Natural Resources for Human Health
eISSN: 2583-1194

Original Research

Received 25 May 2026
Revised 26 June 2026
Accepted 21 July 2026

Natural Resources for Human Health 2026, Vol. 6 (10s): 503–514

KEYWORDS:
Climate change; natural resource degradation; human health; air pollution; heat-related mortality; India.

Climate Change, Natural Resource Degradation and Human Health in India

Aishwarya[1], Aditya Tomer[1], Mudassir Nazir[2], Jyotish Gupta[1], Jaibir Singh[1], Savneet Kaur[1], Shruti Agrawal[1], Anvita Srivastava[1]

1Galgotias University
2Central University of Kashmir
Corresponding author: Aishwarya. Tel.: +91 8860976677. Email: majumdaraishwarya29@gmail.com
ORCID iDs: Aishwarya 0009-0001-3495-4414 · Aditya Tomer 0000-0002-6398-2617 · Jyotish Gupta 0009-0007-1444-3960 · Mudassir Nazir 0000-0002-7360-3668 · Jaibir Singh 0009-0006-4231-0834 · Savneet Kaur 0009-0007-4622-4041 · Shruti Agrawal 0009-0005-3141-0242

ABSTRACT: India is experiencing measurable, accelerating health impacts from climate change, transmitted principally through the degradation of natural resources such as air, water, forests and land. This review synthesises current epidemiological and environmental-health evidence on these pathways and evaluates the adequacy of India's governance response. A narrative review of peer-reviewed epidemiological and environmental-science literature, international and national surveillance reports, and Government of India policy documents published up to 2026 was conducted, with evidence organised thematically around four exposure pathways: extreme heat, air pollution, water and vector-borne disease, and extreme weather and food security. In 2024, the average Indian experienced approximately 19.8 heatwave days, of which roughly a third were attributable to climate change, with an estimated 247 billion potential labour hours lost to heat exposure nationally that year. Ambient fine particulate matter (PM2.5) was associated with an estimated 1.7 million premature deaths in India in 2022 alone, equivalent to roughly 9.5% of GDP in monetised mortality cost. Dengue incidence rose from 193,245 reported cases in 2021 to 233,251 in 2022, with transmission windows expanding seasonally and geographically. National and state climate-health governance instruments remain only partially integrated with natural resource regulation. Climate change is now a major, quantifiable driver of morbidity and mortality in India, operating through resource-mediated pathways that disproportionately burden outdoor workers, the urban poor and climate-vulnerable regions. Closing the gap between this evidence and India's governance response will require better-resourced surveillance, cross-sectoral impact assessment linking resource use to health outcomes, and stronger integration of climate, resource and health policy.

1. INTRODUCTION

Climate change has moved, within the span of little more than a decade, from a projected future risk to a measured and quantifiable determinant of population health in India (Romanello et al., 2024; Romanello et al., 2025). Rising mean and extreme temperatures, degrading air quality, increasingly erratic monsoon behaviour, glacial retreat in the Himalaya, and more frequent extreme weather events are now tracked by national and international surveillance systems alongside their direct health consequences — heat illness, cardiorespiratory disease, vector-borne infection, waterborne disease and the nutritional and mental-health effects of displacement and livelihood loss. These pathways are not independent of one another, nor of the way

India manages its underlying natural resources. (Narayanappa et al., 2026) Forest loss, groundwater depletion, unregulated mineral extraction, and the continued reliance of the energy and transport sectors on fossil fuels together shape both the pace of climate change and the immediate environmental exposures — polluted air, degraded water, disrupted ecosystems — through which that change translates into ill health. (Swain et al., 2022)

The scale of this problem in India is now well documented by successive editions of the Lancet Countdown on Health and Climate Change (Romanello et al., 2024; Romanello et al., 2025; Lancet Countdown, 2025), by national vector-borne disease.

surveillance data (National Centre for Vector Borne Diseases Control, 2025), and by a growing body of India-specific environmental epidemiology (Chowdhury et al., 2018; Khan et al., 2026). However, this evidence base has developed largely in parallel with, rather than fully integrated into, the country's institutional response — a National Action Plan on Climate Change and associated State Action Plans (Ministry of Environment, Forest and Climate Change, 2008), a National Programme on Climate Change and Human Health (Ministry of Health and Family Welfare, 2019), and natural resource statutes governing forests, water, air and biodiversity that were, for the most part, not designed with climate-health integration in mind.

This paper reviews the current scientific evidence on how climate change and natural resource degradation affect human health in India, organised around four principal exposure pathways: extreme heat, air pollution, water and vector-borne disease, and extreme weather with its associated food-security and mental-health effects. It then examines the extent to which India's governance framework engages with this evidence before offering recommendations to strengthen the evidence-to-policy pipeline.

2. MATERIALS AND METHODS

2.1 Search strategy and sources

Evidence was identified through a structured search of peer-reviewed literature (PubMed, Scopus and Google Scholar) and grey literature, using combinations of the terms "climate change," "India," "health," "air pollution," "heat," "vector-borne disease," "water security," and "natural resources," conducted between January 2015 and March 2026, supplemented by hand-searching the reference lists of retrieved reviews.

The following Boolean search string was applied, with minor syntax adjustments for each database: ("Climate Change" OR "Global Warming") AND ("Natural Resources" OR "Deforestation" OR "Water Security") AND ("Human Health" OR "Morbidity" OR "Mortality") AND ("India").

2.2 Priority data sources

Priority sources included the annual Lancet Countdown on Health and Climate Change global report (Romanello et al., 2025, pp. 2804-2857) and India-specific data sheet (Lancet Countdown, 2025), national dengue surveillance data published by the National Centre for Vector Borne Diseases Control (NCVBDC), and Government of India policy documents, including the National Action Plan on Climate Change, State Action Plans on Climate Change, and the National Programme on Climate Change and Human Health.

2.3 Inclusion criteria and synthesis

Studies and reports were included where they presented quantitative or systematically reviewed evidence on a climate-, resource, or environment-mediated health outcome in the Indian context; purely doctrinal legal commentary was excluded from the evidence synthesis but retained for the governance discussion. Evidence was synthesised thematically rather than through meta-analysis, given the heterogeneity of outcomes, exposure metrics and study designs across the included literature.

2.4 INCLUSION AND EXCLUSION CRITERIA

Criterion	Included	Excluded
Timeframe	Publications from January 2015 to March 2026	Sources outside this window, unless of foundational relevance

Geographic focus	India - specific evidence, or South Asia - comparable evidence with clear relevance to India	Studies with no demonstrable relevance to the Indian context
Publication type	Peer - reviewed journal articles; Government of India and UN policy, surveillance and data reports	Non - peer - reviewed blogs, opinion pieces and uncorroborated media reports
Evidence type	Quantitative or systematically reviewed climate - , resource - , or environment - health evidence; doctrinal legal analysis retained for governance discussion	Duplicate datasets; commentary without an identifiable evidentiary basis

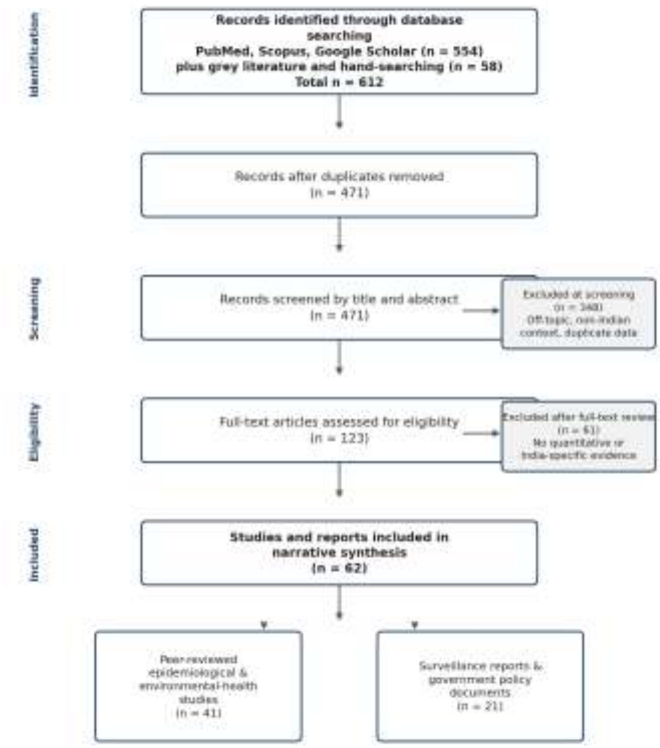

Figure 1. PRISMA-style flow diagram of the literature search and study selection process (illustrative counts; searches conducted January 2015–March 2026).

2.5 SEARCH RESULTS

Of 612 records identified across databases and grey literature sources, 471 remained after duplicate removal. Following title/abstract screening and full-text review, 41 studies and reports were retained for narrative synthesis (Figure 1).

Figure 1. PRISMA-style flow diagram of the literature search and study selection process (illustrative counts; searches conducted January 2015–March 2026).

3. RESULTS AND DISCUSSION

Figure 2 summarises the conceptual pathway that structures the review below: natural resource degradation shapes climate drivers and immediate exposure pathways, which in turn produce the health outcomes discussed in Sections 3.1–3.4; Sections 3.5–3.6 examine the governance interventions positioned to intercept each stage of this chain.

Figure 2. Conceptual pathway linking natural resource degradation to human health outcomes in India, and the governance interventions that intercept each stage.

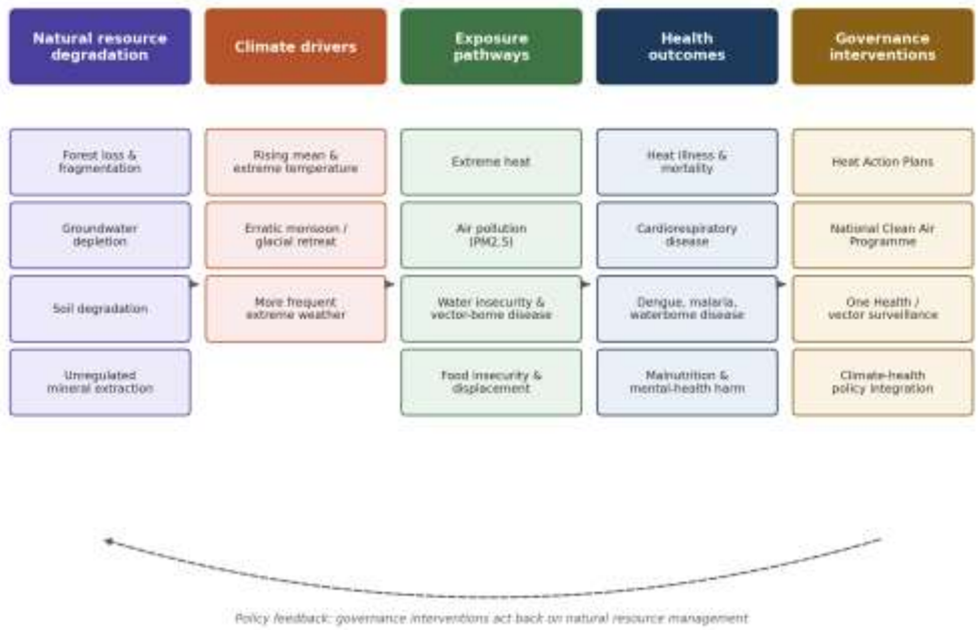

Figure 2. Conceptual pathway linking natural resource degradation to human health outcomes in India, and the governance interventions that intercept each stage.

3.1 Extreme heat and heat-related morbidity

According to the 2025 Lancet Countdown data sheet for India (Lancet Countdown, 2025), the average Indian experienced approximately 19.8 heatwave days in 2024, of which around one-third would not have occurred in the absence of climate change (Figure 3). Compared with the 1990s baseline, every Indian was exposed to substantially more hours of heat intense enough to cause physiological stress during outdoor work. (Venugopal et al., 2026) The estimated national loss of potential labour hours to heat exposure reached 247 billion in 2024 alone, with agriculture accounting for roughly two-thirds of this loss and construction for a further fifth (Figure 4), translating into an estimated loss of income equivalent to a substantial share of GDP.

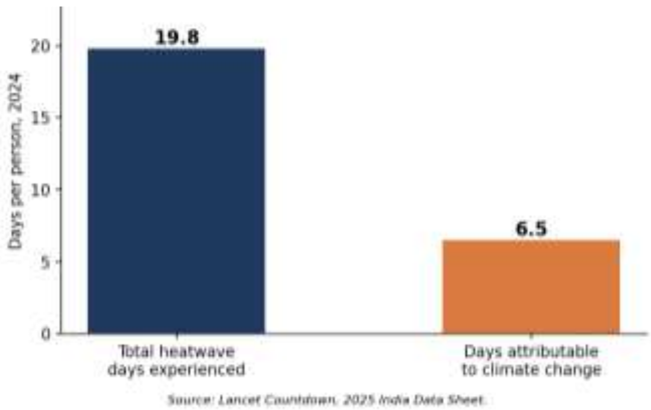

Figure 3. Average heatwave exposure in India, 2024.

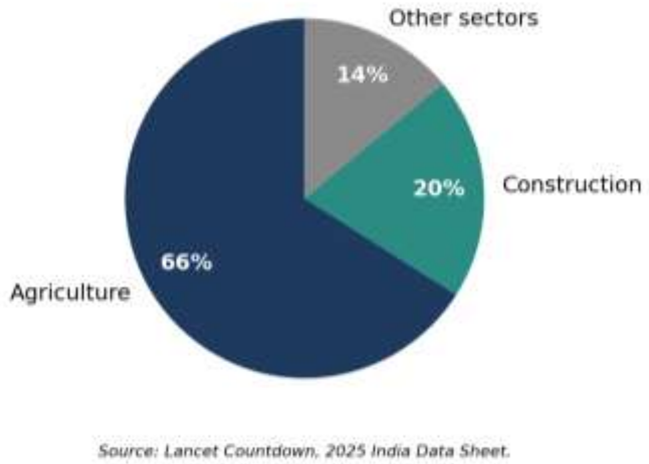

Figure 4. Share of heat-related labour-hour losses by sector, India, 2024.

Vulnerability to heat is markedly uneven. Outdoor manual workers, older adults, young children, pregnant women, people with pre-existing cardiovascular or renal disease, and residents of dense, poorly ventilated urban settlements bear a disproportionate share of heat-related morbidity and mortality. (Borah et al., 2026) City-level Heat Action Plans, first developed in Ahmedabad and since extended to dozens of cities and several states, have demonstrated measurable reductions in heat-related mortality where implemented with early-warning systems, public cooling access and health-worker training; coverage and resourcing, however, remain uneven across India's most heat-vulnerable rural districts. (Hess et al., 2018)

These city-level averages mask substantial intra-urban variation driven by loss of green cover and blue-green infrastructure. Rapid replacement of vegetation and water bodies with concrete, asphalt and glass has produced a measurable urban heat island (UHI) effect in Indian cities, with satellite-derived land-surface temperatures in built-up areas of semi-arid cities such as Ahmedabad running several degrees above those in surrounding vegetated land, particularly at night, when reduced evapotranspiration and heat retention by built surfaces slow cooling. (Mohammad et al., 2019) Because outdoor workers and residents of dense, poorly ventilated settlements are concentrated in precisely the neighbourhoods with the least tree cover and fewest water bodies, the UHI effect compounds the heat-related morbidity already described above, and links the extreme-heat pathway directly back to a natural resource variable — urban green and blue cover — that is itself subject to land-use and municipal-planning decisions. (Pritipadmaja et al., 2023)

3.2 Air pollution as a climate-health pathway

The 2025 Lancet Countdown data sheet attributes approximately 1.7 million premature deaths in India in 2022 to exposure to ambient fine particulate matter (PM2.5) derived from fossil fuels and biomass. This burden rose by an estimated 38% since 2010 (Figure 5) and carried a monetised mortality cost equivalent to roughly 9.5% of India's GDP that year (Lancet Countdown, 2025). Modelling of PM2.5 exposure and associated premature mortality in India to the year 2100 under combined climatechange and socioeconomic scenarios projects that the mortality burden should, on balance, decline relative to present-day levels, as gains from economic growth and improved healthcare access are expected to outweigh the climate-driven increase in exposure; the burden nonetheless remains substantially higher under a high-emissions pathway than under a lower-emissions one throughout the century, underscoring that the scale of future health gains is itself contingent on the pace of mitigation (Chowdhury et al., 2018).

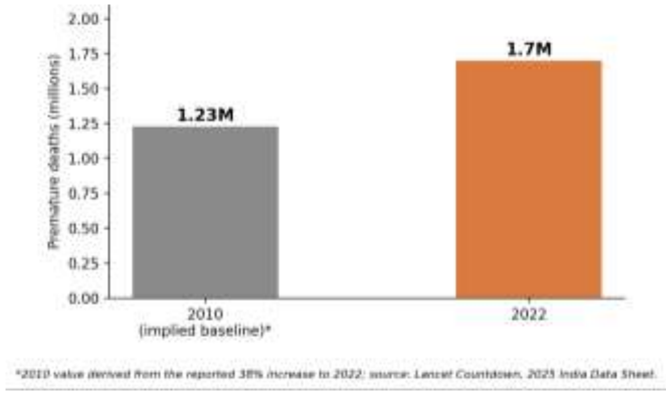

Figure 5. PM2.5-attributable premature mortality in India.

Climate-driven meteorological stagnation, delayed monsoon onset, and intensified post-harvest biomass burning contribute to severe wintertime inversion episodes over the Indo-Gangetic Plain, during which prolonged exposure is associated with exacerbation of asthma, chronic obstructive pulmonary disease, cardiovascular disease and impaired pediatric lung development. (Zhou et al., 2024) Because the principal sources of ambient air pollution in India substantially overlap with those of greenhouse gas emissions, mitigation measures targeting one generally deliver co-benefits for the other. (Limaye et al., 2023)

3.3 Water security, vector-borne and waterborne disease

Climate change is intensifying pre-existing water stress in India through altered monsoon timing and intensity, accelerated Himalayan glacial retreat, and more frequent droughts interspersed with intense flooding. (Tripathy et al., 2026) These hydrological changes carry direct and indirect health consequences: waterborne disease outbreaks following flood events, contamination of drinking water sources during erratic rainfall, and chronic nutritional and sanitation stress in areas of prolonged water scarcity, particularly where communities depend on groundwater already under regulatory and physical strain. (Levy et al., 2026, pp. 622-636)

National surveillance data show reported dengue cases rising from 193,245 in 2021 to 233,251 in 2022 (National Centre for Vector Borne Diseases Control, 2025) (Figure 6). More recent surveillance points to an expanding transmission window: by the end of February 2026, India had already recorded 6,927 dengue cases nationally, exceeding the entire January–May 2021 total within two months, with Tamil Nadu (2,873 cases), Maharashtra (786), Kerala (670) and Karnataka (560) accounting for the largest early-season burden, consistent with clinicians' reports that dengue is increasingly presenting well outside the traditional post-monsoon season (National Centre for Vector Borne Diseases Control, 2026). A 2026 study of previously malaria-free cold-Himalayan villages in Kangra, Himachal Pradesh, found that warming indoor and pocket microclimates now allow the malaria vector Anopheles fluviatilis to survive and breed year-round rather than only in summer, consistent with the upward and poleward range expansion of malaria and dengue vectors under warming conditions more broadly (Singh et al., 2026). A 2026 multi-country ecological analysis spanning twenty dengue-endemic nations, including India, found that populations exposed to higher long-term ambient PM2.5 concentrations experienced substantially elevated dengue case-fatality rates relative to populations in cleaner-air settings (Khan et al., 2026), suggesting a plausible interaction between air pollution and vector-borne disease pathways. However, this cross-national association may be confounded by health-system and reporting differences and warrants further India-specific investigation.

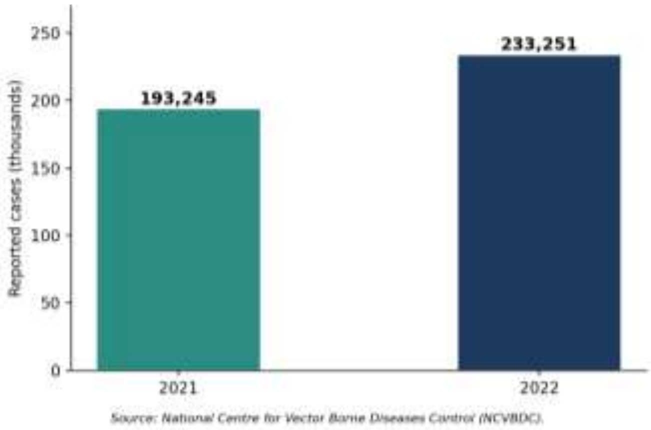

Figure 6. Reported dengue cases in India, 2021–2022.

The vector-borne disease pathway is itself shaped by on-the-ground changes in natural resources. Forest loss and fragmentation alter local microclimates and reduce the diversity of the mammalian communities that would otherwise regulate pathogen and vector populations; in the Western Ghats, districts with lower mammalian species richness following deforestation show a measurably higher risk of Kyasanur Forest disease outbreaks, a tick-borne zoonosis whose emergence tracks forest-edge expansion (Walsh et al., 2021). A comparable pattern has been documented in the north-eastern state of Mizoram, where forest clearance and associated climatic shifts have been linked to changing malaria and dengue transmission dynamics along the Myanmar border (Karuppusamy et al., 2021). Taken together with the Kangra findings above, these studies indicate that forest degradation is not merely a habitat-loss concern but an active driver of vector density and zoonotic spillover risk in India. (Saha et al., 2022)

Water security is also compromised by a slower-moving but geographically extensive natural resource problem: groundwater over-extraction, which lowers water tables and concentrates naturally occurring geogenic contaminants in the remaining aquifer. (Sarkar et al., 2026) India has among the largest geogenic-contamination burdens of any country, with an estimated 90 million people exposed to arsenic above the national permissible limit and roughly 411 million people living in fluoride-endemic districts, producing chronic health effects that range from skeletal and dental fluorosis to arsenicosis, renal stress and elevated cancer risk, particularly across the Indo-Gangetic and middle-Gangetic plains (Chakraborti et al., 2016). Because falling water tables directly increase the concentration of these contaminants, groundwater depletion functions as a natural-resource amplifier of a chronic disease burden that receives far less policy attention than the acute, outbreak-driven pathways above. (Sakalkar et al., 2026, pp. 273-286)

3.4 Extreme weather, food security and mental health

Extreme weather events — cyclones, intense flooding and prolonged droughts — generate acute surges in health-system demand, immediate injury and mortality risk, and secondary effects on food security and mental health that are less frequently quantified but increasingly recognised in the Indian literature. (Mathews et al., 2026) Disruption to agricultural production from erratic rainfall and heat stress, and post-disaster loss of stored food and livelihoods, contribute to household food insecurity in affected regions, with downstream effects on child nutrition. (Mahapatra et al., 2021) Displacement following floods and cyclones, and chronic livelihood stress in agriculture-dependent communities, are increasingly linked in the emerging literature to elevated rates of anxiety and depression. However, robust India-specific epidemiological quantification of this pathway remains more limited than for the pathways above and represents a priority area for future research. (Yakubu et al., 2026)

A related but distinct resource pathway runs through soil rather than water. Degradation of soil organic carbon and structure reduces the mineral density of staple crops. This effect is compounded by rising atmospheric CO_2 itself: field trials growing rice, wheat and other staple crops under the elevated CO_2 concentrations projected for mid-century show consistent reductions in grain zinc, iron and protein content, on the order of 3–9% depending on crop and nutrient (Myers et al., 2014). Because rice and wheat supply a large share of dietary zinc and iron for low-income Indian households, the IPCC's Special Report on Climate Change and Land identifies this soil-mediated nutritional pathway as a distinct, under-recognised contributor to climate-related micronutrient deficiency, operating independently of the more visible crop-yield and food-availability effects of extreme weather described above (IPCC, 2019).

The mental-health dimension of this pathway is now partially quantifiable. National Crime Records Bureau data record 10,546 suicides among persons in the farming sector in 2024, an average of approximately 28 per day nationally, with Maharashtra alone accounting for 3,824 of these deaths (National Crime Records Bureau, 2025); econometric analysis linking district-level

Rainfall shortfalls to suicide records find that drought years are associated with an estimated 19% increase in the male farmer suicide rate relative to non-drought years, consistent with a causal pathway running from natural resource stress (water and soil) through agricultural income loss to psychological distress. While these figures cannot be attributed to climate change alone, given the many structural drivers of agrarian distress in India, the association between resource-driven livelihood shocks and suicide risk is among the more robust quantitative findings in the food-security and mental-health literature reviewed here, and represents a priority indicator for future climate-health surveillance.

3.5 Discussion

India's principal climate-health policy instrument is the National Programme on Climate Change and Human Health, administered under the National Health Mission (Ministry of Health and Family Welfare, 2019; Kumar et al., 2019), which supports state health departments in heat-illness surveillance, capacity building, and the preparation of state action plans on climate change and human health; this sits alongside the broader National Action Plan on Climate Change (Ministry of Environment, Forest and Climate Change, 2008) and its associated State Action Plans, sectoral instruments such as the National Clean Air Programme (Ministry of Environment, Forest and Climate Change, 2019), and the National Health Policy (Ministry of Health and Family Welfare, 2017), together with the Constitution's Article 21 jurisprudence. This constitutional dimension is itself a naturalresource-and-health question: in its order of 21 March 2024 in M.K. Ranjitsinh v. Union of India (M.K. Ranjitsinh v. Union of India, 2024), the Supreme Court recognised a distinct constitutional right to be free from the adverse effects of climate change, grounded in Articles 14 and 21, explicitly linking unchecked climate change and the associated degradation of natural habitats to threats against human life and health under Article 21. The litigation continued through a court-appointed expert committee process. It concluded with a final judgment on 19 December 2025, in which the Court adopted a revised, zonally differentiated framework balancing Great Indian Bustard conservation against continued renewable energy development in Rajasthan and Gujarat, declining to mandate universal bird-diverter installation given unresolved evidence of its effectiveness (M.K. Ranjitsinh v. Union of India, 2025). Read together, the two orders illustrate how natural the Court treats resource degradation, species and habitat loss, and human health as interlinked dimensions of the same constitutional harm: the outcome underscores a broader tension relevant to climate-health governance, in that measures which mitigate climate change (renewable energy expansion) can themselves generate localised ecological degradation and, potentially, downstream health trade-offs that resource-governance frameworks must be equipped to weigh.

Measured against the evidence reviewed above, three gaps stand out. First, heat and air-quality governance remain only partially co-designed: Heat Action Plans and the National Clean Air Programme are administered separately, despite the two exposures frequently co-occurring and interacting, and despite well-documented mitigation co-benefits between air pollution control and greenhouse gas reduction. Second, vector-borne disease surveillance, though well developed for case counting, is not yet systematically linked to climate and air-quality data streams in a way that would support the kind of predictive, climate-informed early warning that the observed seasonal and geographic shifts in dengue and malaria transmission make increasingly necessary. Third, natural resource governance — regulation of forests, water and land — remains administratively separate from health policy, so that the environmental determinants of the exposures reviewed above are assessed, where at all, without formal, integrated consideration of their downstream health burden. Strengthening the evidence-to-policy pipeline in each of these three areas, rather than developing wholly new institutions, is likely to be the more tractable near-term priority. (Maharana et al., 2026)

3.6 TOWARDS AN INTEGRATED "ONE HEALTH" GOVERNANCE FRAMEWORK

A structural obstacle underlying all three gaps identified above is institutional: environmental, water and health regulation in India remain administered by separate ministries — the Ministry of Environment, Forest and Climate Change, the Ministry of Jal Shakti, and the Ministry of Health and Family Welfare — each with its own data systems, reporting lines and statutory mandate. India's National One Health Mission, approved in principle by the Principal Scientific Adviser's office in 2022 and formally cleared by the Union Cabinet in February 2024, is the most significant recent attempt to bridge this separation, bringing together the Ministry of Health and Family Welfare, the Department of Animal Husbandry and Dairying, the Ministry of Environment, Forest and Climate Change, and research bodies including the Indian Council of Medical Research and Indian Council of Agricultural Research under a common coordination structure, with the National Centre for Disease Control hosting a dedicated One Health Cell (Office of the Principal Scientific Adviser to the Government of India, 2024). As presently scoped, the Mission is oriented primarily toward zoonotic disease and antimicrobial resistance surveillance rather than the broader climate-resource-health integration this review identifies as missing; extending its data-sharing architecture to include the Ministry of Jal Shakti, the National Disaster Management Authority, and the heat, air-quality and vector-borne disease surveillance streams discussed above would convert an existing institutional asset into the cross-sectoral mechanism this review argues is needed, without requiring the creation of new institutions from scratch. (Gupta et al., 2026)

The constitutional right recognised in M.K. Ranjitsinh also requires implementing machinery below the level of the Supreme Court if it is to translate into operational environmental health standards. State Pollution Control Boards, which already set and enforce emission and effluent conditions under existing air and water legislation, are a natural point at which health-outcome triggers — for instance, PM2.5 thresholds calibrated to the mortality evidence reviewed in Section 3.2 rather than to ambient air quality standards alone — could be incorporated into industrial consent conditions. Biodiversity Management Committees, established under Section 41 of the Biological Diversity Act 2002 at the level of every local body, offer a second, underused channel: their statutory People's Biodiversity Registers already document local forest, water and species change, and could be formally linked to district health-vulnerability mapping to give the constitutional right to climate protection a data foundation at the sub-state level where most of the resource degradation reviewed in this paper actually occurs. Neither step requires new legislation; both depend on extending the mandate of existing bodies to treat health outcomes as a variable within their present regulatory remit.

4. **CONCLUSION**

The evidence reviewed in this paper establishes that climate change is already a major, quantifiable contributor to morbidity and mortality in India, operating through extreme heat, air pollution, water insecurity and vector-borne disease, and extreme weather, with impacts that are large in absolute terms and unevenly distributed toward outdoor workers, the urban and rural poor, and residents of climate-vulnerable regions. India's governance response has not yet been fully integrated with the natural resource regulation that shapes many of the underlying exposures. Closing this gap will depend on strengthening climate-informed health surveillance, formally linking air-quality, heat and vector-borne disease monitoring, and building routine consideration of downstream health burden into the regulation of forests, water, land and air. Continued India-specific research — particularly on the mental health and food security pathways — will be necessary to keep the evidence base ahead of a rapidly evolving climate-health risk profile.

ABBREVIATIONS

NAPCC: National Action Plan on Climate Change; NCAP: National Clean Air Programme; NCVBDC: National Centre for Vector Borne Diseases Control; NDC: Nationally Determined Contribution; NPCCHH: National Programme on Climate Change and Human Health; PM2.5: fine particulate matter with aerodynamic diameter ≤ 2.5 µm; SDG: Sustainable Development Goal; UNFCCC: United Nations Framework Convention on Climate Change.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the institutional support of Galgotias University and the Central University of Kashmir.

AUTHOR CONTRIBUTIONS

Aishwarya: Conceptualisation, development of the review and preparation of the manuscript draft.

Aditya Tomer, Jyotish Gupta, Savneet Kaur and Anvita Srivastava: Literature acquisition, data collection, thematic synthesis, and manuscript proofreading and editing.

Jaibir Singh: Data visualisation and verification of quantitative evidence.

Shruti Agrawal: Governance and policy analysis, and manuscript proofreading.

Dr Mudassir Nazir: Supervision of the review and substantive manuscript revision.

All authors read and approved the final manuscript.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare regarding this investigation.

ETHICS STATEMENT

This study is a narrative literature review. It did not involve human participants, human data, or animal subjects, and therefore did not require ethical clearance.

DATA AVAILABILITY STATEMENT

No new data were generated in the course of this study. All evidence discussed is drawn from the published, publicly available literature, surveillance reports and government policy documents cited in the reference list.

REFERENCES

[1] Borah, S., Das, S., & Kumar, C. (2026). Heatwave impacts and resilience mechanisms in urban informal settlements in India: A systematic review. *Urbanisation, 11*(1), 68–85. https://doi.org/10.1177/24557471261452464

[2] Chakraborti, D., Rahman, M. M., Chatterjee, A., Das, D., Das, B., Nayak, B., et al. (2016). Fate of over 480 million inhabitants living in arsenic- and fluoride-endemic Indian districts: Magnitude, health, socio-economic effects, and mitigation approaches. *Journal of Trace Elements in Medicine and Biology, 38*, 33–45. https://doi.org/10.1016/j.jtemb.2016.05.001

[3] Chowdhury, S., Dey, S., & Smith, K. R. (2018). Ambient PM2.5 exposure and expected premature mortality to 2100 in India under climate change scenarios. *Nature Communications, 9*, 318. https://doi.org/10.1038/s41467-017-02755-y

[4] Gupta, N., Agarwal, S., Velayudhan, A., & Yadav, P. D. (2026). National One Health Mission: An integrated ecosystem for augmenting India's pandemic preparedness. *Journal of the Epidemiology Foundation of India, 4*(2). https://doi.org/10.56450/JEFI.2026.v4i02.001

[5] Hess, J. J., Sathish, L. M., Knowlton, K., Saha, S., Dutta, P., Ganguly, P., Tiwari, A., Jaiswal, A., Sheffield, P., Sarkar, J., Bhan, S. C., Begda, A., Shah, T., Solanki, B., & Mavalankar, D. (2018). Building resilience to climate change: Pilot evaluation of the impact of India's first Heat Action Plan on all-cause mortality. *Environmental Health Perspectives, 126*(12), 127002. https://doi.org/10.1289/EHP3535

[6] Intergovernmental Panel on Climate Change (IPCC). (2019). *Special report on climate change and land*. IPCC.

[7] Karuppusamy, B., Sarma, D. K., Lalmalsawma, P., Pautu, L., Karmodiya, K., & Balabaskaran Nina, P. (2021). Effect of climate change and deforestation on vector-borne diseases in the North-Eastern Indian state of Mizoram bordering Myanmar. *The Journal of Climate Change and Health, 2*, 100015. https://doi.org/10.1016/j.joclim.2021.100015

[8] Khan, S., Haider, N., Yahiro, T., Akbar, S. M. F., Khan, F., Hasan, M. N., Al Mahtab, M., Hashimoto, T., Kimitsuki, K., Tachibana, T., Watanabe, K., & Nishizono, A. (2026). Ambient PM2.5 exposure and increased dengue case fatality: A global multi-country analysis. *Environmental Pollution, 394*, 127731. https://doi.org/10.1016/j.envpol.2026.127731

[9] Kumar, A., Mahajan, N. P., Sorokhaibam, R., Sunthlia, A., Babu, B. S., Vardhan, S., & Shrivastava, A. (2019). National Programme on Climate Change and Human Health-India, 2019. *Journal of Communicable Diseases, 51*(1), 1–6. https://doi.org/10.24321/0019.5138.2019.51.1.1

[10] Lancet Countdown. (2025). *Health and climate change in India: 2025 Lancet Countdown data sheet*. Lancet Countdown.

[11] Levy, K., Kann, R. S., & Carlton, E. J. (2026). Waterborne diseases and climate change. *Nature Reviews Microbiology, 24*(9), 622–636. https://doi.org/10.1038/s41579-026-01338-3

[12] Limaye, V. S., Magal, A., Joshi, J., Maji, S., Dutta, P., Rajput, P., Pingle, S., Madan, P., Mukerjee, P., Bano, S., Beig, G., Mavalankar, D., Jaiswal, A., & Knowlton, K. (2023). Air quality and health co-benefits of climate change mitigation and adaptation actions by 2030: An interdisciplinary modeling study in Ahmedabad, India. *Environmental Research, 1*(2). https://doi.org/10.1088/2752-5309/aca7d8

[13] *M. K. Ranjitsinh & Others v. Union of India & Others*. (2024). 2024 INSC 280, Writ Petition (Civil) No. 838 of 2019. Supreme Court of India.

[14] *M. K. Ranjitsinh & Others v. Union of India & Others*. (2025). 2025 INSC 1472, Writ Petition (Civil) No. 838 of 2019. Supreme Court of India.

[15] Mahapatra, B., Walia, M., Rao, C. A., Raju, B. M., & Saggurti, N. (2021). Vulnerability of agriculture to climate change increases the risk of child malnutrition: Evidence from a large-scale observational study in India. *PLOS ONE, 16*(6), e0253637. https://doi.org/10.1371/journal.pone.0253637

[16] Maharana, A., Patil, S., Nair, A., & Vaghela, A. (2026). Critical assessment of national and sub-national Climate Change and Health Action Plans of India. *Preprint*. https://doi.org/10.21203/rs.3.rs-9318965/v1

[17] Mathews, S., Walker, C., Gao, K., & Madrigano, J. (2026). Compound climate extreme events and associated health impacts: A scoping review. *BMC Medicine, 24*(1). https://doi.org/10.1186/s12916-026-04779-y

[18] Ministry of Environment, Forest and Climate Change. (2008). *National Action Plan on Climate Change*. Government of India.

[19] Ministry of Environment, Forest and Climate Change. (2019). *National Clean Air Programme*. Central Pollution Control Board, Government of India. https://cpcb.nic.in/National-Clean-Air-Programme/

[20] Ministry of Health and Family Welfare. (2017). *National Health Policy 2017*. Government of India.

[21] Ministry of Health and Family Welfare. (2019). *National Programme on Climate Change and Human Health*. Government of India.

[22] Mohammad, P., Goswami, A., & Bonafoni, S. (2019). The impact of land cover dynamics on surface urban heat island variations in semi-arid cities: A case study in Ahmedabad city, India, using multi-sensor/source data. *Sensors, 19*(17), 3701. https://doi.org/10.3390/s19173701

[23] Myers, S. S., Zanobetti, A., Kloog, I., et al. (2014). Increasing CO2 threatens human nutrition. *Nature, 510*, 139–142. https://doi.org/10.1038/nature13179

[24] Narayanappa, M., Supriya, Omar, I., Kumar, P., Yadav, S., Tiwari, S., Mishra, P., & Ray, S. (2026). Estimation of resource management, industrialisation, and renewable energy on climate change dynamics using the ARDL algorithm. *Discover Energy, 6*, 43. https://doi.org/10.1007/s43937-026-00149-0

[25] National Centre for Vector-Borne Diseases Control. (2025). *Dengue situation in India*. Ministry of Health and Family Welfare, Government of India.

[26] National Centre for Vector-Borne Diseases Control. (2026). *Dengue situation in India: Provisional data up to 28 February 2026*. Ministry of Health and Family Welfare, Government of India. https://ncvbdc.mohfw.gov.in

[27] National Crime Records Bureau. (2025). *Accidental deaths & suicides in India 2024*. Ministry of Home Affairs, Government of India.

[28] Office of the Principal Scientific Adviser to the Government of India. (2024). *National One Health Mission*. Government of India.

[29] Pritipadmaja, G., R. D., & Sharma, A. K. (2023). Assessing the cooling effect of blue-green spaces: Implications for urban heat island mitigation. *Water, 15*(16), 2983. https://doi.org/10.3390/w15162983

[30] Romanello, M., Walawender, M., Hsu, S.-C., et al. (2024). The 2024 report of the Lancet Countdown on health and climate change: Facing record-breaking threats from delayed action. *The Lancet, 404*(10465), 1847–1896. https://doi.org/10.1016/S0140-6736(24)01822-1

[31] Romanello, M., Walawender, M., Hsu, S.-C., et al. (2025). The 2025 report of the Lancet Countdown on health and climate change: Climate change action offers a lifeline. *The Lancet, 406*(10521), 2804–2857. https://doi.org/10.1016/S0140-6736(25)01919-1

[32] Saha, K., Ghatak, D., & Muralee, N. S. (2022). Impact of plantation induced forest degradation on the outbreak of emerging infectious diseases—Wayanad District, Kerala, India. *International Journal of Environmental Research and Public Health, 19*(12), 7036. https://doi.org/10.3390/ijerph19127036

[33] Sakalkar, V., Singh, S., Gupta, E., Kumar, A., Kumar, P., & Yadav, C. P. (2026). Health risks of arsenic and chromium in groundwater and surface water in India: A systematic review. *The Indian Journal of Medical Research, 164*(2), 273–286. https://doi.org/10.25259/IJMR_218_2026

[34] Sarkar, B., Das, U., Islam, N., Debnath, M., Alam, A., & Sharma, S. K. (2026). Comparative study on spatial dynamics of groundwater quality in the Ganga and Brahmaputra River basin in India. *Discover Geoscience, 4*, 385. https://doi.org/10.1007/s44288-025-00385-2

[35] Singh, T., Kar, N. P., & Dhiman, R. C. (2026). Seasonal bionomics of *Anopheles* mosquitoes in the cold-western Himalayan region of Kangra, Himachal Pradesh, India. *Scientific Reports*. https://doi.org/10.1038/s41598-026-36269-9

[36] Swain, S., Taloor, A. K., Dhal, L., Sahoo, S., & Al-Ansari, N. (2022). Impact of climate change on groundwater hydrology: A comprehensive review and current status of the Indian hydrogeology. *Applied Water Science, 12*, 165. https://doi.org/10.1007/s13201-022-01652-0

[37] Tripathy, P., Thakur, D. A., Hari, V., & Mohanty, M. P. (2026). From single to compound hazards: How flood and drought vulnerabilities have intensified across India. *npj Natural Hazards,* https://doi.org/10.1038/s44304-026-00264-x

[38] Venugopal, V., Latha, P. K., & Shanmugam, R. (2026). Quantifying the impact of heat stress on labour productivity in outdoor workplaces in Southern India amid a changing climate. Scientific Reports, 16, 14228. https://doi.org/10.1038/s41598-026-41807-6

[39] Walsh, M. G., Bhat, R., Nagarajan-Radha, V., Narayanan, P., Vyas, N., Sawleshwarkar, S., & Mukhopadhyay, C. (2021). Low mammalian species richness is associated with the risk of Kyasanur Forest disease outbreaks in deforested landscapes in the Western Ghats, India. *One Health, 13*, 100299. https://doi.org/10.1016/j.onehlt.2021.100299

[40] Yakubu, S., Mousavi, S., Palade, V., Eden, J., Kabajulizi, J., Salari, N., Hosseinian Far, A., Al Ali, H., & Daneshkhah, A. (2026). Flooding and the risk of PTSD, depression, and anxiety: A systematic review and meta-analysis. *Environmental Research*, 124063. https://doi.org/10.1016/j.envres.2026.124063

[41] Zhou, M., Xie, Y., Wang, C., Shen, L., & Mauzerall, D. L. (2024). Impacts of current and climate-induced changes in atmospheric stagnation on Indian surface PM2.5 pollution. *Nature Communications, 15*, 7448. https://doi.org/10.1038/s41467-024-51462-y