Futureproofing India Against Climate Change

This editorial is based on "India's climate challenge" which was published in The Hindu on 03/08/2025. The article brings into picture the deepening climate crisis India faces—rising sea levels, erratic monsoons, and recurring disasters—highlighting the urgent need for a climate-resilient and adaptive development approach.

For Prelims: Sundarbans mangrove, Wayanad landslide, Cyclones, Hasdeo Arand, 2023 amendments to the Forest Conservation Act,Great Nicobar Island project, Greenwashing, Urban heat island

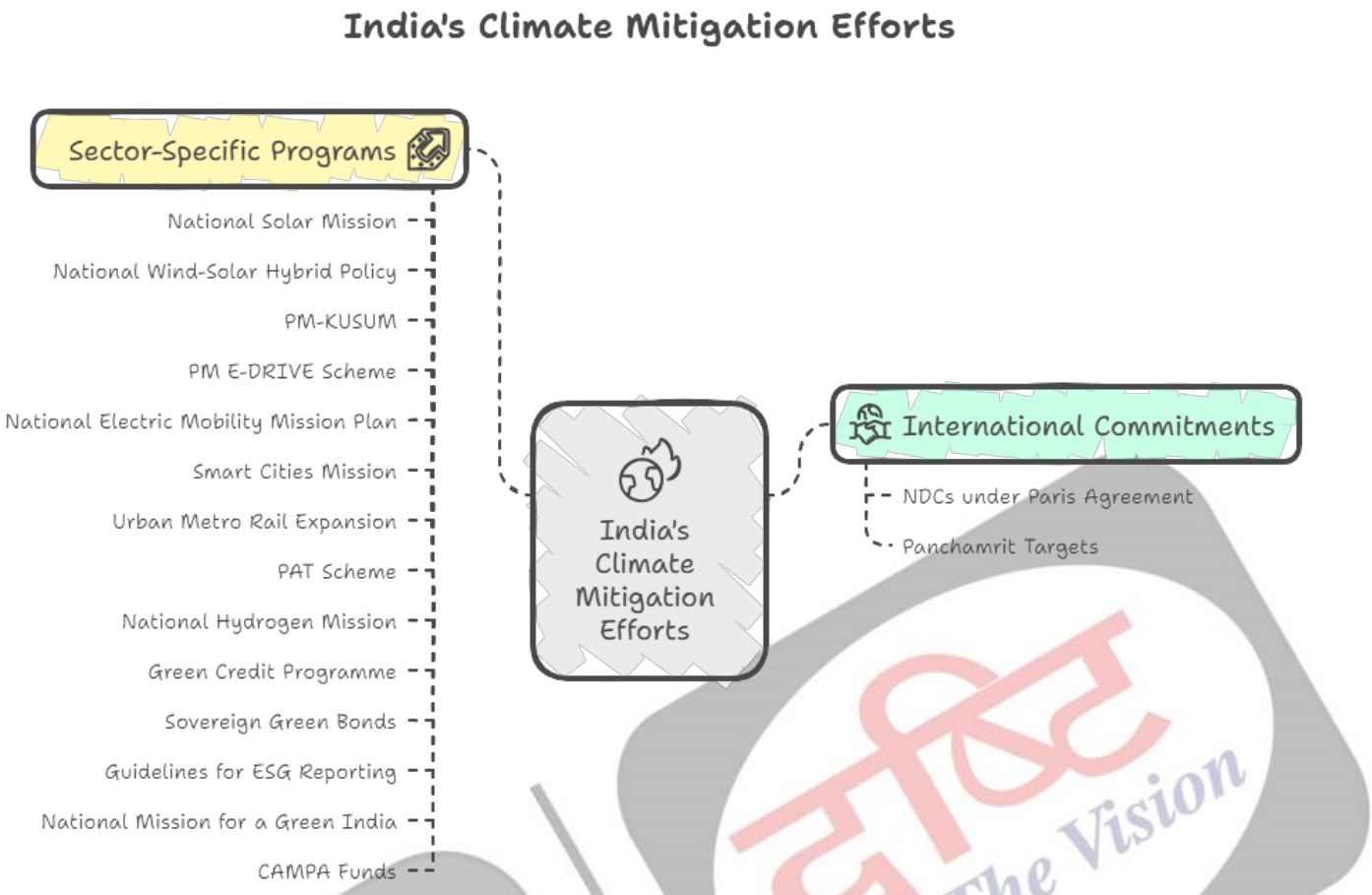
For Mains: Key Climate Change Related Threats that India is Facing, Major Challenges Undermining the Effectiveness of India's Climate Mitigation Efforts.

India stands at the edge of an **unprecedented climatic crisis**. With economic losses of **$79.5 billion from climate disasters** over two decades and erratic monsoons destabilizing entire regions, the nation faces mounting challenges from **rising sea levels, extreme weather events, and agricultural disruption.** Coastal cities like **Mumbai, Chennai, and Kochi** risk partial submergence by **2040**, while the **Sundarbans mangrove** forests could lose **80% of their area by 2100,** threatening both biodiversity and natural disaster buffers. The recent floods in **Uttarakhand, Wayanad landslide**, and intensifying **cyclones in the Indian Ocean** are not seasonal misfortunes but urgent climate alarms demanding that India should adopt a more **climate resilient and adaptive approach to sustainable development.**

What are the Key Climate Change Related Threats that India is Facing?

- **Rising Double Whammy of Heatwaves and Flooding :** India is grappling with increasingly severe heatwaves alongside floods.
    - The frequency and intensity of extreme heat events, **particularly in Northern and Central India,** are threatening public health, agriculture, and energy systems.
        - By 2030 cities like **Mumbai, Delhi and Chennai are supposed to experience a two-fold increase in heatwave days.**
    - On the other hand recently **a cloudburst triggered flash floods** in the high-altitude villages of **Dharali in Uttarkashi, Uttarakhand.**
    - States like **Gujarat, Rajasthan and Tamil Nadu** are witnessing the double whammy of heat stress and extreme rainfall, with **more than 80% of the districts projected to be impacted by this by 2030.**
- **Sea-Level Rise and Coastal Flooding:** India's coastal regions, home to about 170 million people, are highly **vulnerable to sea-level rise driven by climate change.**

    - This will impact infrastructure, livelihoods, and biodiversity. Cities like Mumbai and Chennai face imminent threats.
    - Studies project that by 2100, under worst-case scenarios, **Mumbai could experience up to 101.4 cm of sea level rise,** potentially inundating 22% of the city.
        - West Bengal has lost **110 square kilometres of mangroves in the Sundarbans** in the past two decades due to climate change and global warming, intensifying India's vulnerability to coastal flooding.
- **Water Scarcity and Groundwater Depletion:** India's water crisis is deepening due to climate change, with over 600 million people facing high to extreme water stress.
    - With an annual per capita freshwater availability below the international threshold of 1,700 cubic metres (m3), **India ranks 132nd in the world with respect to per capita water availability.** This makes the country **"water stressed".**
        - Between 1950 and 2024, there has been a decline of **73% in per capita surface water availability in the country.**
    - The overexploitation of groundwater is exacerbating the crisis. The estimated groundwater depletion in India is in the range of **122–199 billion metre cubes.**
- **Rising Healthcare Burden and Vector-Borne Diseases:** The health burden from climate change is rising, with increased cases of heat-related illnesses and vector-borne diseases.
    - India saw a **55% rise in deaths due to extreme heat** between 2000-2004 and 2017-2021. **With 49% of India's workforce employed outdoors,** this poses significant health risks, particularly for vulnerable groups like laborers and the elderly.
        - Also, rising temperatures **extend the habitat for disease vectors like mosquitoes, leading to more malaria** and dengue outbreaks.
- **Climate Induced Energy Security Challenges:** Climate change is compounding India's energy security issues, with increased temperatures **putting pressure on cooling demands and hydroelectric power generation.**
    - While India has ambitious renewable energy targets, **the country still relies heavily on coal, which accounts for 70% of energy production**. The push for coal mining, including in environmentally sensitive regions like **Hasdeo Arand, threatens to undermine India's climate commitments**, making it harder to transition towards a sustainable energy future.
- **Disruption of Agriculture and Impact on Food Security:** The agriculture sector, vital to India's economy and food security, **is bearing the brunt of shifting weather patterns.**
    - In absence of adoption of adaptation measures, rainfed rice yields in India are projected to reduce by **20% in 2050** and **wheat yield by 19.3% in 2050**.
        - Also, Climate change is projected to reduce the kharif maize yields by 18 and 23% in 2050 and 2080 scenarios, respectively.
- **Economic Ripples of Climate Change:** The economic impact of climate change in India is profound, with an estimated **$79.5 billion in losses between 1998 and 2017.**
    - India may lose **3-10% of its gross domestic product (GDP) annually by 2100 due to climate change.** The lack of a cohesive national strategy on climate adaptation exacerbates these losses.



What are the Major Challenges Undermining the Effectiveness of India’s Climate Mitigation Efforts?

- **Weak Enforcement of Climate Policies and Regulatory Gaps:** Despite comprehensive climate frameworks, India’s climate action is consistently undermined by fragmented enforcement, bureaucratic overlaps, and poorly resourced regulators, resulting in a persistent **“policy-practice” gap.**
    - India’s strong push for renewables is **undercut by major new coal investments and prolonged reliance,** especially for base-load power, working against long-term decarbonization targets.
        - The government approved plans to add **80 GW of new coal capacity by 2032** and has **not indicated a timeline for coal phaseout**
    - Moreover, the **2023 amendments to the Forest Conservation Act** have weakened legal protections against deforestation, further compromising mitigation efforts.
- **Conflict Between Economic Growth and Environmental Sustainability:** India’s pursuit of economic growth often clashes with **climate mitigation objectives**. The government’s focus on

industrialization and infrastructure development sometimes leads to policies that weaken environmental safeguards.
    - For instance, the **Great Nicobar Island project** **was cleared in 2024** amidst reports of inadequate public hearings and biodiversity risks, reflecting systemic loopholes in the EIA process.
    - This approach pits developmental interests against the urgent need for climate action, raising concerns over sustainable development.
- **Risks of Greenwashing in Green Credit Scheme:** **India's green credit program** **and carbon credit schemes,** while innovative, face challenges in terms of transparency and effectiveness.
    - The risk of **greenwashing**—where companies falsely claim to meet environmental standards—remains high.
    - Also, while the government's focus on afforestation and tree plantations aims to boost carbon sinks, recent reports found that most of the forest cover increase is in non-forest areas, **casting doubt on the true environmental impact of such initiatives.**
- **Insufficient Focus on Urban Climate Resilience:** India's urban areas, which are rapidly growing, lack the resilience to face the growing impacts of climate change.
    - The **government's** **Smart Cities Mission**, though ambitious, has been criticized for failing to integrate sustainable urban planning fully.
    - Indian cities are prone to heat islands, water scarcity, and poor air quality, and urbanization exacerbates these vulnerabilities.
        - Despite some progress, **6 of the 10 most polluted cities in the world are in India**, highlighting the need for more aggressive urban climate strategies.
- **Undervalued Climate Adaptation:** While mitigation gets headline focus, adaptation and **resilience-building measures especially for vulnerable agriculture and water-stressed communities are underprioritized and underfunded.**
    - Adaptation spending, though up from **3.7% of GDP in FY16 to 5.6% in FY22,** remains well short of actual needs, particularly for agriculture and rural infrastructure.
        - In November 2022, **National Adaptation Fund for Climate Change (NAFCC) was converted to a "non-scheme"** without citing any reasons or stating if the objectives of the fund had been fulfilled (**Down to Earth**).
            - Critics highlight that, despite the urgent need for adaptation, NAFCC's proactive role has diminished in recent years.
    - India is projected to need an **estimated 85.6 trillion rupees ($1.05 trillion) by 2030** to **adapt its industries in order to meet climate change compliance standards.**

What Measures can India Adopt to Enhance Climate Resilience and Adaptation?

- **Localized Climate Risk Mapping and Micro-Zonation:** India must invest in high-resolution **climate vulnerability mapping** at the district and sub-district levels using GIS, satellite data, and AI.
    - **Micro-zonation of areas** based on exposure to heatwaves, floods, and droughts will enable **targeted interventions**.
    - This granular approach strengthens **decentralized climate planning** under State Action Plans.
        - Integration with **disaster preparedness** frameworks enhances community-level resilience. It fosters proactive, place-specific adaptation over reactive response.
- **Climate-Responsive Urban Design:** Urban local bodies must adopt **climate-integrated master plans** using principles like **nature-based solutions**, permeable surfaces, and blue-green infrastructure.
    - Retrofitting cities with **urban heat island** **mitigation** techniques, such as reflective materials and vertical gardens, can greatly reduce vulnerability. Focus should be on **low-income settlements**, often the worst affected.
    - Embedding **resilience standards in building codes** and zoning laws will ensure long-term adaptation. This aligns with **SDG 11 on sustainable cities.**
- **Agroecological Transition Zones:** Establish **agroecological corridors** across vulnerable agro-

climatic zones to promote regenerative, climate-smart farming systems. Transitioning to **agroforestry**, **millet-based systems**, and **soil-carbon enrichment** in rain-fed areas improves food security and climate buffers.
    - These zones act as **resilience buffers** against erratic monsoons and desertification. **Convergence with MGNREGA and Krishi Vigyan Kendras** ensures operational scalability. It also supports livelihood diversification.
- **Climate-Resilient Infrastructure Audits:** Institutionalize mandatory **resilience audits** for all major public infrastructure- **roads, power lines, railways**- in climate-vulnerable zones.
    - Using **risk-based engineering norms**, these audits can identify and mitigate exposure to floods, cyclones, and temperature stress.
    - Embedding such audits into **environmental clearance** mechanisms adds preventive strength. Leveraging **PPP models** for climate-proofing infrastructure can accelerate funding. This ensures lifecycle resilience of critical assets.
- **Decentralized Renewable Energy Clusters:** Promote **community-managed renewable energy clusters** using hybrid solar-wind-bio systems to ensure resilient energy access in disaster-prone and remote areas.
    - These systems reduce reliance on centralized grids vulnerable to disruption. Deployment through **energy cooperatives** empowers local governance and women-led enterprises.
    - Coupling with **cold storage and irrigation** enhances adaptive capacities in agriculture. It ensures climate-proofed rural energy security.
- **Hydroclimatic Early Warning Systems:** Expand **real-time hydroclimatic alert systems** with predictive analytics for flash floods, glacial lake outbursts, and droughts.
    - Integration of **Indigenous knowledge systems** with digital forecasting models enhances community responsiveness.
    - State disaster authorities must deploy last-mile communication through **mobile alerts, sirens, and community radios**. This proactive risk communication transforms passive victims into active participants. It operationalizes resilience at the grassroots
- **Integrated Coastal Buffer Zones:** Develop multi-functional **coastal buffer belts** with a layered approach: mangrove restoration, bioshields, eco-tourism zones, and resilient housing.
    - Zonation must integrate **livelihood safeguards** for fisherfolk and vulnerable communities.
    - Use of **satellite monitoring and LIDAR mapping** enables dynamic coastal regulation. This strategy must be embedded in the **CRZ guidelines** with clear enforceability. It enhances both ecological and socio-economic resilience.
- **Climate-Linked Skill Development Missions:** Launch a national **Green Resilience Skilling Mission** to train youth in climate-adaptive sectors such as solar repair, water harvesting, eco-construction, and biodiversity monitoring.
    - Linking skills to **climate-sensitive sectors** ensures both employment and resilience. Incorporate modules on sustainability in ITIs and skilling platforms like PMKVY. This creates a **future-ready workforce** equipped for climate challenges. It builds adaptive human capital.
- **Water Security via Decentralized Aquifer Governance:** Empower village-level water user associations with **aquifer-level management plans**, grounded in hydrogeological mapping.
    - Promote community-driven **managed aquifer recharge** (MAR), local rainwater harvesting, and **water budgeting**. Integration with **Jal Shakti Abhiyan** and Atal Bhujal Yojana can ensure convergence. This enables **resilient groundwater ecosystems** that sustain agriculture and drinking water. It anchors resilience in hydro-social contracts.
- **Policy Support for Green Finance and Climate Investments:** India should accelerate the mobilization of green finance by incentivizing investments in low-carbon, climate-resilient projects through tax breaks, green bonds, and financial instruments like climate insurance.
    - Developing a **robust framework for financing adaptation and resilience-building activities** will empower businesses and governments to invest in sustainable solutions. Creating a conducive policy environment for private sector involvement in climate resilience projects can bridge funding gaps.
- **Promoting Climate Education and Awareness:** India should prioritize climate education and awareness programs at all levels of society, from rural to urban areas, to empower individuals with the knowledge to take climate-resilient actions.
    - This includes incorporating climate change into school curricula, creating community-level awareness campaigns, and facilitating capacity-building workshops for local leaders and

policymakers.
- **A well-informed public is crucial for fostering collective responsibility** and ensuring widespread adoption of climate-resilient practices.

Conclusion:

To safeguard its development trajectory, **India must embed climate resilience as a core pillar of national planning**, aligning with the **Panchamrit goals** and **SDGs 2, 6, 11, 13, 15 and 16**. A shift from reactive disaster response to anticipatory, systems-based adaptation is crucial. With integrated, inclusive, and innovation-driven strategies, India can transform its climate vulnerabilities into resilience dividends. Building **"Climate-smart Bharat" is not just a necessity it is a strategic imperative for sustainable and equitable growth.**

Drishti Mains Question:

"India's climate vulnerability is no longer a distant environmental concern but a present developmental emergency." In this context, examine the key structural challenges in India's climate adaptation strategy. Suggest a multi-tiered framework to strengthen climate resilience at local, state, and national levels.

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 be affected by climate change? (2017)