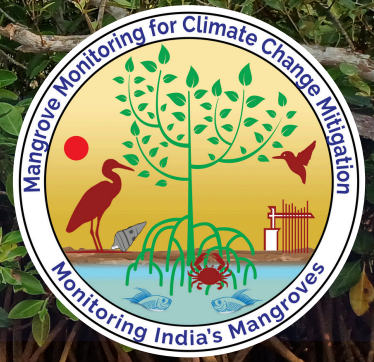


# Mangrove Monitoring for Climate Change Mitigation in India



## Background

Mangroves are recognized as one of the prominent nature-based solutions to climate change due to their capacity to store high levels of carbon and for enhancing resilience of ecosystems and living organisms to increased vulnerability.

Global extent of mangroves is estimated to be ~ 150,000 square kilometers, distributed across more than 100 tropical countries.

The mangroves have reduced by ~40% from their historical extent due to direct pressures caused by anthropogenic demands on mangrove resources and indirectly by the destruction of conditions suitable for mangrove survival.

Some causes of mangrove decline include deforestation for expanding aquaculture, agriculture, and infrastructure development, habitat fragmentation, reduced freshwater flows, and altered salinity regimes. Impacts due to global climate change and increased frequency and intensity of extreme weather events also create adverse conditions for mangrove sustenance. This loss is more acute in the Asia-Pacific region due to greater demand for resources and relatively higher rates of sea-level rise (3.14 mm/yr) compared to the global average (2.5 mm/yr).

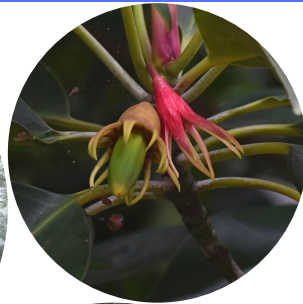
**In India**, mangroves have helped with flood mitigation and protection against storm surges during cyclones' impacts in coastal areas, and they also provide fishery and other resources for the sustenance of local communities. Mangrove ecosystems have high biodiversity, and they provide significant ecological, economic, and social benefits. These can also be instrumental in meeting **India's Nationally Determined Contributions (NDCs)** and become an important part of the country's **'blue economy'** policies.

India has ~ **5,000 sq km** of mangrove along -

- Andaman Islands (13%)
- East Coast (60%)
- West Coast (27%)

Sporadic research has been done in the past, but national, uniform datasets are lacking to inform mangrove management practices and policies at the local and regional scales. Addressing such data and information gaps can be pivotal to develop a long-term integrated management strategy.

Understanding the delicate and dynamic relationship of mangroves to coastal sustainability may be important in advancing our knowledge about these complex ecosystems. Such understanding, based on local (site-specific) information on changes experienced by these ecosystems due to natural and anthropogenic stressors, can be crucial for forging effective and relevant long-term integrated coastal management strategies.



Such an approach will be useful for planning adaptive interventions that remain relevant even as climate change impacts push boundaries with greater extremes. High-quality localized measurements could provide baseline information on mangrove conditions, including the health of ecosystems, to enable an adequate response to the increased vulnerability of these areas.

Therefore, **CIFOR-ICRAF**, along with its collaborators and with the support of local government and research institutions, is setting up a long-term ecological monitoring network at select mangrove sites within India. These sites will allow studies on **sedimentation dynamics, salinity and tidal fluctuations, vegetation characteristics, and carbon stocks of mangroves**.

This pan-India monitoring of mangroves using scientific methodology and standardized protocols will lead to robust datasets and an enhanced understanding of mangrove ecosystems, which underpins coastal sustainability.



## Aim

The project aims to establish ecological monitoring sites to help understand future **climate change vulnerability of mangrove ecosystems** across India and the region.

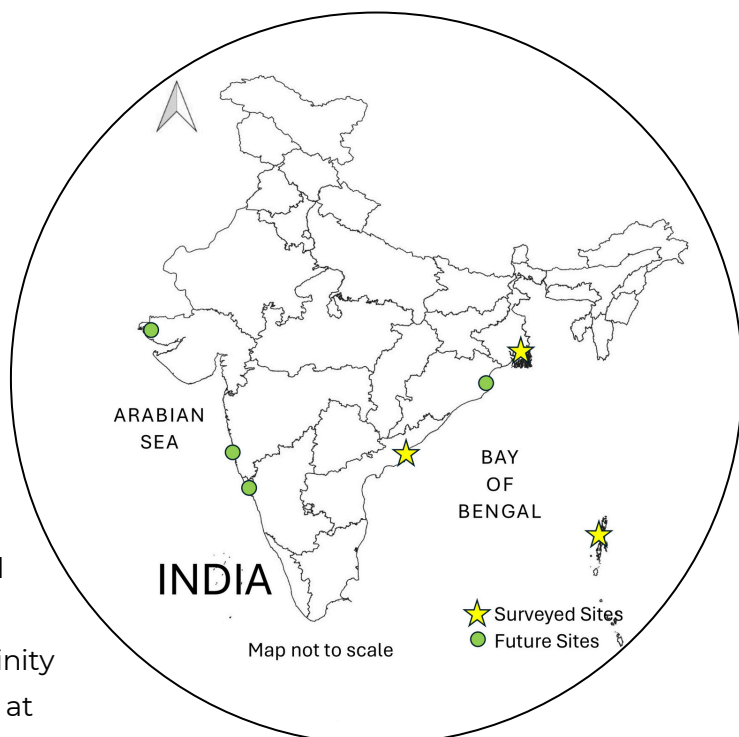


## Long term ecological monitoring of mangroves

By establishing long-term monitoring sites, trends in biophysical changes in these ecosystems along the Indian coast can be determined. This program provides the information needed for **management decision-making, planning interventions** for mangrove conservation, and identifying restoration priorities. This information can help India enhance its climate ambition, report reductions in its forest carbon emissions, and more accurately account for carbon sequestration in its coastal forests, under national greenhouse gases inventory.

In the first phase of this project, monitoring sites will be established along the East and West coasts of mainland India and the Andaman Islands. Initial efforts include characterization of vegetation structure, soil profiles, salinity and hydrology measurements, and sediment dynamics at the selected sites.

Once these instruments are set up, scientific data collection will continue for subsequent years until a robust and meaningful database is created.



# Objectives

Some overarching goals of this project include:

- Determination of total **mangrove carbon stocks** (forest inventory) using standardized scientific protocols.
- Assessment of **soil erosion & accretion rates** by installing rSETs at select locations & following a regular data collection scheme.
- Measurement of **inundation frequency & salinity** using automated sensors.
- Analysis of soil and vegetation data to determine **biomass & soil carbon** from sites.
- Provision of **training opportunities** for mangrove monitoring & **best practices** in mangrove management and restoration aimed at forest department staff, researchers in local institutions, & other stakeholders.
- Identification, development, & offering of guidance through best practices in **mangrove management & restoration** to all stakeholders.



## FOCUS AREAS

### Andaman and Nicobar Islands



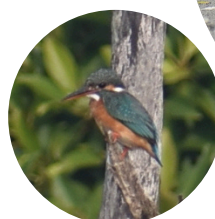
The Andaman and Nicobar Islands contain **13%** of the country's mangrove cover (~**400 square kilometers**). The mangrove forests of the Andamans are known for their rich species diversity and vegetation. The islands were affected by the earthquake and resultant **tsunami of 2004**, which significantly altered regional topography and disturbed coastal ecosystems on a large scale. This event caused a substantial perturbation of the coastal ecosystem due to the significant changes in regional topography. It offers an opportunity to study the response of **mangrove communities to climate extremes**, manifested in the form of altered hydrology and tidal characteristics.

For more details: <https://shorturl.at/DN87h>

### Sundarbans, West Bengal

The Sundarbans, the **world's largest mangrove ecosystem**, represent half of the country's mangroves and hold **UNESCO and Ramsar status**, highlighting their importance for conservation. The Sundarbans' ecosystem services **sustain millions of people**, and efforts are needed to ensure West Bengal's coastal resilience and long-term sustainability.

For more details: <https://shorturl.at/Kfb5p>





## Bhitarkanika National Park, Odisha

Bhitarkanika National Park (BNP) in Odisha, spread across **145 square kilometers**, has high mangrove species diversity and is crucial for protection against **cyclones** and for the conservation of declining species like the **Olive Ridley Sea Turtle (*Lepidochelys olivacea*)**. It offers many other provisioning services and supports a large human population in the surrounding areas.

## Coringa Wildlife Sanctuary, Andhra Pradesh

Coringa, **the third-largest** continuous patch of mangroves (~240 sq km) in India, harbors biodiversity, supports local livelihoods, and provides a substantial proportion of the **fish catch** from Andhra Pradesh. Parts of the sanctuary have been restored to mangroves from aquaculture ponds. The project aims to understand the differences in hydrology, stored carbon, and accretion rates between **restored and natural sites**, and to help design management strategies for both.

For more details: <https://shorturl.at/zuzbv>



Under this project, 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.

## WEST COAST

We will commence ground data collection from mangrove patches along the western coast soon. The tentative sites are the Gulf of Kutch in Gujarat and mangrove patches in Maharashtra or Goa.

### Program Outcomes

- Scientific information for informed decision-making.
- Long-term ecological monitoring scheme for adaptive management.
- Identification of mangrove restoration priority areas.
- Planning interventions for mangrove conservation and management.

### Impact on Climate Efforts

- Enhancement of India's climate ambition by developing baseline information.
- Improvement in carbon stock inventory from coastal systems.
- Refined and accurate accounting for carbon sources and sinks in the context of nationally determined contributions (NDCs).

Photos: Samakshi Tiwari, Sudip Debnath and Ranjit Kamila (Boat Crew, Sundarbans), Pexels- Jeffry Surianto

**Team** **CIFOR-ICRAF:** Ms. Samakshi Tiwari, Dr. Utchimahali M and Dr. Rupesh Bhomia  
**United States Forest Service (USFS):** Dr. Richard MacKenzie and Dr. Sahadev Sharma

**Contact** Dr. Rupesh Bhomia, Senior Scientist, Climate Change (R.bhomia@cifor-icraf.org)  
Dr. Shiv Dhyani, Country Director, India (S.dhyani@cifor-icraf.org)

### Collaborators

**Institutes :** M. S. Swaminathan Research Foundation, Indian Institute of Science Education and Research-K, Wildlife Institute of India, Vidyasagar University, National Centre for Coastal Research, Andhra Pradesh Forest Department, West Bengal Forest Department and Andaman and Nicobar Forest Department



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