EXPLORING SEDIMENT-MORPHODYNAMIC COUPLING IN THE EVOLVING INDIAN SUNDARBAN DELTA

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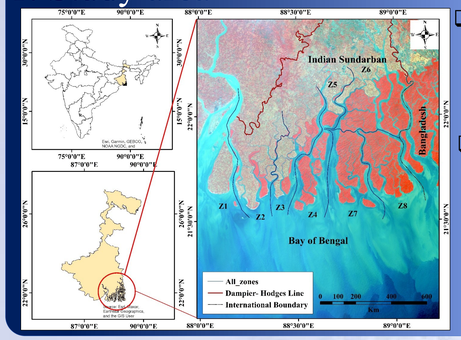


WHY IT MATTERS?

The Sundarban Delta acts as a natural barrier protecting millions of people.

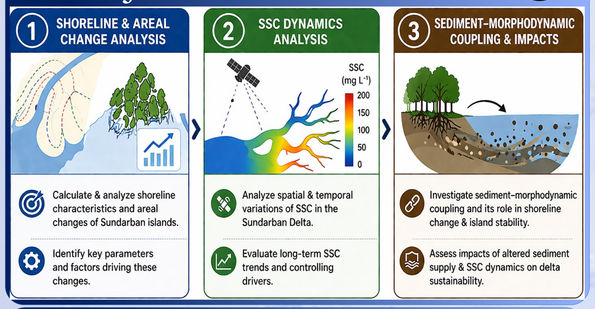
Sustaining sediment supply is key to conserving its land, biodiversity, and future.

1. Study area

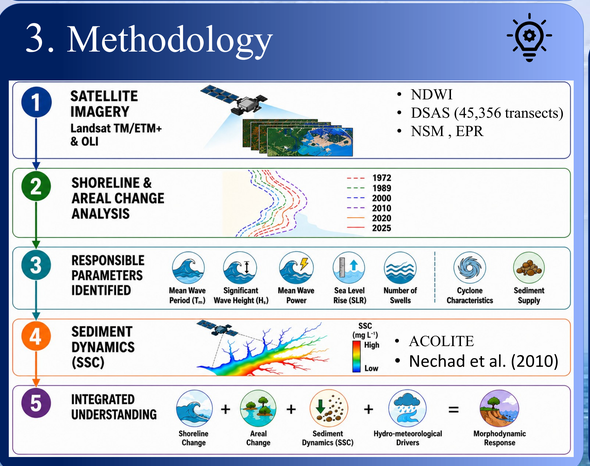


- Indian Sundarban Delta (ISD)
- Divided into 8 Zones based on Major Inlets Present

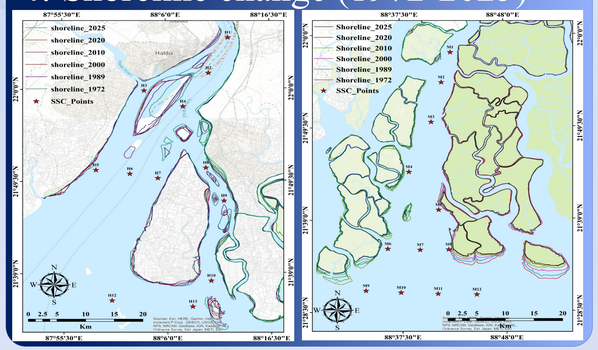
2. Objective



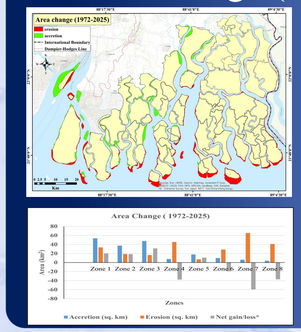
3. Methodology



4. Shoreline change (1972-2025)

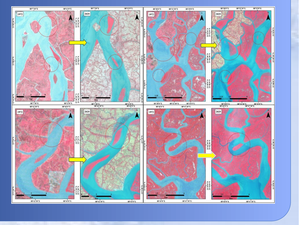


5. Areal change (1972-2025)

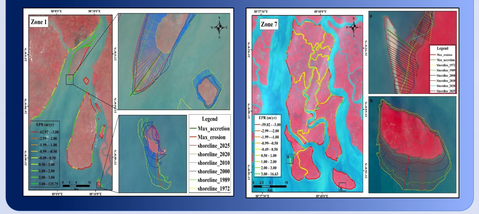


- Net land loss of 72.43 km², with **256.31 km² eroded** and **183.88 km² accreted**.

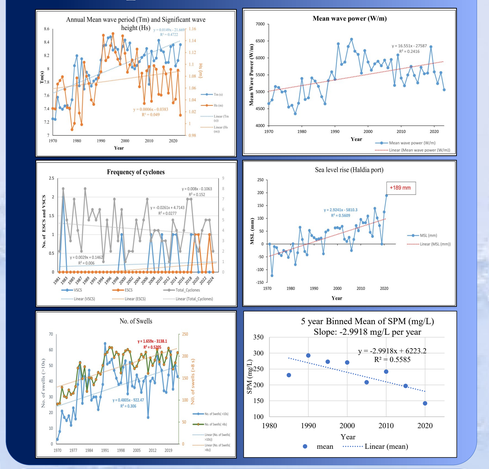
Emergence of new islands



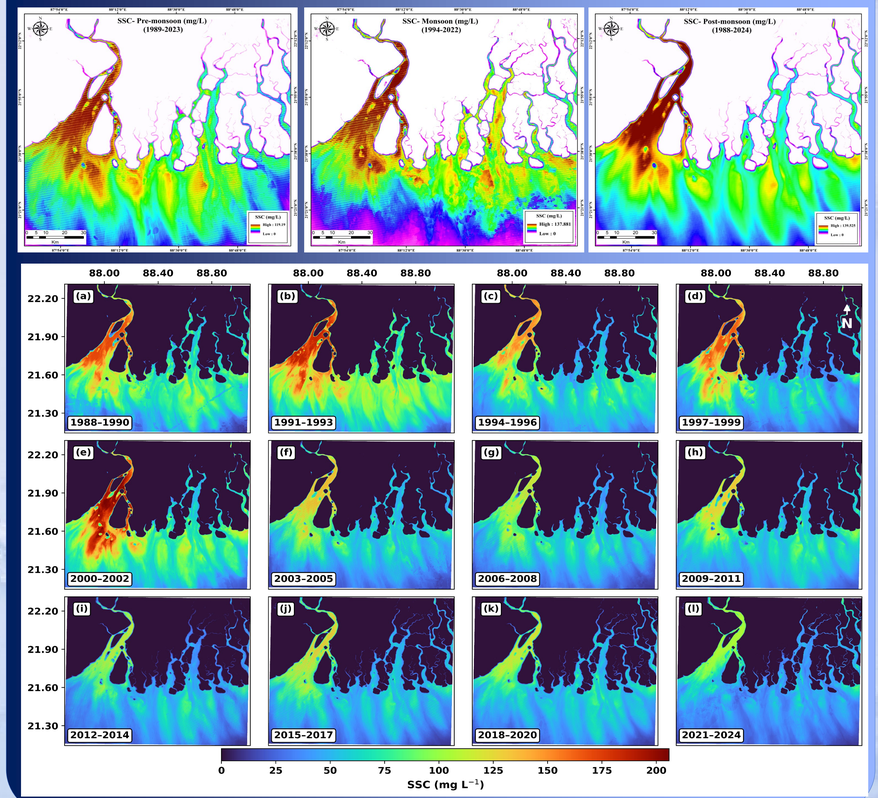
6. Erosion Hotspots



7. Responsible Parameters



8. Suspended Sediment Concentration (SSC)



9. Key Findings

1. **Rising Wave Energy**
   - Wave energy ↑ over last five decades
2. **Strong Swell Activity** (>8 s)
   - Strong swells (>8 s) ↑ erosion potential & sediment reworking
3. **Sea-Level Rise** (+189 mm)
   - Relative sea level ↑ ~189 mm, increasing inundation & flood risk
4. **Cyclone Intensification**
   - Severe cyclones (VSCS/ESCS) intensified, especially post-2015
5. **Reduced Sediment Supply**
   - Reduced sediment from dams & barrages weakens natural land-building capacity
6. **SSC Dynamics** (SSC >150 mg L⁻¹)
   - SSC shows strong seasonal variability; high-turbidity zones >150 mg L⁻¹; long-term declining trend in outer estuary
7. **Net Erosional Shift**
   - Combined impact of sediment starvation, sea-level rise & stronger hydrodynamics → net erosional state

10. Impact on the Delta

1. **Accelerated coastal erosion & land loss**
   Shorelines are retreating faster, leading to loss of whole and partial islands.
2. **Island fragmentation & habitat degradation**
   Islands are shrinking, breaking apart and habitats are deteriorating.
3. **Declining sediment supply & altered SSC dynamics**
   Reduced sediment availability changes deposition patterns and weakens delta stability.
4. **Shifting channels & morphodynamics**
   Rivers and tidal channels shift locations, altering the delta's natural processes.
5. **Reduced resilience to extreme events**
   Sea-level rise and storms cause greater flooding and land degradation.
6. **Increased risk to coastal communities & livelihoods**
   Erosion, flooding and habitat loss threaten lives, property and long-term livelihoods.

11. Acknowledgement

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Take-home message: Declining sediment supply is intensifying morphodynamic stress, accelerating shoreline retreat and island loss in the ISD.