases such as Scopus, PubMed, and Web of Science were searched using keywords including "air pollution," "heat stress," "climate change," and "India." Studies were included if they: (1) focused on human health outcomes, (2) assessed air pollution, heat, or ecological contaminants, (3) provided quantitative estimates, and (4) were published in peer-reviewed

journals. Selected studies span epidemiological analyses (de Bont et al., 2024, 2025), burden assessments (India

State-Level Disease Burden Initiative, 2021), field research (Qureshi & Ahire, 2023), and environmental modeling (Qureshi & Maheshwarkar, 2022).

3. Thematic Review of Findings

3.1 Air Pollution and Health Burden

Air pollution remains the single largest environmental health risk in India. The India State-Level Disease Burden Initiative (2021) attributes 1.6 million deaths to ambient and household pollution, representing 17.8% of all deaths nationally and economic losses of 1.4% of GDP. De Bont et al. (2024) demonstrate causal relationships between daily mortality and PM_{2.5}/NO₂ exposure across ten cities, revealing urban hotspots such as Delhi, Kolkata, and Mumbai. Qureshi & Shende (2022) highlight that PM_{2.5}-driven disease burdens in 53 urban centers disproportionately impact lower-income populations.

3.2 Heat Stress and Mortality

Heat-related mortality is rising as climate change intensifies. Lahari et al. (2023) report mortality increases of 6–8% during heat-stress days across major cities, particularly in the elderly. Mehta et al. (2025) identify that diurnal heat stress patterns amplify respiratory and cardiovascular deaths when coupled with poor air quality, emphasizing the need for heat-health action plans.

3.3 Synergistic Impacts of Heat and Pollution

De Bont et al. (2025) reveal that simultaneous exposure to high PM_{2.5} and extreme heat doubles daily mortality compared to independent exposures. These findings highlight the necessity for integrated hazard warning systems and urban planning that addresses multiple risks concurrently.

3.4 Vulnerable Populations

Dutta et al. (2024) and Adhikary et al. (2024) find children and elderly populations face disproportionately high risks of respiratory infections, heatstroke, and cardiovascular strain. Rural residents suffer added vulnerability due to agricultural dependence, lack of adaptive infrastructure, and higher baseline exposure to environmental hazards.

3.5 Environmental Contamination and Food-Chain Risks

Beyond atmospheric hazards, Qureshi & Ahire (2023) reveal bioaccumulation of arsenic, cadmium, and lead in estuarine crabs consumed by coastal communities near Mumbai, posing dietary health risks. Qureshi & Ray (2022) link seasonal stubble burning in central India to severe PM_{2.5} spikes, compounding risks for respiratory illness in nearby rural populations.

3.6 Policy and Research Implications

The reviewed evidence underscores the urgency of coordinated climate-health strategies in India. Policymakers must:

- Expand renewable energy adoption to reduce air pollution (de Bont et al., 2024).
- Develop early warning systems integrating heat and pollution alerts (Mehta et al., 2025).
- Regulate agricultural residue burning while supporting farmers with alternatives (Qureshi & Ray, 2022).
- Implement heavy metal monitoring in aquatic food sources (Qureshi & Ahire, 2023).
- Enhance adaptive infrastructure in heat-vulnerable rural and urban regions (Dutta et al., 2024).
- Establish long-term climate-health surveillance networks (Qureshi & Maheshwarkar, 2022).

3.7 CONCLUSIONS

Climate change and environmental degradation are driving a public health crisis in India, with air pollution, heat stress, and ecological contaminants collectively accounting for millions of preventable deaths and illnesses. The synergy of these risks demands integrated interventions that combine mitigation, adaptation, and public health measures. By leveraging renewable energy transitions, multi-hazard early warning systems, ecological monitoring, and targeted protections for vulnerable populations, India can reduce the health burden while advancing toward its Sustainable Development Goals.

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