Indian Regional Association for Landscape Ecology

PANORAMA

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Photo: Debajit Datta

In Focus: The Coasts

AMRITA NEELAKANTAN | NETWORK FOR CONSERVING CENTRAL INDIA

Introduction: The coasts of India span 5700 kilometres (!) across 66 districts in 10 states and union territories, following the path, down from the bay of Bengal to around the southern tip of Kanyakumari and back up to northern-most Gujarat. When considering the wild spaces of India, perhaps the large coastline does not comes foremost to the mind. However, these regions are rife with biodiversity crossing boundaries between terrestrial and marine as well as wet and dry climes. Coasts are transitioning spaces between land and sea with a many goods and services. These benefits extend across ecological as well as commercial realms which add immense pressures on coasts to provide for human needs as some of the most productive ecosystems on the planet. In India, nearly 250 million people live within 50 kilomtres of the coastline. Therefore, the rapid degradation and destruction of coastal habitat is something of grave concern, but is also the fact that only about 38% of it remains ecologically stable provides hope to ensure sustainably managed coastlines. Geomorphologically, India's coasts are 43% sand, 36% mud, 11% rock and 10% marsh.

Biodiversity: The coasts due to their transitionary nature have diverse habitats with their own typical flora and fauna from land to coast and seascapes. From the Sundarbans (trans-boundary mangrove forests) to sandy beaches and marshlands, they hold floral and faunal diversity that when considered as a whole is a remarkable mix that engages with each other to survive. Consider the gradients in temperature and moisture but also salinity and sedimentation! Notable perhaps for our readers is the Olive Ridley Arribada in Orissa, Whaleshark in the waters off the Gujarat coastline and the plethora of biocultural traditional knowledge alongside the unique dugong.

People: Fisher-folk, colonial towns and legacies, trade-routes and specific biocultural landmarks abound along India's coasts in a shared destiny. Climate change and ecological change affects these peoples directly and therefore the management of coasts resonates within each village and newer urbanizing sites as water temperature changes, fish ranges change and livelihoods transition from small trade and harvest to modern large infrastructure as well as urbanization. It is on India's coasts that humanity and biodiversity share the same fates and the same threats – making it a unique case to see if conservation goals can coexist with social goals and balance the economic and politically driven large infrastructures planned for the region.

Nature-People Interface: Indian conservation is perhaps the most balanced in the coasts where not considering human-needs could never be part of the equation, in part due to the rich and alive interconnections between people and wildlife. To manage such areas, the most used tool has been the Marine Protected Area (MPA) network – balancing human well-being goals alongside those of wildlife conservation. India's protected area (PA) network spans all parts of the country and every biogeographic region. Those PAs within 500m from the high tide line and in marine environments are considered as part of the MPA network – 24 of these are in part of peninsular India with a total 8214 kilometre square or <0.3% of the total land area of India. The coasts of India also highlight the need to reconcile human needs with biodiversity goals to meet the Aichi Biodiversity Targets (Target 11 and 14 talk about coastal protected areas and the

This issue

Photo: Debajit Datta

safeguards needed to meet human needs respectively in the same regions). As a consequence of trying to meet these targets India has introduced and identified 106 coastal and marine sites as Important Coastal and Marine Areas (ICMBAs – by the Wildlife Institute of India and some are included in the islands biogeographic region too). These sites represent spaces where community goals can be considered jointly with those of wildlife conservation with increased participation in governance by local communities. Protected landscapes such as the Gulf of Mannar Marine National Park, Point Calimere Wildlife Sanctuary, Sundarbans National Park, Gulf of Kachchh National Park, Gahirmatha Marine Sanctuary, Coringa Marine Sanctuary and Chilika are bursting with biocultural diversity (unique and yet typical to these specific sites) that can enthrall those who explore more about them.

Please do see the below links to immerse yourselves in the manifold treasures on India's coasts:
1. Forests of the Coromandel Coasts
2. Arribada!
3. Sundarbans: a frontline for tigers and people as the climate changes

Photo: CC BY 4 Manoj Kamingamadathil

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The Intensely Humanized Mangrove Landscape of Sundarbans Biosphere Reserve: Need for Co-management of Biodiversity and Livelihood

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"This is a forest where roots defy gravity and move towards the sky. This is a forest where leaves remain underwater and seeds germinate on air!"
- A local Bengali saying on the 'beautiful forest' called Sundarbans.

Background: India is one of the very few countries globally to possess more than 200,000 hectares of mangrove cover along its long coastlines. Mangrove forests of India are widespread as well as ecologically diverse. The most famous as well as largest contiguous mangrove forest among these is in the state of West Bengal, i.e. the Sundarbans. It is situated in the largest prograding deltaic region of the world, created by the continual deposition of alluvial sediments by combined flow of the Ganges-Brahmaputra-Meghna river system. It covers a total area of about 26,000 sq. km across Bangladesh and India, encompassing a mosaic of landscape units such as forests, swamps, mudflats, inhabited islands and rivers. Administratively, more than two-third of the Sundarbans is in Bangladesh and rest is in India. According to popular belief, the name 'Sundarbans' originated from the once abundant *Heritiera fomes* (local name: Sundari) tree species in this region.

Introducing Sundarbans: The Indian part of Sundarbans is of 9,630 sq. km in area and lies within 21°32' N to 22°40' N and 88°03' E to 89° E. It was declared as a World Heritage Site by the International Union for Conservation of Nature in 1987 and Biosphere Reserve by UNESCO in 1989 due to its unique ecosystem functions and biodiversity status. Only about 4,263 sq. km area of the Indian part is under mangrove cover at present although considerable discrepancies exist in the estimation of actual forestland. The major causes of these discrepancies are primarily related whether to include rivers and mudflats within the purview of forest area or not. Gradual changes in environmental conditions occur from north to south as landscapes transform from mature alluvial islands and stable forests through active tidal flats and newly formed forests to coastal sand dunes and barren sand beaches. This deltaic region is very active and dynamic as continuous creation and destruction of landmasses is going on through the processes of periodic flooding, sedimentation and avulsion since the last 2,000 years. The climatic pattern is of tropical wet type having mean annual temperature of 25 °C and mean annual precipitation of 1900 mm with a pronounced monsoonal outburst. The soils are generally saline (Ardisols) or non-saline alkali (Alfisols) type with textural range from clay to sand and sandy loam. Moreover, soil profiles exhibit a gradual increase in salinity from inner to outer estuaries and east to west.

Biodiversity Profile: Due to higher range of habitat conditions in all micro-ecosystems of this vast mangrove landscape, abundant biodiversity had been reported here. Till date, 36 true mangroves, 28 mangrove associates and 7 obligatory mangrove species had been identified from the Indian part. The notable ones among these are *Heritiera fomes, Avicennia varieties, Bruguiera gymnorrhiza, Ceriops decandra, Excoecaria agallocha, Nypa fruticans, Rhizophora apiculata, Sonneretia apetala* etc. Along the sand dunes and beaches of coastlines, few non-mangrove saline varieties like *Pongamia pinnata, Acacia* species and *Casuarina equisetifolia* are dominant. However, the Indian Sundarbans is almost devoid of *Heritiera fomes* and *Nypa fruticans* at present chiefly due to excessive salinity in soil and water as well as overexploitation by local communities. Along with the diverse flora, more than 240 species of fishes,

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27 species of mammals, 42 species of reptiles and lizards, 200 species of birds and other avifauna are found here. The mangrove food and energy web, in its own unique way, possesses provisions of food and shelter for every organism of this region. Notable species of mammals in the Sundarbans are *Panthera tigris tigris, Felis viverrina, Axix axix, Sus scrofa, Platanista gangetica* etc. Regarding reptiles and lizards, *Lepidochelys olivacea, Bungarus caeruleus, Naja naja, Daboia russelli, Crocodylus porosus* etc. are noteworthy. Among birds, several are migratory in nature but the prominent sedentary ones are *Alcedo atthis, Halcyon amauroptera, Ardeola grayii, Callus gallus, Athene brama* etc. Apart from these organisms, numerous invertebrates like *Tachypleus gigas, Uca rosea, Peneus monodon, Ceithidea cingulata* etc. are also vital parts of this ecosystem. Several species of mudskipper fishes like *Boleopthalmus boddarti* are found along the muddy riverbanks and they have important functions in nutrient recycling of mangrove ecosystems along with fiddler crabs (*Uca rosea*). Many of the wildlife of Sundarbans have noteworthy economic importance, e.g. tiger prawns (*Peneus monodon*), shrimps, crabs, lobsters and honeybees (*Apis indica*) in both national and global markets. However, Sundarbans is most famous for its large population of Royal Bengal Tigers having unique adaptability features for survival in the saline mangrove environment and related myths of frequent indulgence in man-eating incidents. In the last 150 years, intense human interventions and natural calamities had been posing increasing intimidation to the existence of Sundarbans as evident from the continual loss of significant amount of biodiversity. Species like Javan rhinoceros had become extinct and several others like the Royal Bengal Tiger, Barking Deer (*Muntjanus muntjack*), Indian Rock Python (*Python morulus*) and Gangetic Dolphin (*Platanista gangetica*) are highly endangered.

The People and Livelihood: At present, more than 3.5 million people live in this area and most of them are primarily marginal farmers and fishermen. Total 54 islands of Indian Sundarbans have presence of human settlements covering an area of about 5,367 sq. km. These settlements are predominantly of rural character, although some urban centres have developed in recent years especially in the western and southwestern parts of the Sundarbans. However, it is still one of the least developed, poorest as well as densely populated regions of South Asia, where millions of people live in forest-fringe environments exerting pressure on the mangroves for extraction of resources. Apart from subsistence agriculture, a variety of fishing and aquaculture activities comprising coastal fisheries, brackish-water aquaculture, estuarine and riverine fisheries, riverside prawn seed collection, shrimp farming and freshwater aquaculture practices are observed here. A small yet notable number of people in the forest-fringe villages earn their livelihood from honey and wax procurement as well as from other non-timber forest products (NTFPs) collection. Honey, collected from both wild (*Apis indica*) and artificial captive boxes, has high market demand. Similarly, wax is also a valuable commodity. Every year, especially in the months of April-May, hundreds of people, with or without valid permits issued by the government, enter the reserve forests to collect honey and wax. Many of them are being killed by tiger in the wild in this process. These high risks associated with wild honey collection have compelled many to turn towards artificial cultivation of *Apis dorrseta* in the beehives along the village embankments opposite to the forests. In addition, the marginal forest dependent people collect various NTFPs like tannin, gum, resin, wild fruits, leaves and tree parts as primary medicines, mainly for subsistence and sell in the local markets. The creation of National Park and Wildlife Sanctuaries in the Sundarbans has drastically reduced the scope of legal procurement and harvest of these products from the wild due to total or partial bans. As a result, many of the forest dependent people had either switched to prawn seed collection or engaged themselves as labours in aquaculture farms.

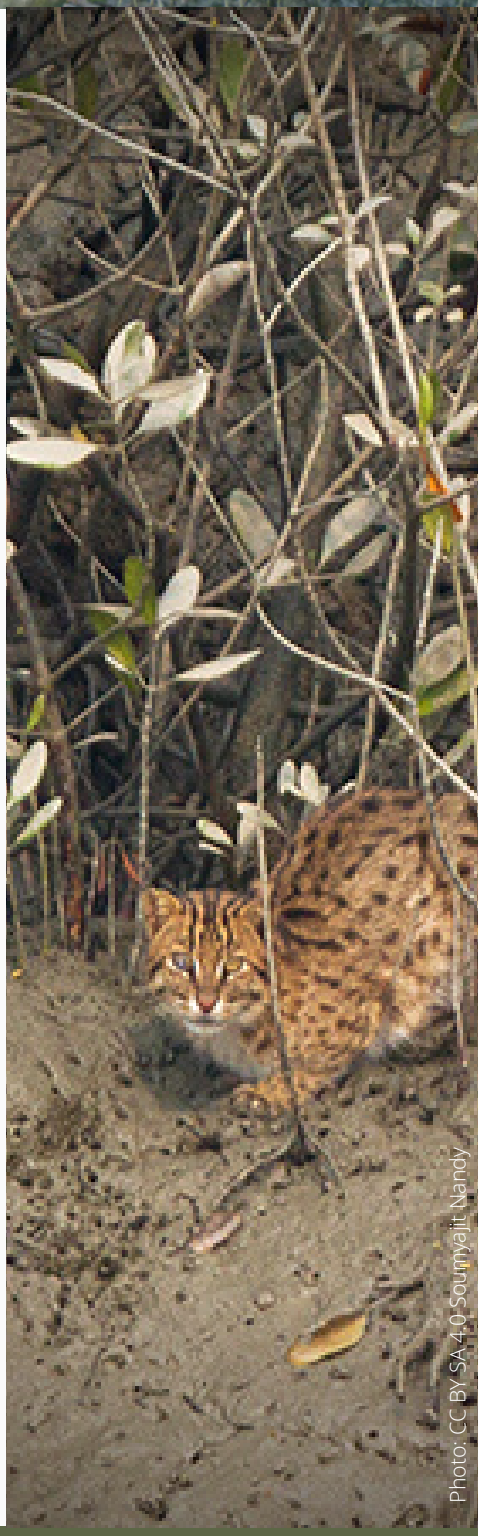
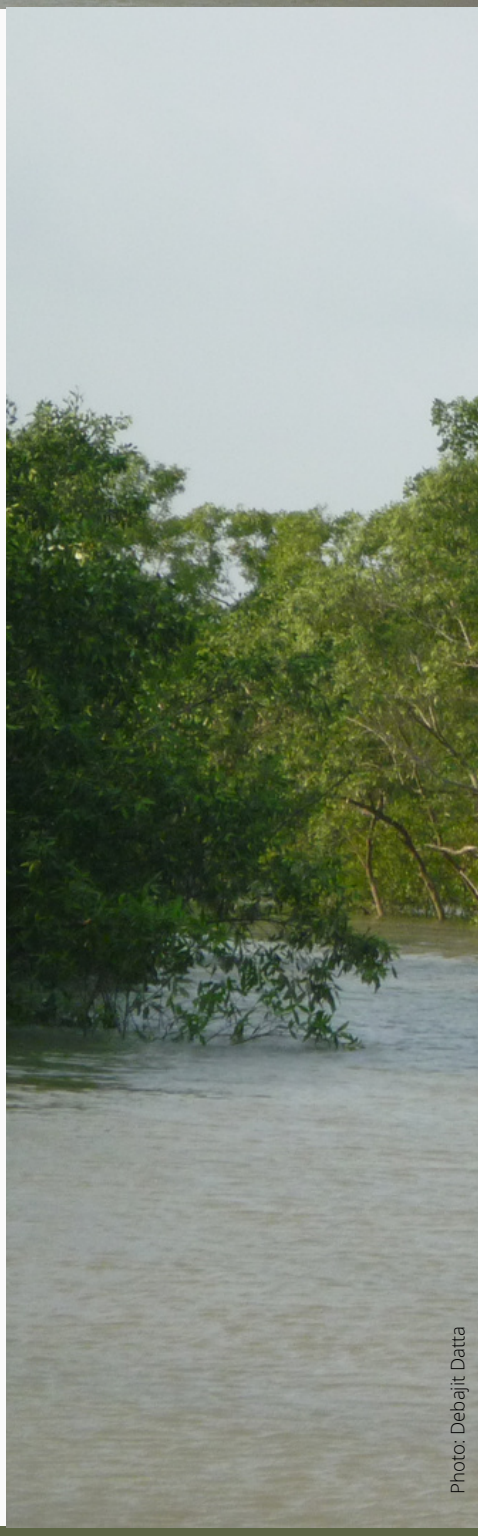


Photo: CC BY SA 4.0 Soumyajit Nandy

Photo: Debajit Datta

Nature-People Nexus: In spite of the fact that the areal extent of mangrove covers in the Indian Sundarbans had not changed much in the last four decades, i.e. only 1.2-1.3 % of of the original forest had been lost, considerable transformations had occurred in terms of changes in vegetation composition (dense to open mangroves), spread of brackish water aquaculture and loss of fertile croplands. The transformations are more vivid in the buffer areas and forest fringes, where the local village communities frequently disturb mangrove dynamics owing to their unsustainable livelihood practices. Coupled with that, shifting of major flows of freshwater rivers towards east, proliferation of illegal small-scale logging, land conversion to shrimp farms, exploitative coastal and riverine fishing practices, poaching, riverbank erosion, uncontrolled tourism and related mal-development, tiger trespassing in villages, accumulation of urban-industrial wastes cum micro-plastics and oil-spill, and, most importantly, climate change induced rise of sea levels and intensification of tropical cyclones are the major threats at present to the very existence of this mangrove habitat. To mitigate these menaces, several initiatives had been taken up by the governmental and non-governmental bodies at different spatial scales, viz. national, regional and local. Among these, the notable ones are the declaration of national park (southeastern part) and wildlife sanctuaries (Sajnekhali, Lothian, Haliday) status for most of the ecologically important yet fragile areas, continuation of Joint Forest Management program in the forest-fringe villages, and introduction of Social Forestry activities in the more inland inhabited areas of Indian Sundarbans. Besides, ecotourism activities and NGO-based plantation programs had also been initiated in few sites in the recent past. However, this is yet to be seen that how much these initiatives will be beneficial to comprehensively reduce the vulnerability quotient and ensure a resilient future for this unique mangrove ecosystem.



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NEWS

Islands in turmoil

"For the Sunderbans, bilateral dialogue over cross-border migration is better than communally-exclusive policies" Read more here.

Poverty, State Apathy, and Resource Exploitation Afflicts Indian Sunderbans

"A cycle of misery surrounds inhabitants who are forced to fish the mangrove delta due to the utter lack of other employment opportunities" Read more here.

Cross-border conservation project for endangered turtles in Sunderbans

"The first phase of the programme was completed in January this year, with the release of 10 turtles — born and raised in captivity — into the wild" Read more here.

Rare Nordmann's greenshanks sighted on Sunderbans island

"The pigeon-size bird is named after a 19th-century Finnish biologist and parasitologist, Alexander von Nordmann" Read more here.

How a Debt-Ridden Fisherman on His Canoe Increased Kerala's Mangrove Cover in 40 Years

"Kandal Rajan from Kannur, Kerala, has been conserving the mangrove belt on the Pazhayandi River for over four decades. He also owns a small mangrove nursery with 5,000 saplings at home." Read more here.

Odisha to map coastal stretches vulnerable to tidal surges

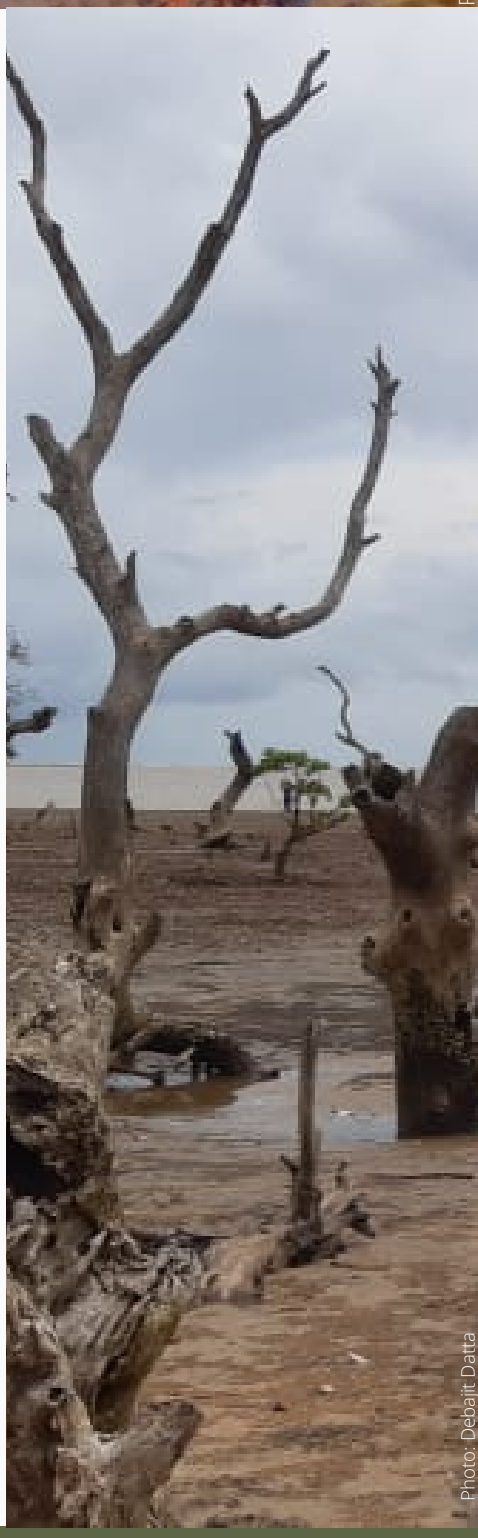
"Increased frequency and intensity of the cyclones has made it vital to strengthen embankments" Read more here.

Disaster deaths, sinking: Unprepared Kolkata face multiple climate risks, warns IPCC report

"Scientists offer solutions how city can contain impact of climate change" Read more here.

Potential offshore wind project in the Gulf of Mannar leaves fishers anxious

"Though the local people and fishers' union representatives understand the benefits of offshore wind power, they fear that the region is far too sensitive in terms of fish populations and pearl oyster banks, which are directly related to their livelihood." Read more here.



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VIEWS

CLIMATE MITIGATION POTENTIAL OF COASTAL ECOSYSTEM

ARUN KUMAR A.

Global Climate Scenario

Climate change mitigation is recognised in multilateral agreements such as the United Nations Framework Convention on Climate Change (UNFCCC). However, we are on track to miss the UNFCCC's Paris Agreement goal of keeping global warming below 2 degrees Celsius, as well as the CBD biodiversity targets. If the worst consequences of climate change are to be averted, immediate and far-reaching action is required to reduce greenhouse gas emissions and remove CO2 from the atmosphere. According to the 2020 Emissions Gap Report, countries must increase their mitigation goals "threefold to meet the 2°C goal, and more than fivefold to meet the 1.5°C goal"[1] .

Nature based solutions (NbS)

Nature-based solutions are defined as "activities to protect, sustainably manage, and restore natural or modified ecosystems that effectively and adaptively solve societal challenges while also offering human well-being and biodiversity benefits" [2]. The NbS has the potential to minimise greenhouse gas emissions caused by ecosystem loss, degradation, and mismanagement while also increasing natural CO2 sequestration. Climate change mitigation and adaptation, natural catastrophes, human health, food and water security, and biodiversity loss are all issues that can be addressed simultaneously by well-designed Nature-based solutions. The NbS can both reduce greenhouse gas emissions and improve natural CO2 sequestration by reducing greenhouse gas emissions caused by ecosystem loss, degradation, and mismanagement. Around 56 percent of anthropogenic CO2 is absorbed by the Earth's marine and terrestrial ecosystems [3].

The highest carbon stocks per hectare are found in all-natural terrestrial/coastal ecosystems, with tropical forests, peatlands, and mangroves having the highest carbon stocks per hectare. In the latter two habitats, much of the carbon is stored in soil organic carbon: 1375 tonnes/hectare on average for peatlands worldwide [4] and 361 tonnes/hectare for mangroves [5].

Coastal Ecosystem as a Climate Solution

Coastal ecosystems are among the most productive natural systems on the planet, and they are habitat to a diverse range of organisms. Coral reefs, mangroves, seagrass meadows, tidal marshes, sand dune systems, and salt marshes are just a few of the crucial habitats in coastal and marine ecosystems. With CO2 burial rates 20 times higher than any other terrestrial ecosystem, including boreal and tropical forests, they are among the world's greatest carbon storehouses [6]. Policymakers around the world are increasingly recognising their role in sequestering and storing 'blue' carbon from the atmosphere and oceans.

Mangroves, seagrasses, and tidal salt marshes–commonly referred to as blue carbon ecosystems–provide a wide range of mitigation, adaptation, and resilience benefits, including protection from storm surge and sea-level rise, erosion prevention, coastal water quality regulation, nutrient recycling, sediment trapping, habitat establishment for numerous commercially important and endangered marine species, and flora and fauna [8].

With a total coastline of around 7,516.6 km, including island territories, India has a mangrove cover of over 6,749 km2 [9] and with a total predicted mangrove cover of 4,95,842 ha in 2020 and a carbon stock value of 386 tonnes/ha, the mangrove's total carbon sequestration potential is estimated to be 702.42 million tonnes of CO2. Carbon sequestration potential will rise to 748.17 million tonnes of CO2e in 2030. It has been calculated that conserving and protecting mangrove cover might result in an increased sequestration potential of 207.91 million tonnes of CO2e. With a carbon stock of 108 tonnes/ha and a total mapped area of seagrass of 25,378.4 ha, the total carbon sequestration potential has been calculated to be 10.2 million tonnes of CO2e[10]. The tidal salt marshes' carbon sequestration capacity is still to be documented, and more research is needed to map their extent and to estimate their carbon sequestration potential.

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Expected Mitigation Potential of Nature-based Solutions

To protect natural ecosystems from conversion, the total mitigation potential varies from 3.4 GtCO2e (Carbon-Dioxide equivalent) in 2030 to 4.6 GtCO2e in 2050. Although damaged and vulnerable peatlands have a small area, their potential contribution to mitigation is extremely significant, accounting for 10% of total mitigation by 2050, and coastal wetlands (mangrove, salt marshes, and seagrass) account for roughly 4% (3-4%) of overall mitigation potential by 2050 [11]. Despite their small size in comparison to other ecosystems, they sequester and store significant amounts of carbon in their soil, as well as providing a variety of ecosystem benefits and services critical for climate change adaptation, such as coastal protection and food security for many communities.

Conclusion

Numerous initiatives and reforesting projects aimed at keeping carbon stored in the world's forests on land have publicly recognized. Sadly, similar solutions in the marine ecosystem are frequently disregarded. The management of marine ecosystems as a potential climate mitigation option, as well as the use of the UNFCCC to incentivise better management action, is now a point of contention, and is not adequately reflected in most coastal countries' NDC plans, including India's.

The Indian government should adopt a Carbon Neutrality Policy as a mandate for additional carbon finance for coastal environment conservation. Marine bonds, blue bonds, and blue financing, particularly involving shipping, oil refineries, cement plants, fish processing plants, power plants, port infrastructure, and other manufacturing plants, should be adopted. In addition, research must be revamped in order to establish methodologies for assessing the carbon stocks of different coastal ecosystems particularly soil organic carbon (SOC) and below-ground biomass [12]. Although natural-based solutions have a great potentiality for decarbonization, they must be paired with rapid, wide ranging emission reductions in the energy, industry, and transportation sectors. Without this combined strategy, total mitigation will be inadequate to avert climate-related risks, reducing nature-based solutions' ability to contribute to climate change mitigation.

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[3] Intergovernmental Panel on Climate Change (2021). Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.
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[11] United Nations Environment Programme and International Union for Conservation of Nature (2021). Nature-based solutions for climate change mitigation. Nairobi and Gland.
[12] Pörtner, H.O., Scholes, R.J., et al. (2021). IPBES-IPCC Co-Sponsored Workshop Report on Biodiversity and Climate Change. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services and the Intergovernmental Panel on Climate Change.

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Photo: CCBY4 Niraj mani chourasia

Membership Renewal

Requesting members whose membership ended last year or before but was extended until 2021 to kindly visit the page to renew it at the earliest. Those who became member last year (2021) will have their membership until one year from the date of registration.

Members can now choose between annual and term membership based on their interest.

Membership type	Tenure	Membership Fee (INR)
Student	Annual	1000
	Term (3 Years)	2500
Regular	Annual	2000
	Term (3 Years)	5000
Institutional	Annual	10000
	Term (3 Years)	25000

Opportunities

New Dates

XV World Forestry Congress | 2-6 May 2022 | Coex, Seoul, Republic of Korea
Building a Green, Healthy and Resilient Future with Forests

Sentinel Hub Custom Script Contests

"This special edition of the Sentinel Hub Custom Script Contest is organized in partnership with the World Meteorological Organization. The contest starts on 15th March 2022 and ends at midnight on 30th June 2022. The objective of this activity is to demonstrate the power of EO data in helping detect the effects of climate change." Find out more at https://www.sentinel-hub.com/develop/community/contest/

IALE World Congress 2023

The International Association for Landscape Ecology (IALE) has announced that the 2023 IALE World Congress will take place in Nairobi, Kenya, from 10th – 15th, July 2023. The World Congress will be a hybrid (online/in person) event and it is for the first time being hosted in the Global South. The World Congress theme is 'Transboundary Resource Management, Climate Change and Environmental Resilience'.

Data worth exploring

Land and Carbon Lab: Global data on Land Cover, Cropland change, Forest Height Change and more.
https://www.landcarbonlab.org/data