Site-Specific Adaptation Measures for Coastal Hazards in Cox's Bazar Sadar Upazila, Bangladesh

Course Code: WFM6305
Course Title: Coastral Zone Management
Group-2

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Introduction

- Bangladesh's coastal zone is highly vulnerable to climate change due to its low-lying terrain, dense population, and reliance on natural resources. The region faces threats such as sea-level rise (SLR), salinity intrusion, and storm surges, which impact livelihoods and resource sustainability (Chowdhury et al., 2025).
- Sea-level rise and stronger cyclones have led to land degradation and food insecurity, while salinity intrusion has decreased agricultural yields and freshwater resources (Ashrafuzzaman et al., 2022).
- Effective adaptation strategies include diversifying agriculture and aquaculture, strengthening infrastructure, and implementing community-led, gender-responsive approaches to enhance resilience (Asian Disaster Preparedness Center, 2023).

Specific Objectives

- Evaluate how coastal hazards affect the study area, focusing on salinity intrusion, erosion-accretion, and storm surges.
- Project areas at risk of future coastal flooding due to sea-level rise for the years 2050 and 2100.
- Develop tailored adaptation strategies based on livelihoods, local resource base, and regulatory frameworks to enhance resilience.

Study Area

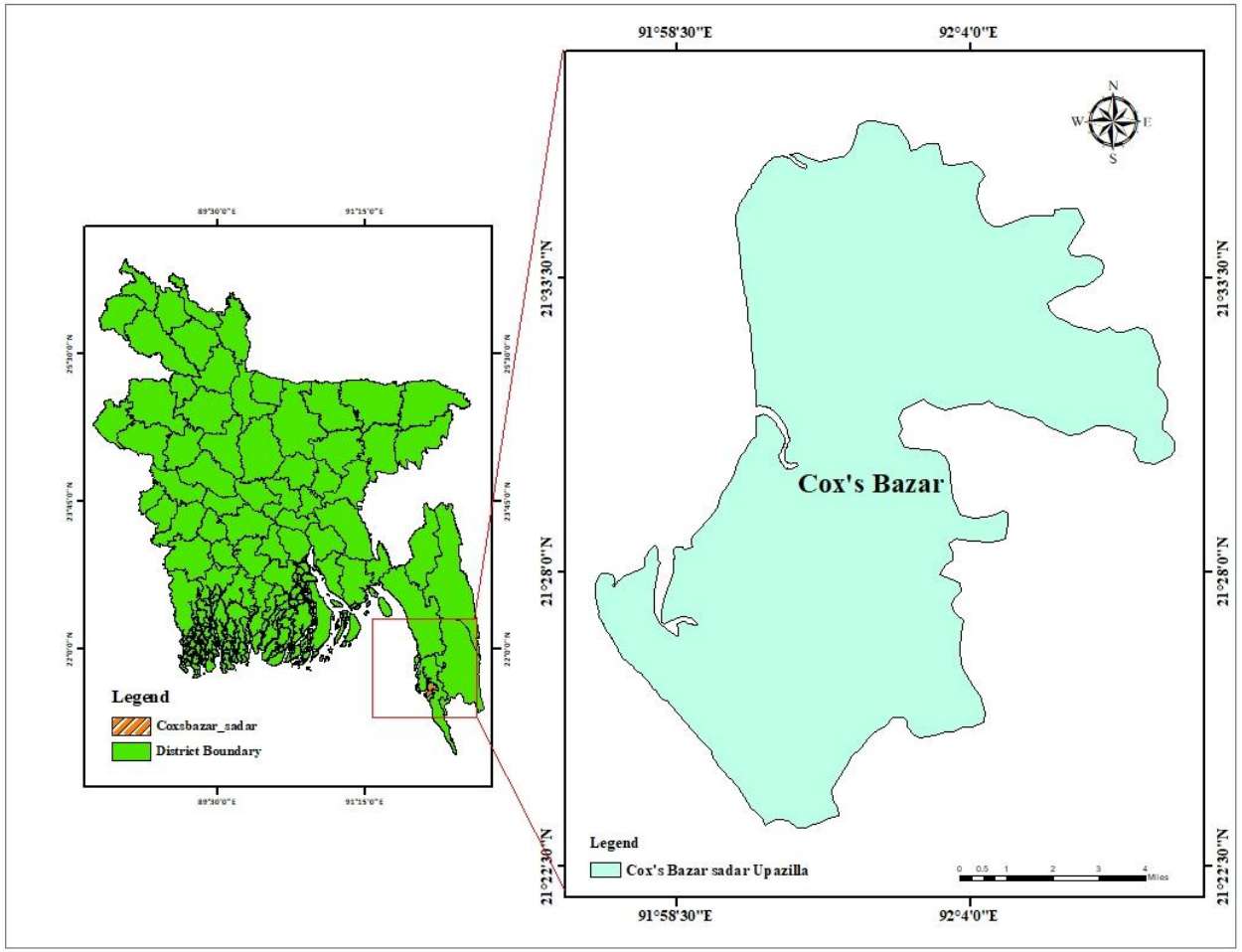


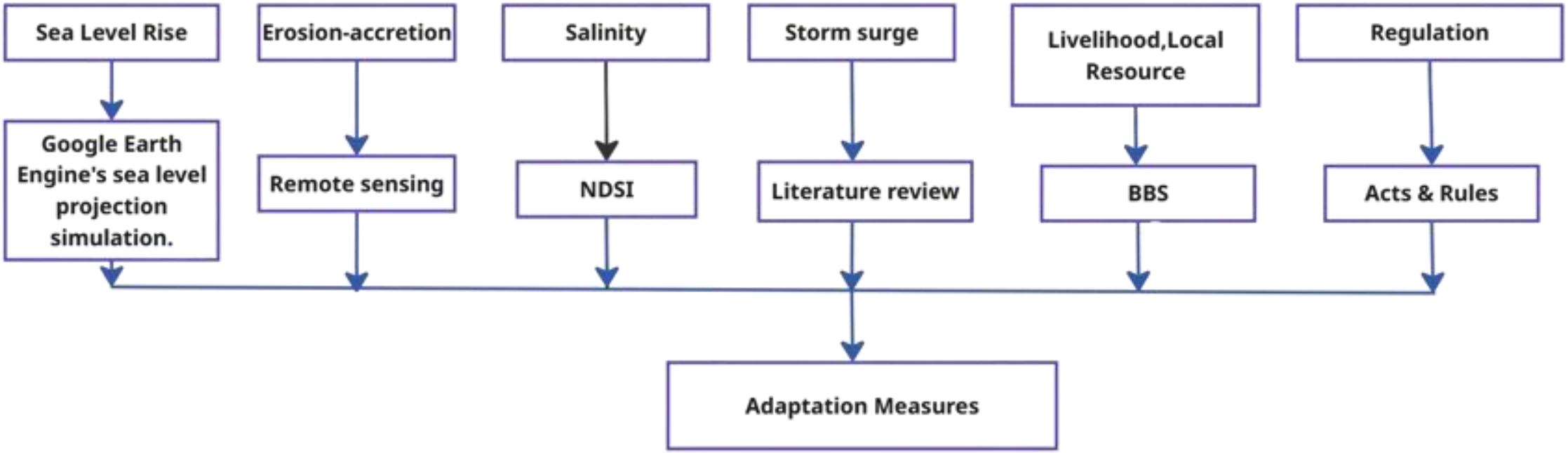
Figure 1: Study Area

➢Cox's Bazar Sadar Upazila (20.7–21.5° N, 92.0–92.5° E): highly prone to coastral flooding, storm surges, coastal erosion, and salinity intrusion.

Data and Sources

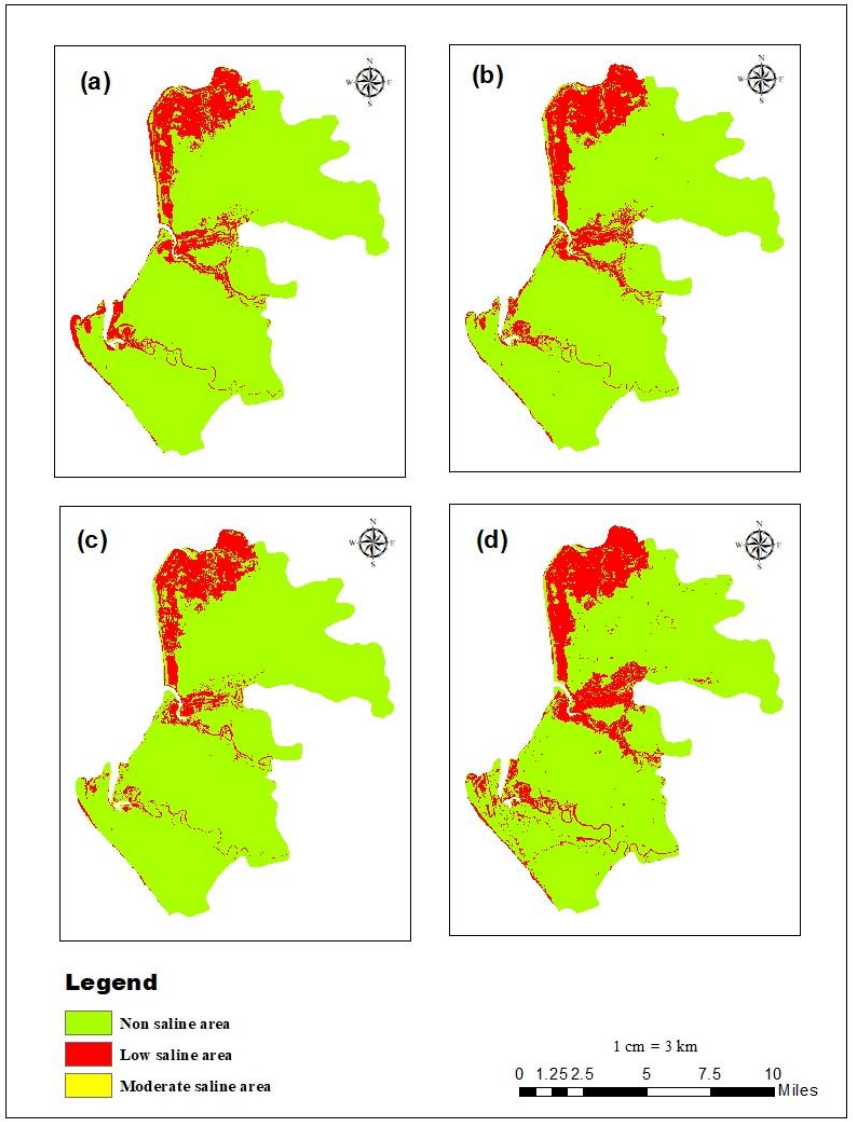
Sl. No.	Parameter	Source	Year
1	Sea level rise	Literature review	2050,2100
2	Erosion-accretion	Remote sensing	1994,20004,2014,2024
	Salinity	NDSI	1994,20004,2014,2024
3	Strom surge	Literature review	Multiple years
4	Local Resource	BBS	2022
5	Livelihood	BBS	2022
6	Regulation	Various government regulations and acts	Multiple years

Methodology



Results

Salinity intrusion NDSI map (a) 1994 (b) 2004 (c) 2014 (2024)



Key Findings

- **Salinity Intrusion Zones**: Maps highlight salinity intrusion in **Bharuakhali**, **Pokhkhali**, and **Jhilwanja** unions

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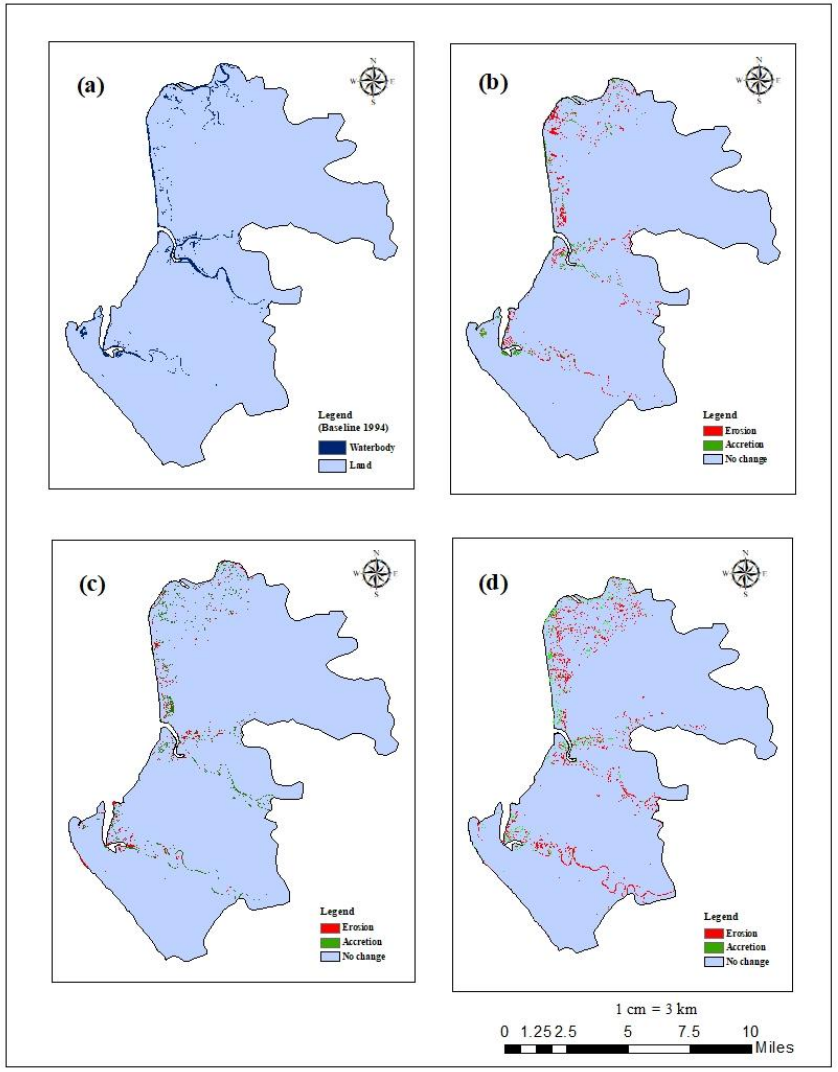
Results

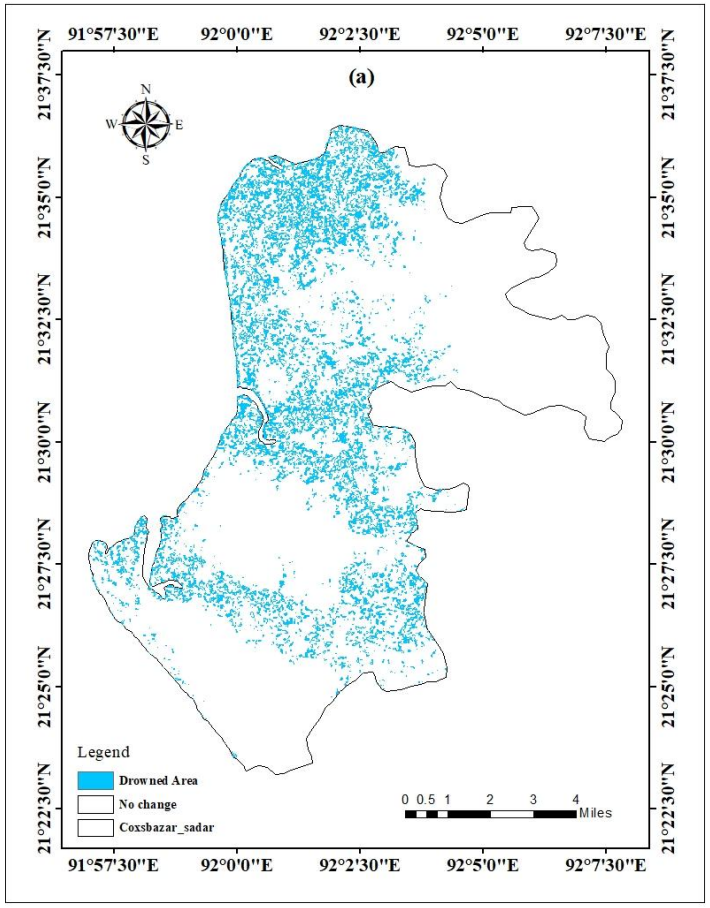
Erosion-accretion (a) Baseline 1994 (b) 2004 (c) 2014 (d) 2024

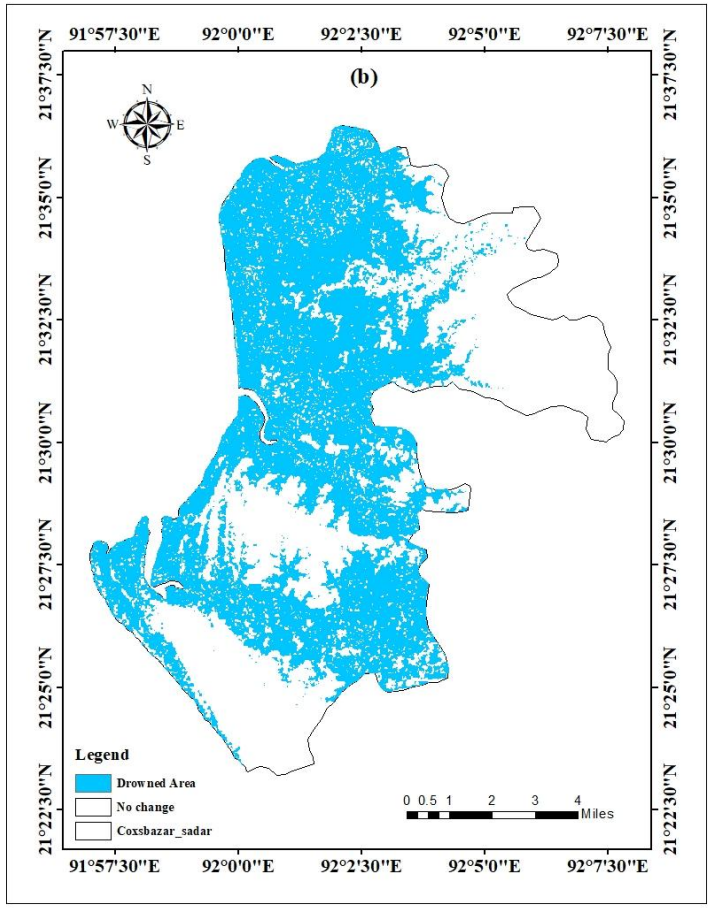


Time	Total Area (km^2)	Erosion (km^2)	Accretion (km^2)	Change (km^2)
1994-2004	228.23	3.14	1.80	-1.34
2004-2014		1.58	2.67	+1.09
2014-2024		5.29	1.67	+3.62

Results

Projection Inundation due to SLR for 2050 and 2100





Key Findings

- Maps highlight **Bharuakhali**, **Pokhkhali**, **Jhilwanja**, and **Patail Machuakhali** unions as highly susceptible to future flood inundation
- These unions are key areas at risk in the study of future coastal impacts

Storm Surges:

Year	Location	Storm surge height (m)	Damages	References
15 Dec 1965	Cox’s Bazar	6.1	873 death and 40 000 salt beds in Cox’s Bazar were inundated. 35 636 houses were destroyed	(Alam & Dominey-Howes, 2014)
7 Mar 1970	Cox’s Bazar	4.88	No data available	Alam & Dominey-Howes, 2014)
24–28 Nov 1974	Cox's Bazar to Chittagong coast	3.1	20 people were died	(Akter & Dayem, 2021)
16–20 May 1998	Cox's Bazar	2.44	No data available	(Akter & Dayem, 2021)
16 Nov 2007	Cox's Bazar	8.0	Cyclone Sidr, 10,000 death	(Rezaie & Haque, 2022)
2009	Cox's Bazar	4.5 - 6	Cyclone Aila, 339 death case	(Rezaie & Haque, 2022)
29–31 May 2017	Cox's Baza	2.03	20,000 houses damaged in refugee camps	(Akter & Dayem, 2021)
May 2021	Cox's Baza	1.52	Cyclone Yaas, several villages flooded	BIWTA

Existing local resource

Demographic Information	
Area (Sq.km)	228.23
Population (Urban)	357357
Population (Rural)	434901
Population (Slum)	10355
Population (Floating People)	131
Employed Population	128434
Ethnic Population	4048 (Highest in Cox's Bazar District)
Households	90680
Growth Rate	-0.85%
Sex Ratio	108.48
Literacy Rate	76.71
Internet User	19.37% (Lowest in Cox's Bazar District)
Dependency Ratio	55.77 (Lowest in Cox's Bazar District)

Source; Bangladesh Bureau of Statistics, 2022 (Cox's Bazar District Report)

Agriculture & Land

- **Fertile** lowlands for crops
- **Suitable** for **vegetables & fruits**
- **Salt cultivation** areas (NW & South)
- **Potential for upgrading** with better governance & processing

Forests & Hills

- Hills and *tilas* cover large areas
- Valuable trees: **Shal, Mehagoni, Garjan, Rubber**
- Rare **Orchid species** found
- Timber & forest ecosystem services

Fisheries & Processing

- **BFDC Fish Landing Center** (handles artisanal catches)
- Upgraded with **JICA support** → reduced post-harvest loss
- **Bakhkhali** River water quality supports landing & processing

Coastal & Marine Resources

- Mangroves supporting biodiversity & protection
- Beach-dune materials
- Coastal resources along **Bakhkhali River**
- Over **50+ fish species** recorded seasonally
- High **economic & conservation value**

Tourism & Infrastructure

- Numerous **tourist attractions**
- **Hotels** & key infrastructure developed
- **Tourism boosts local economy**

Economic Assets & Enterprises

- Rich **natural resources** (land, forest, marine, minerals)
- Strong base for **fisheries & salt cultivation**
- Growing **tourism & SME sector**
- **Opportunities:** improved governance, eco-tourism, sustainable resource use

Economic Base

- **70% economy** from service & trade (ACAPS, 2020)
- **Sector** : Tourism, fisheries, SMEs, construction
- Mostly **informal, low-skill, low-wage jobs** (WFP, 2020)

Labour Patterns

- **Daily-wage labour** earns more than salaried workers
- But no fixed jobs → **highly exposed to disasters & shocks**
- **Tourism labour** prominent but highly **seasonal**
- Affected at the time **COVID-19**

Gender & Social Issues

- **Women: low education, unskilled labour**, fewer opportunities
- **Men:** more jobs due to conservative norms
- Poor households cope by **cutting meals → weak health**

Livelihood

Fisheries & Aquaculture

- Supported by **two branches of Bakhkhali River**
- **Activities:** boat crews, fish processing, coastal aquaculture
- **Production growth**: +4.9 MT (2022–23) (DoF, 2024)
- Expanding market pull, but **safety concerns for labour**

Salt Cultivation

- **Dominant livelihood practice** due to seawater entry
- Hundreds of **salt pans** create seasonal wage opportunities
- Supports harvesting & trading economy
- Concern: **microplastic intrusion** → need for quality control (Rakib et al., 2021)

Regulations:

Fisheries & Marine Use
- Marine Fisheries Act 2020
- Fish Act 1950 (+rules)
- Hilsa Mgmt Action Plan
- Territorial Waters Act 2021

Salt & Food Safety
- Iodized Salt Act 2021
- Food Safety Act 2013

Legal & Policy Frameworks
for Cox's Bazar Coastal Zone

Environment & Biodiversity
- Env. Conservation Act 1995
  +Rules 2023
- Wildlife Act 2012
- Coastal Zone Policy 2005

Water & Land/Urban
- Water Act 2013
- Municipalities Act 2009
- CoxDA Act 2016
- Disaster Mgmt Act 2012

Adaptation Measures for Cox's Bazar Sadar Upazila

Sea-Level Rise

- Coastal setback policy (considering SLR + morphology)
- Upgraded embankments & seawalls with future standards
- Hybrid protection: hard structures + mangroves & dunes

Erosion–Accretion

- High-resolution shoreline monitoring (satellite + ground)
- Soft measures: beach nourishment, dune stabilization
- Offshore low-crested breakwaters (carefully monitored)

Salinity Intrusion

- Managed aquifer recharge & protective ponds
- Salt-tolerant crops, adjusted calendars, raised-bed farming
- Mangrove regeneration & estuarine restoration

Storm Surge & Cyclones

- Strengthened community early warning + evacuation
- Reinforced & strategically located cyclone shelters
- Expanded mangroves & tidal wetlands for surge buffering

Adaptation Measures for Cox's Bazar Sadar Upazila (cont..)

Local Resource Bases

- Coral & oyster reef rehabilitation for fisheries + stability
- Restrict unregulated dredging & reclamation

Livelihoods

- Diversify: eco-tourism, aquaculture, mangrove enterprises
- Microfinance, insurance, cash-for-work in restoration
- Skills & seasonal migration for supplementary income

Governance & Regulations

- Revise land-use/building codes to reflect risk zones
- Participatory governance (communities, women, NGOs)
- Compensation/resettlement frameworks for equity

Implementation & Policy

- Pilot mangrove belts, TRM, upgraded shelters + monitoring
- Scenario-based planning for future SLR & cyclones
- Integrated structural + ecosystem + livelihood approaches

Conclusion:

- Sea-level rise, salinity intrusion, erosion, and cyclones are intensifying threats in Cox's Bazar.
- Practical measures such as mangrove restoration, resilient embankments, and early warning systems can reduce vulnerability.
- Local knowledge, participatory governance, and robust regulatory frameworks are vital for long-term success.
- Diversifying income sources and ensuring sustainable resource use strengthen resilience.
- An integrated approach offers the best chance to build a safe and sustainable coastal future.

References

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Thank You