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Sea-Level Rise: Global Crisis, India's Coastal Vulnerability, Human Rights and Climate Adaptation

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Recent Developments:

- The United Nations Secretary-General's 2026 Special Report, *Challenges related to sea-level rise and ways and approaches to address it*, has highlighted sea-level rise as a rapidly intensifying global crisis affecting **infrastructure, livelihoods, human rights, culture and statehood**. The report was presented on 31 August 2026 and emphasizes that sea-level rise is already affecting communities rather than remaining a distant future threat.
- Global mean sea level rose at an average rate of **4.7 mm per year during 2014–2023**, while the annual increase reached a record **5.9 mm in 2024**, reflecting accelerating climate-related changes in the ocean system.
- Around **770 million people**, nearly one in ten people globally, live in coastal areas less than five metres above the high-tide line and face significant exposure to flooding and other coastal hazards.
- The United Nations warns that sea-level rise and associated climate impacts could contribute to the displacement of **up to 1.2 billion people by 2050** without adequate adaptation.
- In South Asia, **Mumbai, Kolkata and Dhaka** are among the low-lying urban centres facing increasing risks of permanent inundation and displacement, with land subsidence intensifying the consequences in some locations.
- The issue is also gaining importance in **international law**, particularly concerning statehood, maritime zones, baselines, sovereignty and the rights of people affected by permanent territorial loss. The International Law Commission completed its consideration of sea-level rise in relation to international law in 2025.

Scale and Drivers of the Crisis:

Scientific Basis of Sea-Level Rise:

- Global sea-level rise is primarily driven by **ocean warming and the melting of glaciers and ice sheets**.
- Warming seawater expands through **thermal expansion**, while melting land-based ice adds additional water to the oceans.
- The acceleration of sea-level rise is closely associated with **anthropogenic climate change**, particularly increasing greenhouse-gas concentrations and rising global temperatures.

Human and Economic Exposure:

- Around **770 million people** already live in very low-lying coastal areas, making coastal population density a major determinant of future climate vulnerability.
- Coastal infrastructure damage is already estimated at **more than $1.8 trillion**, while annual global economic losses could reach **$1.2–4 trillion by the end of the century** without adequate adaptation.
- Sea-level rise therefore creates a compound risk involving **flooding, erosion, storm surges, saltwater intrusion, infrastructure damage and displacement**, rather than acting as an isolated environmental hazard.

Unequal Regional and Social Impacts:

Coastal Cities and Deltas:

- Major coastal cities such as **Mumbai, New York and Guangzhou** face substantial exposure because large populations, infrastructure, ports, industries and high-value assets are concentrated close to sea level.
- Low-lying **South Asian deltas** are particularly vulnerable because population density, agricultural dependence and limited elevation combine with rising seas and land subsidence.
- In the Indian subcontinent, Mumbai and Kolkata face increasing risks from permanent inundation, coastal flooding and displacement, while Dhaka faces similar pressures across the Ganga-Brahmaputra-Meghna delta system.

Human Rights and Cultural Identity:

- Sea-level rise threatens fundamental rights related to **adequate housing, safe drinking water, sanitation, food, healthcare and education**.
- Flooding and coastal erosion can damage homes, schools, hospitals, transport networks and agricultural land, thereby disrupting essential services and livelihoods.
- **Saltwater intrusion** can contaminate freshwater resources and agricultural soils, while damaged sanitation systems can increase exposure to water-borne diseases.
- **Small Island Developing States, Indigenous Peoples and low-lying coastal communities** face particularly severe risks because their adaptive capacity, land availability and freshwater resources may be limited.
- For Indigenous Peoples, permanent loss of ancestral land can weaken **cultural identity, spiritual connections and intergenerational transmission of traditional knowledge**.
- Climate-induced displacement is therefore not merely an economic problem but also a **human-rights, cultural-identity and human-dignity challenge**.

Economic and Legal Challenges:

Adaptation and Losses:

- The growing economic burden demonstrates that adaptation must be treated as an essential component of development planning rather than as a separate environmental expenditure.
- Developing countries require an estimated **$310–365 billion annually by 2035** for climate adaptation, whereas international public adaptation finance was only around **$26 billion in 2023**, creating a substantial financing gap.

Statehood and Maritime Law:

- Permanent territorial loss creates unprecedented questions concerning **statehood, sovereignty, nationality, maritime boundaries and maritime entitlements**.
- The International Law Commission has examined the legal implications of sea-level rise for **baselines, maritime zones, maritime delimitation, island status and statehood**, reflecting the emerging importance of climate-related international law.
- The issue is particularly significant for small island states whose physical territory may become partially or completely uninhabitable even though their populations, governments and national identities continue to exist.

Sea-Level Rise in India:

Current Trend and Causes:

- India’s coastal regions are experiencing **gradual sea-level rise** driven mainly by **ocean warming, thermal expansion and melting glaciers and ice sheets**.

- Long-term observations indicate an average rise along the Indian coast of roughly **3.3 mm per year**, although the rate varies across locations and depends on local geological and oceanographic conditions.
- **Relative sea-level rise** can become substantially higher locally where land itself is sinking because of land subsidence, groundwater extraction, sediment compaction and other human-induced changes.

Most Vulnerable Regions:

- **Mumbai, Kolkata, Chennai and other coastal cities** face increasing exposure to coastal flooding, storm surges, erosion and damage to critical infrastructure.
- The **Sundarbans and Ganga-Brahmaputra-Meghna delta** are particularly vulnerable because of their extremely low elevation, dense population and exposure to cyclones and saline-water intrusion.
- **Andaman and Nicobar Islands and Lakshadweep** face heightened exposure because of their island geography, limited land availability and dependence on vulnerable coastal ecosystems.
- India's coastal vulnerability is also influenced by shoreline modification, urbanisation, ports, coastal infrastructure and other human interventions that alter natural sediment movement and coastal processes.

Government and Policy Response:

Monitoring and Early Warning:

- The **National Centre for Coastal Research** monitors shoreline changes, studies coastal processes and assesses coastal vulnerability associated with climate change, sea-level rise and natural hazards.
- The **Indian National Centre for Ocean Information Services** provides ocean information, forecasts and early-warning services that support coastal disaster preparedness.
- The **Coastal Regulation Zone framework** seeks to regulate development in environmentally sensitive coastal areas and reduce ecological degradation.

Disaster Risk Reduction and Nature-Based Adaptation:

- The **National Disaster Management Authority** and state disaster-management agencies focus on cyclone preparedness, evacuation, early warning, resilient infrastructure and disaster response.
- **Mangrove restoration, wetland conservation, dune protection and other nature-based solutions** can reduce wave energy, storm-surge impacts and coastal erosion while providing ecosystem and livelihood benefits.
- Scientific coastal planning should therefore combine structural measures with **ecosystem-based adaptation** rather than relying exclusively on seawalls and other hard infrastructure.

Way Forward:

Building Climate-Resilient Coasts:

- Effective adaptation requires **early action, reliable scientific assessments, resilient infrastructure and locally appropriate coastal planning**.
- Early-warning systems should be strengthened alongside evacuation planning, climate-resilient housing, critical infrastructure protection and disaster-resilient urban development.
- **Greenhouse-gas emission reductions** remain essential because adaptation alone cannot eliminate long-term sea-level rise.
- Developing countries require **predictable and accessible climate finance, technology transfer and international cooperation** to close the adaptation gap.
- Coastal planning should adopt a **people-centred and human-rights-based approach**, particularly for communities facing displacement, livelihood loss and cultural disruption.
- India should integrate **disaster resilience, sustainable urbanisation, ecosystem-based adaptation and protection of vulnerable communities** into coastal-zone planning.

- Adaptation measures should include **protect, accommodate and managed retreat** approaches according to local risk, land availability, ecological conditions and community preferences.
- Financing mechanisms should prioritise grants and concessional resources for vulnerable developing countries because excessive dependence on debt can reduce their future capacity to adapt.

Value Addition for UPSC:

Key Concepts and Keywords:

- **Thermal expansion**, **saltwater intrusion**, **land subsidence**, **coastal erosion**, **storm surge**, **managed retreat**, **nature-based solutions**, **climate justice**, **loss and damage**, **ecosystem-based adaptation** and **climate-resilient infrastructure** are important conceptual terms for understanding sea-level rise.
- The topic directly connects **climate change, disaster management, urbanisation, ocean governance, human rights, international law and sustainable development**.

Conclusion:

- Sea-level rise has evolved from a long-term environmental concern into an immediate **development and human-security challenge** affecting economies, ecosystems, communities and states.
- The 2026 United Nations report reinforces the need to move from reactive disaster management towards **anticipatory adaptation, climate justice and resilient development**.

For India, the most effective approach is to combine emission reduction with scientifically informed coastal planning, ecosystem restoration, resilient infrastructure, adequate adaptation finance and protection of vulnerable communities.