



## Towards a Climate Resilient India

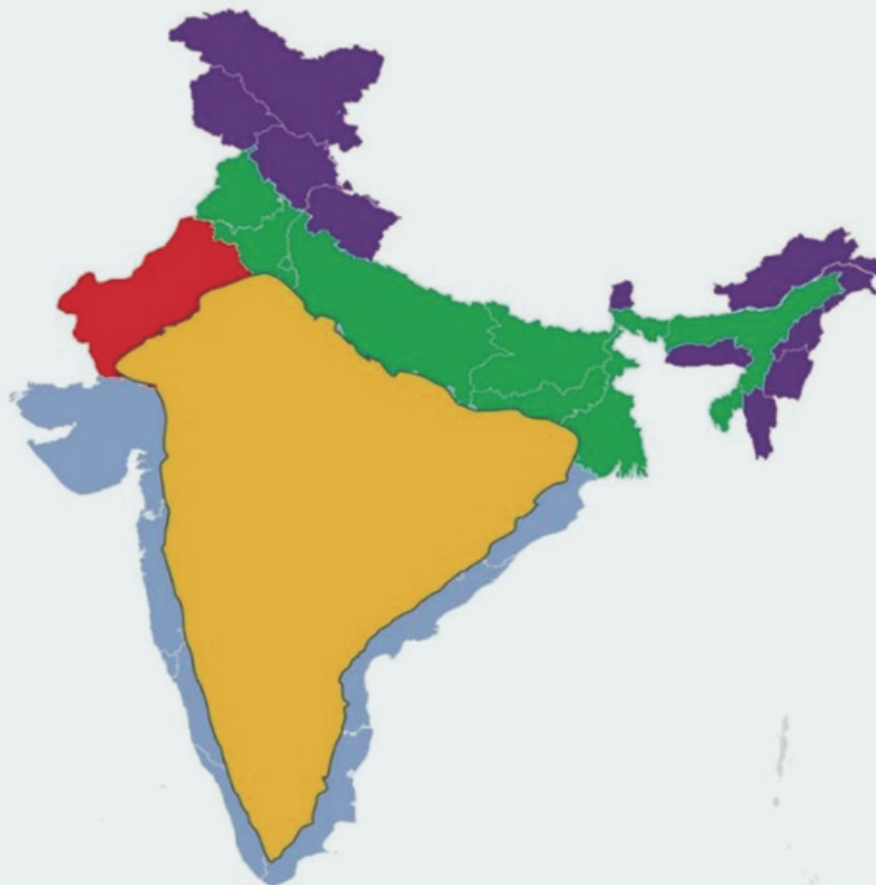
This editorial is based on “[Rain and repeat: On extreme weather and governance](#)” which was published in The Hindu on 04/09/2025. The article brings into picture India’s rising vulnerability to extreme climate events, stressing the need to move from reactive relief to proactive resilience through robust infrastructure, real-time monitoring, and climate-informed planning.

**For Prelims:** [Cloudbursts](#), [Urban heat island effect](#), [Climate Risk Index 2025](#), [Glacial lake outburst floods](#), [National Mission on Sustainable Agriculture](#), [Critical minerals](#), [Perform, Achieve and Trade \(PAT\) scheme](#).

**For Mains:** Extreme Weather Patterns Reshaping India’s Climate Risk Landscape, Major Gaps in India’s Climate Adaptation and Mitigation Strategies.

The devastating [floods](#) in **Punjab, Andhra Pradesh and Telangana** highlight India's escalating vulnerability to [extreme climate events](#) nationwide. From **Kerala's unprecedented floods to Uttarakhand's cloudbursts** and **Delhi's record-breaking heatwaves**, India faces intensifying weather patterns that overwhelm existing infrastructure and governance systems. The country's 1.4 billion people are increasingly exposed to climate risks that demand urgent adaptation measures beyond traditional disaster response. India must transition **from reactive relief to proactive resilience-building through upgraded infrastructure, real-time climate monitoring, and climate-informed urban planning** that anticipates rather than merely responds to extreme weather.

**Chart II.1: Risks Emanating from Climate Change across Geographical Regions in India**



<b>Thar Desert</b> Heatwaves	<b>Great Himalayas</b> Landslides Cloudbursts Melting of glaciers	<b>Indo-Gangetic Plains</b> River floods Heatwaves Thunderstorms
<b>Coastal Plains and Ghats</b> Heavy precipitation Urban floods Cyclones Landslides	<b>Central Peninsular Plateau</b> Heatwaves Forest fires Droughts	

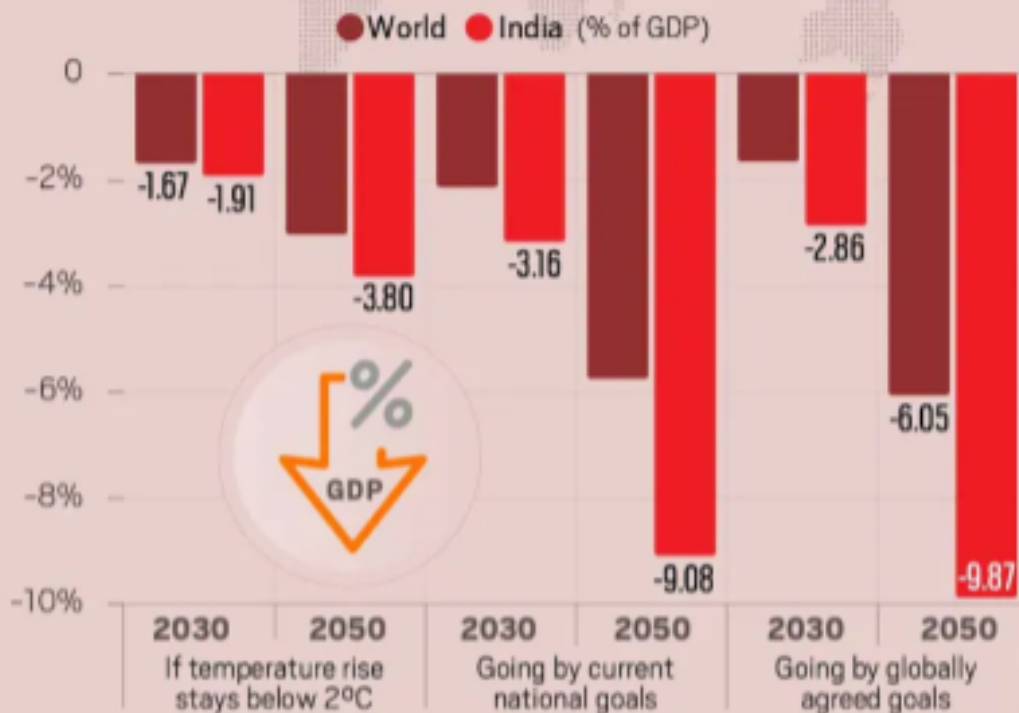
**Note:** Map not to scale.

## How are Extreme Weather Patterns Reshaping India's Climate Risk Landscape?

- **Agricultural Vulnerability and Crop Losses:** The agricultural sector is particularly vulnerable, as extreme weather causes significant crop damage and losses.
  - With the frequency of climate events rising, crop failures are increasing, impacting food security.
  - In 2024, extreme weather affected 4.07 million hectares of agricultural land, marking an 84% increase from 2023.

- A 2024 report stated that more than 50% of marginal farmers reported losing at least half of their standing crops due to extreme weather conditions.
- Such extreme weather shifts highlight the urgent need for climate-resilient agricultural practices.
- **Impact on Urban Infrastructure and Vulnerability:** India's rapidly urbanizing landscape is ill-equipped to handle escalating climate risks, especially extreme heat and flooding.
  - The [urban heat island effect](#) and poorly planned drainage systems are exacerbating the vulnerability of cities.
  - Cities like Delhi saw record-breaking heatwaves in 2024, with temperatures exceeding 46°C.
    - The World Bank estimates that India will need over \$2.4 trillion by 2050 to build climate-resilient urban infrastructure.
  - With more than 80% of the urban population living in hazard-prone areas, a paradigm shift in urban planning is essential for climate resilience.
- **Human Health and Mortality Risks:** The growing intensity of extreme weather events, particularly heatwaves and floods, is placing unprecedented stress on public health systems.
  - Heatwaves, which have become more severe, are directly linked to higher mortality rates.
  - The lack of proper infrastructure, such as cool shelters and equipped hospitals, and a failure to implement existing guidelines, further compound the risks, as evidenced by the tragic deaths of 33 polling personnel from heatstroke in Uttar Pradesh during the 2024 Lok Sabha elections.
- **Displacement and Loss of Livelihoods:** Extreme weather events are increasingly leading to displacement and loss of livelihoods, particularly in flood-prone regions.
  - For instance, overall, 3.8 million people have been affected by the recent flooding in Punjab.
  - These displacements often lead to social and economic upheaval, further complicating the task of recovery.
    - As extreme events become more frequent, long-term resilience planning must incorporate better livelihood security measures for at-risk populations.
- **Economic Losses and Development Setbacks:** The cumulative effect of these climate-related disasters is inflicting severe economic losses and threatening India's developmental trajectory.
  - The [Climate Risk Index 2025](#) ranked India as the sixth most affected country globally from 1993 to 2022, with losses exceeding \$180 billion.
  - Recent research indicates that the climate crisis could cost the country from 6.4% to more than **10% of its national income by 2100**, pushing **50 million more people back into poverty**.

# Cost of Climate Change on GDP



- **Glacial Melt and Himalayan Instability:** The [Himalayan ecosystem](#), a critical water source for millions, is highly vulnerable to climate change, with rising temperatures causing rapid glacial retreat and the formation of unstable glacial lakes.
  - Glacial lakes and other water bodies across the Himalayan region saw a 10.81% increase in area from 2011 to 2024 due to climate change, raising the risk of catastrophic [glacial lake outburst floods \(GLOFs\)](#).
  - This threat was realized in the October 2023 GLOF in Sikkim, which underscored the extreme risks to downstream communities and infrastructure.
    - The continued melting of glaciers threatens to disrupt the flow of major rivers like the Ganga and Brahmaputra, jeopardizing water security, agriculture, and hydropower generation for millions.

## What are the Major Gaps in India's Climate Adaptation and Mitigation Strategies?

- **Lack of Coordinated and Localized Adaptation Plans:** While national-level climate missions exist, there is a critical gap in their implementation at the state and local levels.
  - Many State Action Plans on Climate Change (SAPCCs) are not fully integrated into local governance and budgeting, failing to address region-specific vulnerabilities.
    - Currently, **no standard climate impact or adaptation monitoring framework** exists to track SAPCC.
  - **The lack of a robust, decentralized framework means that climate risks often go unaddressed, particularly for agriculture.**

- Also, although initiatives such as the [National Mission on Sustainable Agriculture \(NMSA\)](#) are in place, estimates suggest that less than 5% of Indian farmers have adopted sustainable farming practices.
- **Financial and Technological Gaps:** Financing remains a major bottleneck for both adaptation and mitigation efforts. India's climate action requires trillions of dollars in investment, but there is a significant gap between the need and available finance.
  - A Deloitte report (2025) finds India requires about \$1.5 trillion by 2030 for climate action across sectors such as renewable energy, clean transport, sustainable agriculture, water, and resilient infrastructure.
  - The country also faces a technological dependency on [critical minerals](#) like lithium and cobalt, essential for the renewable energy transition, which are largely controlled by a few nations (like China), creating a significant supply chain vulnerability.
- **Slow Progress on Decarbonization:** India's energy transition is sluggish due to heavy coal dependence, regulatory hurdles, and slow adoption of renewables and clean technologies.
  - India has not committed to a full [phase-out of coal](#) and the government continues to push for more coal-fired plants.
    - India's state-controlled coal producer Coal India (CIL) has set an output target of 863mn t in 2025-26. Further, the Ministry of Power in 2023 disclosed its plan to increase close to 90.0 GW of coal-fired capacity through 2032.
  - Also, electric mobility, grid modernization, and industrial decarbonization are lagging, **risking missed 2030 and 2070 climate targets.**
- **Social Inequality and Inclusivity Deficits:** India's climate policies often fail to adequately protect its most vulnerable communities, who disproportionately bear the brunt of climate impacts.
  - The focus on large-scale infrastructure projects often overlooks the rights and needs of local populations, leading to displacement and increased risk.
  - For instance, Private Renewable Power Corporations (PRPCs) have acquired **community grazing lands (Orans) in Thar Desert for solar projects** without consulting local Indigenous tribal communities.
  - Also, the **top 20% of high expenditure households in India generate nearly seven times the carbon emissions** compared to low-expenditure households, yet vulnerable communities bear disproportionate climate impacts.
- **Weak Climate-Health System Integration:** India's healthcare infrastructure is unprepared for climate-induced health risks, lacking early warning systems for heat waves, vector-borne diseases, and air pollution spikes.
  - The health sector contributes minimally to climate adaptation planning, with most State Action Plan for Climate Change and Human Health (SAPCCHH) remaining on paper.
  - Vector-borne diseases like dengue and chikungunya are expanding geographically due to changing rainfall patterns, yet surveillance systems remain inadequate.
- **Weak Water-Climate Security Nexus:** India's water management operates in silos from climate planning, despite water being the primary medium through which climate impacts manifest.
  - River basin organizations lack climate adaptation mandates, and inter-state water disputes ignore climate projections.
  - Groundwater depletion accelerates in climate-stressed regions like Punjab and Haryana, yet recharge strategies remain disconnected from climate resilience planning.
    - 75% of households in India lack access to safe drinking water and climate change will worsen this crisis.
- **Industrial Decarbonization and Circular Economy Deficits:** Heavy industries—steel, cement, aluminum, chemicals—contribute significantly to India's emissions (steel industry alone accounts for 10-12% of India's total emissions) but lack sector-specific decarbonization roadmaps with clear timelines.
  - The [Perform, Achieve and Trade \(PAT\) scheme](#) covers energy efficiency but not deep decarbonization through technology shifts.
  - Circular economy principles remain marginal, with industrial symbiosis and waste-to-energy initiatives scattered.
    - Critical sectors like steel still rely on blast furnace technology with minimal adoption of hydrogen-based direct reduction.

## What Measures can India Adopt to Strengthen its Resilience



## Against Climate Risks?

- **Decentralized Climate Action Framework with Localized Governance:** India must institutionalize a decentralized climate governance model that ensures local vulnerabilities are addressed in real-time.
  - A standardized framework for monitoring climate impacts, aligned with the State Action Plans on Climate Change (SAPCCs), will enable states to tailor policies according to regional risks.
  - Empowering local governments with the necessary resources, data, and accountability mechanisms will ensure that climate adaptation is integrated into local planning and budgeting.
    - This approach can streamline efforts from grassroots to national levels, fostering effective climate resilience at all scales.
- **Enhanced Financial Mechanisms and Green Financing Tools:** Addressing the financial bottleneck requires innovative solutions like green bonds, climate insurance, and blended finance models to channel private and public funds into climate resilience projects.
  - Establishing dedicated climate funds at the state and local levels can help bridge the financing gap in sectors like agriculture, renewable energy, and infrastructure.
  - Encouraging public-private partnerships in developing clean technologies and climate-resilient infrastructure can leverage private investment while ensuring that climate action is fully integrated into India's economic growth model.
- **Technological Upgradation and Localized Climate Solutions:** Investing in low-cost, indigenous technologies for climate adaptation, such as solar-powered irrigation systems for farmers or decentralized water purification solutions, will help reduce India's dependency on imported technologies.
  - India must build its own tech base, especially for energy storage solutions, electric mobility, and carbon capture technologies.
  - Bridging the technological gap by enhancing R&D in green technologies for industries such as steel, cement, and chemicals will accelerate industrial decarbonization.
    - The use of AI and machine learning for real-time weather monitoring and disaster prediction can also provide invaluable data to better prepare vulnerable communities.
- **Accelerated Renewable Energy Transition with Regional Adaptation:** While renewable energy investments are on the rise, India must fast-track its transition by integrating solar, wind, and hydro projects more effectively into regional power grids.
  - Expanding decentralized renewable energy solutions in rural areas will reduce grid dependency and enhance energy access, which is crucial during climate disruptions.
  - Additionally, coal-dependent regions must diversify their energy infrastructure by adopting cleaner technologies such as green hydrogen.
    - Encouraging regional renewable energy hubs, based on geographical advantages, can balance energy demands while reducing carbon emissions significantly.
- **Strengthening Climate-Health Integration and Early Warning Systems:** To prepare for climate-induced health risks, India needs to integrate climate adaptation strategies within its public health systems.
  - Building real-time early warning systems for extreme weather, vector-borne diseases, and air pollution events can save lives and reduce the burden on healthcare infrastructure.
  - Implementing climate-resilient healthcare infrastructure in disaster-prone regions—equipped with power backup systems, water-efficient solutions, and strong disease surveillance—will ensure the health sector is not overwhelmed during climate crises.
- **Revamping Water-Climate Resilience with Integrated Water Management:** India must integrate climate projections into its water management strategies, focusing on watershed management and groundwater recharge.
  - River basin organizations need mandates to incorporate climate change scenarios into their planning processes to mitigate water scarcity and flooding risks.
  - Implementing rainwater harvesting and stormwater management at the local level, alongside large-scale infrastructure, will ensure water resilience in urban and rural areas.
- **Inclusive and Just Climate Action for Vulnerable Communities:** Climate resilience plans must prioritize vulnerable communities by addressing social inequality and ensuring that climate

action does not exacerbate existing disparities.

- Fostering inclusive development through community consultations and ensuring that local populations are involved in decision-making will make climate policies more effective.
- Policies must safeguard land rights and provide alternative livelihoods for communities displaced by climate projects, such as large-scale renewable energy farms.

▪ **Building Climate-Resilient Urban Infrastructure:** Indian cities are at the frontline of climate risks, facing floods, heatwaves, and rising temperatures.

- Integrating climate resilience into urban planning by expanding green infrastructure, such as green roofs and urban forests, will help mitigate the urban heat island effect and improve air quality.
- Furthermore, designing flood-resistant drainage systems and investing in sustainable housing will ensure cities remain livable even during extreme weather.

▪ **Education and Capacity Building for Climate Resilience:** India must invest in large-scale climate education campaigns to raise awareness and build capacity at all levels, from policymakers to local communities.

- Empowering individuals with the knowledge and tools to respond to climate risks will enhance community-led resilience efforts.
- Offering specialized training to local government officials on climate adaptation strategies, including disaster management and sustainable land use planning, will ensure better implementation of national and regional climate action plans.

## Conclusion:

**India's climate future hinges on 3Cs— Coordination, Capacity, and Community—** coordinated governance across all levels, capacity-building through finance, technology, and infrastructure, and community-centric inclusive action. By mainstreaming these 3Cs into adaptation and mitigation, India can align its efforts with **SDG-13 (Climate Action), SDG-6 (Clean Water), and SDG-11 (Sustainable Cities)**. This holistic approach will shift the **nation from reactive disaster relief to proactive climate resilience**.

### ***Drishti Mains Question:***

With intensifying extreme weather events, India's climate risk landscape is undergoing a fundamental transformation. Suggest a roadmap for building long-term climate resilience while aligning with the Sustainable Development Goals.

## UPSC Civil Services Examination, Previous Year Question (PYQ)

### **Prelims**

Q.1 In the context of India's preparation for Climate-Smart Agriculture, consider the following statements: (2021)

1. The 'Climate-Smart Village' approach in India is a part of a project led by the Climate Change, Agriculture and Food Security (CCAFS), an international research programme.
2. The project of CCAFS is carried out under Consultative Group on International Agricultural Research (CGIAR) headquartered in France.
3. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India is one of the CGIAR's research centres.

Which of the statements given above are correct?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

Ans: (d)

Q.2 With reference to 'Global Climate Change Alliance', which of the following statements is/are correct? (2017)

1. It is an initiative of the European Union.
2. It provides technical and financial support to targeted developing countries to integrate climate change into their development policies and budgets.
3. It is coordinated by World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD).

Select the correct answer using the code given below:

- (a) 1 and 2 only
- (b) 3 only
- (c) 2 and 3 only
- (d) 1, 2 and 3

Ans: (a)

## **Mains**

**Q.1 Describe the major outcomes of the 26th session of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC). What are the commitments made by India in this conference? (2021)**

**Q.2 'Climate Change' is a global problem. How will India be affected by climate change? How Himalayan and coastal states of India are affected by climate change? (2017)**

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