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The Scorched Ledger: Counting the True Cost of Climate Change in India

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Abstract
Climate change is no longer a distant environmental threat but an immediate economic crisis for India, where conventional GDP-based accounting systematically understates the true burden. Conventional metrics overlook the erosion of ecosystem services, the hidden losses in the vast informal economy, and the non-market costs of health and human suffering. Drawing on district-level, large-scale household surveys, geospatial climate datasets, computable general equilibrium modelling, and a systematic synthesis of over 300 peer-reviewed studies, this paper offers one of the most comprehensive valuations yet undertaken. The analysis estimates India's current annual climate-related economic losses at ₹7–10 lakh crore—roughly 4–6 % of GDP. These figures are rising sharply and could reach 12–18 % of GDP by 2050 under high-emissions pathways. The impacts are starkly unequal: the poorest households lose three to five times more of their income than the national average; women and children bear disproportionate health and care burdens; and climate-vulnerable states in central and eastern India suffer losses far exceeding the national mean. Yet the ledger is not only about costs. Adaptation investments deliver benefit-cost ratios of 4:1 to 8:1, while ambitious mitigation pathways generate substantial long-term savings through reduced fossil-fuel imports, new green jobs, and avoided damages. The findings make a compelling economic case for urgent, equity-centred climate action. They also expose the urgent need for "green national accounting" that incorporates natural capital, carbon pricing that recycles revenues into social protection, and institutional reforms that place climate economics at the heart of development planning. Recognising the true scorched ledger is the first step towards a sustainable and inclusive India.

Keywords: Climate Change Economics, India, Economic Valuation, Adaptation, Inequality, Environmental Accounting, Distributional Impacts.

Introduction

India's remarkable economic ascent is increasingly shadowed by a changing climate. Rising temperatures, erratic monsoons, intensifying heatwaves, and accelerating ecosystem degradation are no longer abstract risks but daily realities that erode productivity, damage infrastructure, and deepen poverty traps. Agriculture, which still supports nearly half the workforce, is especially exposed; yet urban centres too face mounting heat stress, flooded streets, and spiralling health costs. Despite mounting evidence, national economic planning continues to rely on narrow GDP indicators that treat environmental losses as externalities and informal-sector disruptions as invisible. This creates a dangerous disconnect: the official growth story looks robust while the real economy bleeds from unaccounted wounds. Three critical blind spots persist in existing assessments—measurement gaps that exclude ecosystem services and non-market costs, distributional invisibility that masks impacts on the poor and marginalised, and fragmented sectoral analyses that fail to capture economy-wide feedbacks.

This study addresses these gaps through an integrated economic lens. It quantifies the comprehensive cost of climate change in India, maps its highly uneven distribution, and demonstrates that proactive climate action is not a cost but one of the highest-return investments available to the nation. By placing rigorous economic valuation at the centre, it seeks to reframe climate policy as core development strategy.

Methods

The research employs a mixed-methods framework designed to overcome the limitations of single-sector or top-down approaches. District-level panel data spanning 1990–2024 were combined with climate and satellite observations to estimate impacts on agricultural output, labour productivity, and infrastructure. A nationally

representative household survey of 3,600 families captured lived experiences of income shocks, health expenditures, and unpaid care burdens. Computable general equilibrium modelling integrated these micro-level findings with national accounts to simulate economy-wide effects under alternative climate and policy scenarios. Geospatial vulnerability mapping highlighted regional hotspots, while a systematic review of 312 studies provided valuation coefficients for ecosystem services and health costs.

Fixed-effects econometric models controlled for time-invariant district characteristics and common time shocks, while economic valuation techniques (replacement cost, avoided damage, and contingent valuation) monetised non-market impacts. All monetary figures are expressed in 2023–24 constant rupees. Uncertainty bounds reflect alternative climate scenarios and valuation assumptions.

Results

Aggregate economic costs

Current annual losses from climate change are estimated at ₹7–10 lakh crore, equivalent to 4–6 % of GDP. These costs have risen steadily over three decades and are projected to accelerate. By mid-century under a high-emissions trajectory, they could consume 12–18 % of GDP—larger than the combined fiscal outlays for health and education today.

Sectoral impacts

Agriculture remains the hardest hit, with wheat, rice, and pulse yields declining markedly in rain-fed regions. Water-resource stress compounds the problem: groundwater depletion, recurrent droughts, and flash floods together generate massive losses while threatening long-term aquifer viability. Public-health costs—driven by heat stress, vector-borne diseases, and reduced labour productivity—account for a growing share of the total. Ecosystem degradation, particularly the loss of forests, wetlands, and coastal mangroves, represents the single largest component when valued at replacement or service-provision cost.

Distributional effects

The burden falls most heavily on those least able to bear it. Poor households experience income losses three to five times higher, as a share of their earnings, than the national average. Women shoulder additional unpaid care work during extreme weather, while children face long-term nutritional and educational setbacks. Regional disparities are equally stark: states in the central and eastern plains suffer losses far exceeding the all-India average. Climate change is therefore not merely an environmental issue but a profound driver of economic inequality.

Table 1. Estimated annual climate-related losses in India (₹ lakh crore, 2023–24 prices)

Component	Low estimate	High estimate	Share of total (%)
Agriculture & allied	2.2	3.1	32
Water resources & disasters	1.4	2.0	20
Public health & productivity	1.5	2.2	22
Ecosystem services	1.8	2.5	26
Infrastructure & others	0.1	0.2	—
Total	**7.0**	**10.0**	**100**

Table 2. Economic returns to climate action

Intervention	Benefit-cost ratio	Key co-benefits
Adaptation (irrigation, early warning, resilient crops)	4:1 to 8:1	Reduced poverty, gender equity
Mitigation (renewables, energy efficiency)	Long-term net positive	Lower import bill, green jobs
Integrated social protection + carbon pricing	3:1+	Reduced inequality

Economic benefits of climate action

The analysis reveals powerful positive returns. Well-designed adaptation measures consistently deliver benefit-cost ratios between 4:1 and 8:1. Shifting to clean energy reduces fossil-fuel imports, creates millions of green jobs, and yields substantial health co-benefits. Ambitious mitigation pathways generate net economic gains within two to three decades through avoided damages alone.

Discussion

These findings expose a fundamental accounting failure in India's growth model. Official statistics paint a picture of resilient expansion while the real economy—especially its poorest and most climate-exposed segments—pays a hidden and rapidly growing price. The non-linear temperature–growth relationship documented globally (Burke et al., 2015) is particularly punishing for a tropical country like India, where most districts already lie near or beyond the temperature optimum for economic productivity.

The distributional results reinforce a deeper truth: climate change is an inequality multiplier. It widens the gap not only between rich and poor nations but within India itself. Women and children, who rarely appear in GDP calculations, bear costs that conventional economics renders invisible. Yet the same data show that targeted, equity-focused investments can simultaneously reduce emissions, build resilience, and narrow these gaps—an opportunity too compelling to ignore.

Policy implications

Green national accounting

India must move beyond GDP to a comprehensive wealth accounting framework that values natural capital and ecosystem services. Regular publication of "climate-adjusted" national accounts would provide policymakers and citizens with a truer picture of economic performance.

Carbon pricing and revenue recycling

A well-designed carbon price, with revenues directed toward adaptation and social protection, can cut emissions while protecting vulnerable households. The political economy is manageable if revenues visibly benefit those most affected.

Institutional coordination

A dedicated Climate Economic Authority or strengthened mandate within NITI Aayog could integrate climate considerations across all ministries and ensure consistency between fiscal, trade, and environmental policies.

Targeted social protection

Expanded climate-resilient social security—weather-indexed insurance, heat-action plans, and gender-sensitive livelihood support—must become a core pillar of development strategy.

Conclusion

Climate change already imposes a massive, under-recognised toll on the Indian economy. The costs are large, rising fast, and distributed in ways that deepen existing inequities. Yet the same evidence that reveals the problem also illuminates the solution: climate action is one of the highest-return investments India can make. By recognising the true scorched ledger—through better measurement, integrated policy, and unflinching focus on equity—India can secure not only environmental sustainability but also faster, fairer, and more resilient economic progress. The choice is no longer between growth and climate action. It is between an incomplete ledger that hides the costs and a full accounting that unlocks the gains. The time to balance the books is now.

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