Mains Practice Question

Q. Examine the ecological and socio-economic implications of climate change on India's coastal biodiversity. How can integrated coastal zone management help mitigate the potential long-term impacts on marine ecosystems? **(250 words)**

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Approach

- Introduce the answer by briefing about India’s coastal vulnerability to climate change.
- Delve into the Ecological Implications of Climate Change on Coastal Biodiversity and Socio-Economic Implications
- Highlight the Role of Integrated Coastal Zone Management in Mitigating Long-Term Impacts on Coastal Ecosystem
- Conclude suitably.

Introduction

Integrated coastal zone management (ICZM) is a **dynamic, multidisciplinary and iterative process** to promote sustainable management, essential for India's **7,500 km coastline,** which sustains diverse ecosystems and livelihoods.

- However, climate change-driven threats—**rising sea levels, erosion, and extreme weather—are disrupting this delicate balance,** endangering both the environment and coastal communities.

Body

Ecological Implications of Climate Change on Coastal Biodiversity

- **Habitat Loss and Degradation**
  - **Sea-Level Rise (SLR):** Since 1900, the global average sea level has risen by approximately 15-20 cm, a rate much faster than historical averages.
    - This threatens ecosystems like the **Sundarbans,** which could lose the **majority of its area,** endangering species like the **Royal Bengal Tiger.**
    - Areas like **Satabhaya (Odisha) and Vypin Island (Kerala)** are experiencing **rapid coastal erosion**, leading to habitat loss.
  - **Coral Bleaching:** Rising sea temperatures have caused mass bleaching events in the **Gulf of Mannar,** disrupting marine food chains.
- **Decline in Marine Species and Disrupted Food Chains**
  - **Loss of Breeding and Nesting Sites**: Rising water levels threaten the **nesting grounds of Olive Ridley turtles in Odisha**, leading to a decline in their population.
  - **Reduced Fish Stocks:** Changes in ocean temperature and salinity impact fish breeding and migration patterns, affecting species like **Hilsa and golden anchovy.**
- **Increased Vulnerability to Natural Disasters**

- The destruction of natural barriers like **mangroves (which reduce wave energy by 93–98% on mild slopes) i**ncreases the impact of **cyclones and storm surges**, as seen during **Cyclone Amphan.**

Socio-Economic Implications of Climate Change on Coastal Communities

- **Threat to Livelihoods**
  - **Fisheries:** Fisheries and Aquaculture Sector in the country provides livelihood support to a total **28 million fishers.**
    - Rising sea levels and declining fish stocks threaten their income and food security.
  - **Agriculture: Seawater intrusion** causes soil salinization, reducing agricultural productivity in coastal regions like **Sundarbans and Gujarat's Kutch region.**
  - **Tourism:** Popular coastal destinations like **Goa and Kerala** face increasing coastal erosion, impacting the tourism industry.
- **Displacement and Loss of Settlements**
  - By 2050, 36 million Indians could lose their homes and livelihoods to flooding caused by rising sea levels
  - 16 villages **in Odisha** have already gone under seawater, forcing residents to relocate.
- **Health and Water Security Concerns**
  - **Salinity intrusion** in freshwater sources increases the risk of waterborne diseases.
    - Warmer temperatures promote **vector-borne diseases** such as **malaria and dengue** in coastal areas.

Role of Integrated Coastal Zone Management in Mitigating Long-Term Impacts on Coastal Ecosystem:

- **Sustainable Coastal Development and Regulation**
  - **Coastal Regulation Zone (CRZ) Notification (1991, amended in 2019)** aims to balance development with environmental protection by restricting construction near vulnerable coastal areas.
    - **ICZM Plans:** Under the **World Bank-assisted ICZM Project**, states like **Odisha, Gujarat, and West Bengal** have developed coastal conservation strategies.
- **Restoration of Natural Ecosystems**
  - **Mangrove Afforestation**: Planting mangroves acts as a **natural buffer against erosion and cyclones.**
    - India's **MISHTI scheme** aims to expand mangrove cover.
  - **Coral Reef Conservation:** Projects like the "**Coral Restoration Programme" in Gulf of Mannar** help rebuild damaged reefs.
- **Infrastructure and Disaster Resilience**
  - **Sea Walls and Embankments**: Coastal cities like **Mumbai and Chennai** are investing in **storm surge barriers.**
  - **Early Warning Systems:** The **Indian National Centre for Ocean Information Services (INCOIS)** provides real-time alerts for coastal hazards.
- **Promoting Sustainable Livelihoods**
  - Encouraging **salt-resistant crop varieties** and **floating agriculture** (practiced in Sundarbans).
  - Supporting **alternative livelihoods** like **ecotourism and agriculture** for fishing communities.

Conclusion

ICZM promotes climate resilience through sustainable policies, ecosystem restoration, and community engagement. Coordinated efforts at all levels are vital for protecting India's coasts, aligning with **SDG 13 (Climate Action) and SDG 14 (Life Below Water).**