

## **Integrating Climate Resilience and Sustainable Growth in India's Development Agenda**

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### **Abstract:**

Climate change poses a significant challenge to India—a rapidly growing economy with a population exceeding 1.4 billion and a rich diversity of ecological systems. Accelerating greenhouse gas (GHG) emissions, combined with urbanization, deforestation, and industrial expansion, threaten to undermine both economic progress and ecological stability. India's commitment to the Paris Agreement and the Sustainable Development Goals (SDGs) has spurred the integration of climate action into its national development strategy. This review examines the country's policies, strategic interventions, and persistent challenges in promoting environmental sustainability, with a focus on renewable energy deployment, afforestation initiatives, sustainable agricultural practices, and the expansion of green finance. It highlights key national programs—including the National Action Plan on Climate Change (NAPCC), the National Electric Mobility Mission, and the Green India Mission—while critically analysing their achievements, limitations, and alignment with global climate targets. The paper concludes by advocating for a multi-stakeholder, low-carbon development pathway that can help India reach its net-zero ambitions without compromising socio-economic progress

**Keywords:** Climate change, sustainable development, renewable energy, green finance, National Action Plan on Climate Change (NAPCC), net-zero emissions, India, environmental policy

### **1. Introduction**

India, as the world's third-largest greenhouse gas emitter and one of the fastest-growing economies, faces a dual challenge: sustaining economic growth while mitigating environmental degradation (Government of India, 2023). Climate change impacts are increasingly evident through extreme weather events, rising temperatures, glacier retreat, biodiversity loss, and water stress (MoEFCC, 2008). Agriculture, which employs nearly 40% of the workforce and depends heavily on monsoons, makes environmental sustainability inseparable from economic resilience.

India has integrated climate action into its development agenda, aligning with the United Nations SDGs and the Paris Agreement. Key targets include achieving net-zero emissions by 2070, reducing carbon intensity of GDP by 45% by 2030 (from 2005 levels), and ensuring 50% of total electricity generation capacity comes from non-fossil fuels by 2030 (Government of India, 2023). Balancing energy security, poverty alleviation, industrial growth, and environmental conservation remains a complex challenge for a developing country.

This review examines how India's development policies integrate environmental sustainability, evaluates the implementation of climate action initiatives, and identifies pathways for a low-carbon, resilient economy.

## 2. Literature Review

India's pursuit of sustainable development and climate resilience has prompted significant research on the intersection of policy, institutions, and environmental outcomes. Across studies, several core themes emerge: **urban and rural adaptation gaps, institutional coordination challenges, financing mechanisms, renewable energy transitions, and ecosystem vulnerabilities.**

**Urban and Sub-National Climate Action:** Singh, Madhavan, Arvind, and Bazaz (2021) find that adaptation efforts in 53 Indian megacities are largely project-based, reactive, and poorly integrated into long-term planning. Azhoni et al. (2017) and Govindarajulu (2020) highlight that municipal and Panchayat-level institutions lack technical and financial capacity, slowing execution of State Action Plans on Climate Change (SAPCCs) despite the central framework provided by NAPCC (MoEFCC, 2008).

**Institutional and Federal Frameworks:** India's climate governance is hampered by fragmented coordination between central institutions such as MoEFCC, the Prime Minister's Council on Climate Change (PMCCC), and state-level bodies (Dubash, Khosla, Kelkar, & Lele, 2018). Singh and Kolluri (2025) advocate for a National Climate Law, decentralized mandates, fiscal incentives via the Finance Commission, and a permanent intergovernmental climate council to address this gap. Cambridge's federalism study (2024) emphasizes that states, responsible for key sectors like agriculture and water, must have greater policy-making power for climate resilience.

**Financing the Transition:** Pant and Pathak (2023) and Partiti et al. (2025) observe that green bonds and ESG frameworks are growing but face green washing risks, regulatory gaps, and limited private participation. An MDPI study (2024) argues that India's green bond market is still nascent, calling for standardized disclosure norms and credit rating systems.

**Renewable Energy and Energy Security :** Mohan et al. (2021) use state-level modelling to show that **solar, wind, and battery storage** could replace coal by 2040, but only if solar PV costs drop below \$250/kW and battery prices halve. This underscores the need for **technology cost reductions, low-cost capital, and policy-driven de-risking mechanisms** to accelerate coal phase-out.

**3. Ecological and Carbon Sink Challenges:** Das et al. (2022) reveal that despite an **18.5% increase in forest greening (Leaf Area Index)** from 2001–2019, **Net Primary Productivity declined by ~6%** due to rising temperatures. This suggests that warming may undermine India's terrestrial carbon sink capacity, necessitating **adaptive forest management policies.**

Climate Change and Environmental Challenges in India

### 3.1 Greenhouse Gas Emissions Profile

India contributes approximately 7% of global CO<sub>2</sub> emissions, with coal-fired power generation as the dominant source (Government of India, 2023). Despite this, per capita emissions remain significantly below developed nations.

### 3.2 Key Environmental Challenges

1. **Air Pollution:** India hosts 14 of the 20 most polluted cities globally (Pant & Pathak, 2023).
2. **Water Scarcity:** Over 50% of districts face critical groundwater depletion (MoEFCC,

2008).

3. **Deforestation and Biodiversity Loss:** Forest ecosystems are under pressure from mining, agriculture, and infrastructure (Dubash & Jogesh, 2014).
4. **Climate Vulnerability:** Floods, droughts, and cyclones impact 200 million people annually, affecting GDP and livelihoods (Government of India, 2023).

#### **4. Policy Framework for Climate Action**

##### **4.1 National Action Plan on Climate Change (NAPCC)**

The NAPCC (MoEFCC, 2008) integrates eight core missions, including the National Solar Mission, National Mission on Sustainable Agriculture, and the Green India Mission, to promote renewable energy, water conservation, and afforestation.

##### **4.2 State Action Plans on Climate Change (SAPCCs)**

Every state has developed SAPCCs to localize climate adaptation and renewable energy expansion (Dubash & Jogesh, 2014).

##### **4.3 Renewable Energy Transition**

India targets **500 GW of non-fossil fuel capacity by 2030**, with investments in solar, wind, and green hydrogen (Pant & Pathak, 2023). International Solar Alliance (ISA) initiatives position India as a global leader.

##### **4.4 Afforestation & Green Finance**

The Green India Mission seeks to **increase forest cover by 5 million hectares**, while **sovereign green bonds (2023)** aim to mobilize funding for renewable projects (Pant & Pathak, 2023).

#### **5. Progress and Achievements**

India surpassed **170 GW of renewable energy capacity in 2023**, saving **300 million tons of CO<sub>2</sub> between 2015–2022** through efficiency measures (Government of India, 2023). Electric vehicle adoption is rising under FAME-II subsidies, and India's **Global Climate Change Performance Index (CCPI) ranking** has improved (Pant & Pathak, 2023).

##### **Barriers and Challenges**

India remains **70% dependent on coal** for power generation (Mohan et al., 2021). The estimated **\$10 trillion required to reach net-zero by 2070** far exceeds the <\$50 billion annual investment flow (Pant & Pathak, 2023). **Institutional bottlenecks and social equity issues**—including risks for coal workers—further hinder progress (Singh & Kolluri, 2025).

##### **Future Pathways for Sustainable Development**

**Decarbonization of Industry:** Adoption of green hydrogen and carbon capture (Mohan et al., 2021).

**Just Transition:** Reskilling coal-dependent workers (Singh & Kolluri, 2025).

**Urban Sustainability:** Smart cities, mass transit, waste-to-energy (Singh et al., 2021).

**Climate Finance:** Enhanced international funding and domestic mobilization (Pant & Pathak, 2023).

**Community-Based Adaptation:** Leveraging local knowledge for rural resilience (Azhoni et al., 2017).

#### **6. Conclusion**

India's sustainable development trajectory depends on **aligning economic growth with environmental stewardship**. Meeting the 2070 net-zero targets will require **strong institutions, adequate finance, technological innovation, and participatory approaches** (Dubash et al., 2018; Singh & Kolluri, 2025). By ensuring **just and equitable transitions**, India

can achieve a climate-resilient, inclusive growth pathway, making climate action both an environmental necessity and a foundation for economic resilience.

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