In-situ Data from Indian Mangroves to Assess Habitat Vulnerability and Resilience to Climate Change

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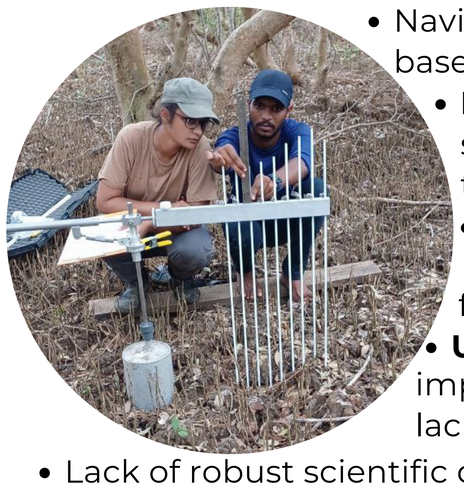
Abstract

Mangrove ecosystems provide many ecological services, such as habitat for unique biodiversity, and are an important nature-based solution to address climate change. Mangroves sequester large quantities of carbon and protect coastal communities against extreme floods and cyclones. Conventionally, a delicate balance of ecological conditions such as optimal salinity, tidal range, and sedimentation rates has allowed mangroves to sustain themselves, but shifting baselines pose a critical threat to this ecosystem. Escalating rates of sea level rise pose a severe threat to Indian mangroves and endanger communities, necessitating a robust method to identify these gaps. Our attempt to monitor mangroves for climate change mitigation in India aims for a better understanding of these dynamics. Select mangrove systems on the east and west coasts, and the Andaman Islands, were chosen to quantify existing carbon stocks and vegetation characteristics. These sites will be monitored for sedimentation rates using Rod Surface Elevation Tables (rSETs). Quantifying sedimentation rates, hydrological conditions, and stored carbon will help prioritize conservation and restoration actions and make informed and adaptive management decisions.

Developing Effective Conservation Strategies for Mangroves : Motivation



- Navigating **challenging terrain/sites** lead to studies based on remote sensing.
- **Lack of data** related to soil erosion, land subsidence and environmental parameters from the same region to determine mangrove resilience.
- Difficultly in **predicting future carbon** stock in mangroves to further aid in their conservation.
- **Uncertainty in quantifying** impacts on mangroves due to lack of past data.

- Lack of robust scientific data at **regional scales.**
- Greater **collaboration** between forest departments, research organizations and communities residing in coastal areas.
- High **costs** of conducting research and **long term monitoring**.

Mangrove Monitoring in India Program : Objectives

- Study **sediment dynamics in relation to salinity and tidal inundation frequency** to understand the **resilience** of mangroves to changing environmental parameters e.g. influx of freshwater or ocean water/ pollution/ siltation of creeks.
- Examine **ground elevation change** and **rate of subsidence** to understand mangroves' response to sea level rise.
- Understand **carbon stocks, and sequestration potential** using globally accepted scientific methodology to generate data that can be used for inclusion in **Nationally Determined Contributions (NDCs)**.
- Monitor mangroves across India to develop **regional databases** for designing effective conservation strategies.
- Prepare **guidelines and info briefs** for communication with forest department and other relevant stakeholders.

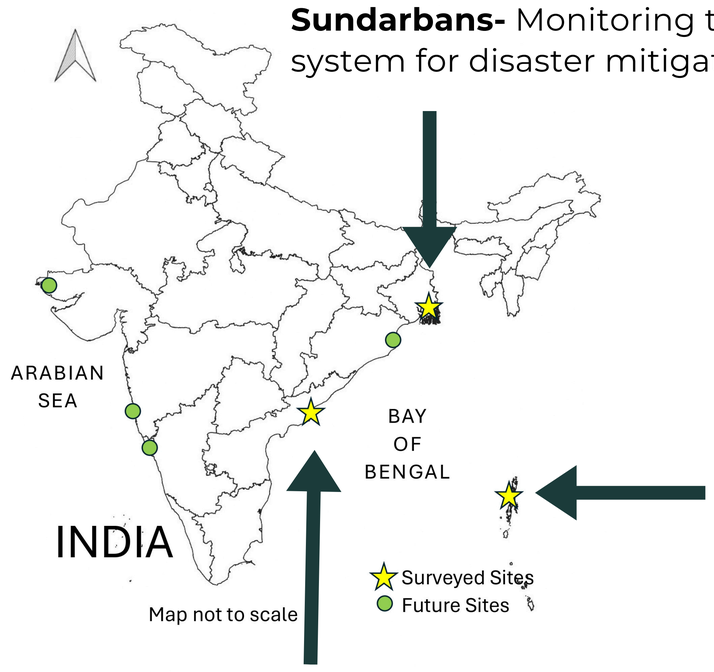
Monitoring to Understand Mangrove's Resilience : Progress and Outputs

Monitoring sites have been established in the **Andamans, Coringa Wildlife Sanctuary, and the Sundarbans Biosphere Reserve.** This includes the installation of **56 rSETs, 44 automated water level and salinity sensors,** and characterisation of mangrove vegetation and carbon stocks from these sites.

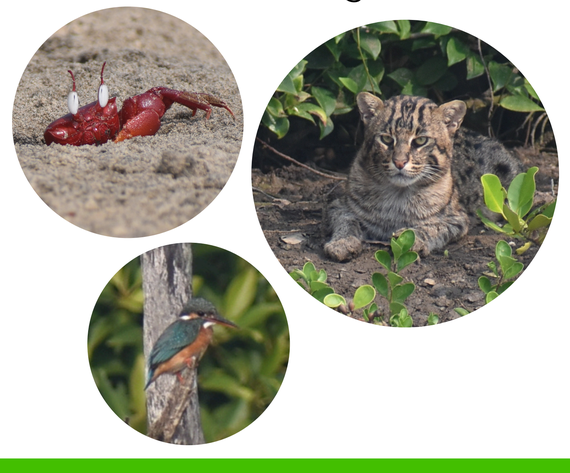
- Quantification of carbon stocks using the **Sustainable Wetlands Adaptation and Mitigation Program (SWAMP)** Protocol, which can be compared globally.
- Understanding climate change at a **regional scale** by using **rSETs** to monitor mangroves along the Indian coast for sediment flux and subsidence using scientific methodology.
- Developing database to provide **long-term data** on mangrove resilence.

Study Locations

Sundarbans- Monitoring to help sustain the largest mangrove system for disaster mitigation and provisioning services.



Andamans- Understanding impact of geo-tectonic shift in ground elevation(uplift and subsidence) on mangrove vegetation by **studying altered physiology and tidal characteristics** as proxy for future environmental changes.



Coringa Wildlife Sanctuary- Exploration of differences in hydrology, stored carbon, and accretion rates **between restored (from aquaculture) and natural sites** for designing effective management strategies.

Outreach and Training

Project website was created to disseminate information about project outputs to relevant stakeholders and interested readers : cifor-icraf.org/mangrove-monitoring-india/ .

Info-sheets were developed to communicate and inform wider audience including organisations, researchers and forest staff.

Blog: Tiwari, S., (2024). Tigers, crocodiles, rising tides: Fieldwork in the largest mangrove forest on Earth. *Forest News*.

News Feature: Ghosh, S., (2024). Why scientists are planting steel rods in India's mangroves. *Nature Communications*.

Scientific Publications :

Singh, A. R., Thirumurugan, V., Bhomia, R. K., & Prabakaran, N. (2024). Mangrove vegetation response to alteration in coastal geomorphology after an earthquake in Andaman Islands, India. *Regional Studies in Marine Science*.

Mondal, B., Bhomia, R. K., Saha, A. K., & MacKenzie, R. A. (2024). Assessment of coastal and mangrove vulnerability in the Andaman Island, Indian Ocean. *Geoscience Frontiers*.

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