Q18

Explain the causes and effects of coastal erosion in India. What are the available coastal management techniques for combating the hazard ?

UPSC Civil Services Mains 2022 · GS III · 15 marks · Indian Economy

Indian Economy and issues relating to planning, mobilization of resources, growth, development and employment.

Core demand of the question

- Explain causes and effects of coastal erosion in India
- Describe coastal management techniques

Revision summary

Coastal erosion is net loss of shore from waves, storms, sea-level rise and human interruption of sand.

Dams, seawalls, ports, sand mining and mangrove clearance are the main human causes in India.

Effects include lost villages and roads, saline intrusion, habitat loss and higher cyclone damage.

Soft and nature-based methods (nourishment, dunes, mangroves) treat the sand budget; hard structures protect a point and often starve the next beach.

CRZ, ICZM, sand bypassing and, where needed, managed retreat are the planning tools.

Introduction

India's **long coastline** is not a fixed line. **Coastal erosion** is the net loss of beach and cliff to waves, currents, storms and human structures. Some stretches accrete; many, especially after a port or a seawall, **retreat**. Management is a choice between hard armour, soft beaches, and moving people back.

Body

Causes

- **Natural:** monsoon wave climate, cyclones and storm surge, longshore drift that starves a downdrift beach, sea-level rise, and river-mouth shifts that cut sand supply.
- **Sediment starvation:** dams on east- and west-flowing rivers trap sand that used to feed deltas and beaches.
- **Hard structures:** groynes, seawalls and breakwaters on one plot **rob sand** from the next; unplanned **ports and inlets** do the same at larger scale.
- **Mangrove and dune destruction** for shrimp ponds, real estate and sand mining removes the **buffer**.

- **Relative sea-level** rise from warming plus local subsidence (groundwater, compaction) worsens inundation and erosion.
- **Inlet and creek** training can focus currents that scour banks.

Effects

- **Loss of land, houses and roads** in fishing villages; saltwater in wells and fields.
- **Habitat:** nesting beaches for turtles, dunes, and mangroves shrink.
- **Livelihoods:** landing spaces and drying yards disappear; tourism beaches narrow.
- **Infrastructure:** ports, coastal roads, and defence installations need recurrent repair.
- **Disaster risk:** a thinner beach means waves reach inland sooner in a cyclone.

Coastal management techniques

- **Hard engineering:** seawalls, revetments, groynes, offshore breakwaters, tetrapods. They protect a specific asset but often **shift erosion** alongshore. Use where a city or port cannot retreat.
- **Soft engineering:** **beach nourishment** (placing sand), dune fencing and vegetation, and **living shorelines**. They need a sand budget and repetition.
- **Nature-based: mangrove and shelter-belt restoration**, coral and wetland buffers, and protecting dune corridors. India's National Coastal Mission / CAMPA-type and mangrove programmes sit here.
- **Hybrid:** a low revetment with a nourished beach and a mangrove belt in front.
- **Planning instruments: Coastal Regulation Zone (CRZ)** rules, setback lines, ban on sand mining in sensitive reaches, and **Integrated Coastal Zone Management (ICZM)** projects (World Bank-supported in some States).
- **Managed retreat:** relocating the most exposed hamlets; politically hard, physically honest where the sediment budget is gone.
- **Sediment management:** dam flushing where feasible, bypassing sand around ports, and stopping illegal mining.
- **Science:** shoreline mapping (NCSCM and Survey of India-type products), monsoon monitoring, and not building in the **active profile**.

Principle

- Erosion is often a **sand-budget** problem. A wall without sand is a delay, not a cure.

Flow diagram

Waves cyclones sea-level -> Erosion

Dams ports seawalls mining -> Erosion

Erosion -> Land habitat livelihood loss

Soft nourishment mangroves CRZ -> Erosion

Hard walls groynes -> Erosion

Hard walls groynes -> Downdrift shift

Conclusion

Indian coastal erosion comes from waves and storms plus dams, walls, mining and mangrove loss. Effects are lost land, salt and livelihoods. Management should prefer sand, dunes and mangroves, use hard armour only for vital assets, and keep CRZ setbacks. Shifting the scar down the coast is not protection.

Facts & figures

CRZ

Coastal Regulation Zone notifications under the Environment (Protection) Act: setbacks and prohibited activities on the shore.

ICZM

Integrated Coastal Zone Management: planning that treats the shore, hinterland and sea as one system.

Longshore drift

Alongshore sand transport by waves; groynes and ports interrupt it and cause downdrift erosion.

Beach nourishment

Placing sand on an eroding beach; a soft method that must be repeated as storms move the fill.

Mangroves

Intertidal forests that dissipate wave energy and trap sediment; their clearance accelerates erosion.