

Coastal Erosion

Mains: GS I - Geography

Why in News?

Union Minister for Ports, Shipping and Waterways in a recent reply tabled in Rajya Sabha, said that about 28% of Odisha's 564-km coastline is undergoing erosion.

What is Coastal erosion?

- **Definition** - It is the wearing away of land and the removal of beaches, sand dunes, or rock cliffs along a coastline.
- This happens when the energy from waves, tides, currents, and wind moves soil and rock away from the shore faster than new material can replace it.
- **Main Causes**
 - **Wave action** - Powerful waves slam against the shore and break down rocks and sand.
 - **Storms** - High winds and sudden storm surges speed up the loss of land.
 - **Rising sea levels** - Higher water levels let waves reach higher up the shore and wear away more land.
 - **Loss of Mangroves** - Cutting down natural green barriers leaves shores open to heavy waves.
 - **Human activities** - Building ports, removing sand, or putting up hard walls can block natural sand movement.
- **Mechanisms**
 - **Hydraulic action** - Water forces air into cracks in rocks, which makes the cracks break apart over time.
 - **Abrasion** - Waves use sand and pebbles like sandpaper to grind down cliffs and shores.
 - **Attrition** - Rocks and stones carried by waves smash into each other and break into smaller pieces.
 - **Solution** - Sea acids slowly dissolve certain types of rock like limestone.

What is the status of coastal erosion in India?

- About 33.6% of India's 7,516-kilometer coastline is vulnerable to coastal erosion.
- The National Centre for Coastal Research (NCCR) reports that West Bengal, Kerala, Tamil Nadu, and Gujarat face the highest rates of shoreline loss due to rising sea levels, intense cyclones, and human activities.
- **Most Affected States**

- **West Bengal** - About 60.5% of its coast is eroding, the highest share in India.
- **Kerala** - Roughly 46.4% of its shoreline faces continuous retreat and flooding.
- **Tamil Nadu** - Around 42.7% of its coast loses land, harming local fishing towns.
- **Gujarat** - Holds the largest total length of eroding shoreline (over 537 kilometers).
- **Odisha** - More than 28% of coastline is affected.

What are the effects of coastal erosion?

- **Loss of land** - Beaches, agricultural land and inhabited areas gradually disappear.
- **Damage to infrastructure** - Roads, railways, houses, ports, tourism facilities and other coastal infrastructure may be damaged.
- **Displacement of people** - Coastal communities may be forced to relocate, creating environmental migration.
- **Loss of livelihoods** - Fishing, agriculture, tourism and other coastal occupations are affected.
- **Saltwater intrusion** - Seawater can enter groundwater and agricultural soils, reducing freshwater availability and crop productivity.
- **Damage to ecosystems** - Mangroves, sand dunes, wetlands, coral reefs and nesting grounds can be degraded.
- **Increased disaster vulnerability** - Erosion can weaken natural coastal barriers, increasing exposure to cyclones, storm surges and flooding.
- **Economic losses** - Governments and communities face higher costs for coastal protection, rehabilitation and relocation.
- **Loss of cultural heritage** - Coastal temples, archaeological sites and culturally important settlements may be threatened.
- **Reduced beach and tourism value** - Loss of sandy beaches can negatively affect coastal tourism.

What are the measures taken by India to control coastal erosion?

- **Shoreline Monitoring & Mapping** - The **National Centre for Coastal Research (NCCR)** uses satellite imagery, GIS, field surveys and modelling to identify erosion-prone stretches and monitor shoreline changes.
- **Coastal Regulation Zone (CRZ)** - The **CRZ Notification, 2019** regulates development in coastal areas to protect fragile ecosystems and coastal communities.
- **Shoreline Management Plans** - NCCR has prepared **Shoreline Management Plans (SMPs)** for states such as Tamil Nadu, Kerala, Andhra Pradesh and Puducherry, promoting site-specific and scientifically based solutions.
- **Structural & Nature-Based Measures** - India uses measures such as **seawalls, groynes, submerged reefs/dykes, beach nourishment, artificial reefs and dune rehabilitation** depending on local coastal conditions.
- **Funding & Disaster Management** - Under the **National Disaster Management Fund (NDMF)**, guidelines issued in 2024 provide funding for coastal and river erosion mitigation, with provisions for resettlement of displaced populations.

- **Extent** - Around 28.3% of Odisha's 564-km coastline is undergoing erosion, while 17.6% is stable and 54.1% is experiencing accretion, according to the NCCR's 1990-2022 assessment.
- **Major Causes** - Shoreline change is driven by waves, tides, storms, cyclones, sea-level rise, as well as human activities such as port construction, sand mining and unplanned infrastructure.
- **Most Affected Districts** - Jagatsinghpur (47.6%), Ganjam (45.7%) and Kendrapara (45%) have the highest proportion of eroding coastline, followed by Balasore (23.8%), Puri (10.2%) and Bhadrak (4.6%).
- **Vulnerable Stretches** - NCCR has identified several erosion-prone areas around Gopalpur, Penth-Satbhaya, Gahirmatha, Jagatsinghpur coast, Chilika sea mouth, Devi river mouth, Talsari and other stretches.
- **Key Concern** - Coastal erosion threatens settlements, livelihoods, ecosystems and infrastructure, making scientific shoreline monitoring and integrated coastal-zone management essential.
- **Impact** - Climate-induced coastal erosion and sea-level rise have submerged 16 villages in Kendrapara, displacing hundreds and destroying land and livelihoods.
- In Ganjam, villages such as Podampeta and Ramayapatna have faced severe erosion, forcing residents to abandon their homes.
- **Measures Taken**
- **Climate Resettlement Colony** - Odisha has developed a dedicated resettlement colony for people displaced by coastal erosion.
- **Geotextile Tube Embankment** - At Penth, Kendrapara, geotextile tubes filled with sand slurry act as artificial sea walls and reduce wave impact.
- **Sea Wall-cum-Service Roads** - Dual-purpose coastal structures are being developed at vulnerable locations in Balasore and Ganjam, providing both erosion protection and road connectivity.

What could be done?

- **Science-Based Planning** - Continuous satellite monitoring, GIS mapping and Shoreline Management Plans will be crucial for identifying vulnerable stretches.
- **Nature-Based Solutions** - Greater focus is needed on mangroves, sand dunes, wetlands and beach nourishment alongside conventional sea walls.
- **Climate-Resilient Communities** - Vulnerable settlements will require early warning systems, resilient infrastructure, livelihood protection and planned relocation where necessary.
- **Integrated Coastal Management** - India needs stronger coordination among Centre, States, local communities and scientific institutions for sustainable and long-term coastal protection.

References

1. [The Indian Express| Coastal erosion in Odisha](#)
2. [PIB| Coastal Erosion](#)