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Why do I attend climate COPs? 10 | Shifting shorelines and changing tides: A mangrove story 22 |
Between the sea and the weed 27 | The geopolitics of climate change in the Indian Ocean Region 38



SPECIAL ISSUE
Indian Ocean
and Climate

Current Conservation carries the latest in research news from natural and social science facets of conservation, such as conservation biology, environmental history, anthropology, sociology, ecological economics and landscape ecology.

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Contents

editorial

3 Introduction: Dissonant Futures

Aarthi Sridhar and Meera Anna Oommen | Prabha Mallya

feature

5 Sailing through change: Climate communication for coastal communities

Anirban Roy | Karunya Baskar

perspective

10 Why do I attend climate COPs?

Priyadarshini Karve | Shraddha Mandale

feature

14 Is it possible to balance climate action, equity, and social justice in blue carbon governance?

Sisir Kanta Pradhan | Athulya Pillai

feature

22 Shifting shorelines and changing tides: A mangrove story

Radhika Bhargava Gajre | Pooja Sreenivasan

feature

27 Between the sea and the weed

Surya Prabha K. and Sunil D. Santha | Hitesh Sonar

photo essay

32 On the vanishing shore

Pavitra Vasudevan and K. Bhawna | K. Nagamma and Ch. Pratima

feature

38 The geopolitics of climate change in the Indian Ocean Region

Dhanasree Jayaram and Haritha S. Narayanan | Ipsa Jain





Cover art **Prabha Mallya**

Welcome to this special edition, where we unpack how climate change is impacting the Indian Ocean Region—home to 2.5 billion people across 36 countries, stretching from East Africa to the west coast of Australia.

For this issue, we wanted the artwork to resonate deeply with the theme. Though created by seven different artists with distinctive styles and approaches, the illustrations are tied together by a shared conceptual thread.

A 2023 study published in *Nature* showed that human-induced climate change has significantly changed the colour of more than half the world's oceans, especially in tropical regions—from blue to green—over the past two decades. With this in mind, we invited each artist to incorporate a particular **shade of green** into their pieces, in any way they saw fit.

Illustrating conceptual themes is never easy, but our artists took this on as an additional challenge. What emerged are artworks that are as varied as they are connected—each one interpreting the themes in every article through a personal lens, yet held together by a subtle visual echo of green.

– **Labonie Roy**

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Introduction: Dissonant Futures

Authors **Aarthi Sridhar and Meera Anna Oommen** | Illustrator **Prabha Mallya**

The Indian Ocean is hot stuff and one can't say this enough; though being 'hot' is great until it's not. Despite the fixing of maritime and territorial boundaries across its waters, Indian Ocean countries—lined up from African to Antipodean shores—remain connected, bustling multicultural sites, reminiscent of its ancient markets and trade routes. However, the imaginaries of souk-style easy cultural mobility and intermingling have given way to modern, specialised and elite gatherings, symposia, and seminars, where new inequalities and configurations replace the old. Legitimate mobility is no longer the defining feature of this part of the world; rather, it is distress migration from the deltaic and degraded ecosystems of the Indian Ocean that has gained notoriety in our times.

Information, strategy, and capital are traded and reproduced in exclusive networks of Indian Ocean blue economies. Subjects range from security, terrorism, tourism, ecology, mining, undersea exploration, carbon conservation, illegal, unreported and unregulated fishing, disasters, and echoes of oceanic (dis)connected histories. The literal heating up of the Indian Ocean with rising global temperatures affects all of these sectors and conversations. Two aspects mark this new interest in climate discourse—there are few voices from where climate impacts the most, and there is little plain speak on the inconvenient truths of climate, such as differentiated responsibilities for climate impacts (or simply put: who is going to pay for saving the Indian Ocean).

India is a good case in point. Marine systems receive limited attention and there is a need to mainstream 'real' issues into conversations about climate. The changing climate dynamic of the Indian Ocean entails a range of consequences from perturbations to the monsoon to cascading impacts on fisheries, agriculture, and the people dependent on them. Despite these looming threats, most of the recent press on the subject discusses little

else other than extraction and harvesting resources under the blue economy umbrella. However, this extraction-focused mode is still in its early stages in some sectors, and there is potential for course correction even if we start now.

While countries should of course benefit from fish and other marine resources, planning needs to have an eye on future scenarios—not only in terms of continued availability of resources, but also in terms of inclusion, equity, and justice. Some geographies need special attention. In the Indian mainland, these can be states dealing with overfishing and distress migrations. On the other hand, with their large Exclusive Economic Zones and their remoteness, Indian island systems such as the Lakshadweep Islands and the Andaman and Nicobar Islands are more comparable to Small Island Developing States, which have their own peculiar set of challenges. These regions need new approaches that simultaneously integrate the blue economy with the challenges to blue justice.

One way to get climate action going is the arena of communication. Experts point to some unhealthy trends in this domain too, across the globe. On the one hand, there is little attention to solutions related to meaningful adaptation or feasible green energy transitions. On the other, an excessive focus on doomsday scenarios inures the general public into numbness, akin to doom scrolling or watching daily war reports on the news. Finally, there is a slow closing within the public sphere of marginal streams of knowledge that could transform on-the-ground and policy practices in controversial areas such as aquaculture, merely on account of communication capture by powerful actors.





Local governments in maritime nations struggle with the capacities to address the nuances of climate impacts in coastal areas. Preliminary enquiries in our areas of work in Odisha and Tamil Nadu, for instance, reveal inconsistent state funding for adaptation, absence of expertise within state Climate Cells, and an equation of climate adaptation with disaster management. Virtually none of the socio-technical infrastructure for climate in local and regional governments is sensitive to fisheries declines or marine ecosystem degradation (such as through marine plastics). The plethora of multinational projects that seek to address climate impacts largely rely on conventional disaster management techniques such as shoreline reinforcements, bunding, etc., that have proven poor track records. Other projects simply include plantations, often without attention to community tenurial arrangements over coastal commons.

Climate change strategies across the Indian Ocean lack a coastal-marine focus, specialist knowledge, and community engagement. Marine and coastal issues are often neglected in the larger narratives surrounding development, conservation, and climate change. Recentering coastal communities and ecosystems will require the building of capacities, but also investment of energy and diverse knowledge in strategic communications.

Several examples exist across civil society spaces, led by non-governmental organisations, universities, student groups, and individual actions. Some of these efforts are described in the articles in this issue. Not all efforts result in positive feedback for the system as a whole. The commercial interest in blue carbon sequestration against all odds, highlighted by Sisir Pradhan, is an example of negative implications of climate action. Surya Prabha and Sunil Santha's work on seaweed farming draws attention to the difficulties inherent in crafting simplistic win-win solutions, where winners are few and losses multiple.

Climate change interventions also need funding and appropriate philanthropic engagement—and there is very little of that, at least for the oceans. When it comes to environmental issues, we find that marine issues receive only a fraction of the funding that terrestrial systems receive. Climate change with its imperceptible shifts (at least in its early years) as opposed to sudden visible catastrophes has been perceived as more of a benign risk, if at all. The few philanthropic dollars and rupees that actually do overcome climate deniers and their ilk often find their way into mitigation rather than adaptation projects.

Two oceans away in New York, each year Climate Week comes together as another bustling gathering. Drawing the world's strongest advocates, innovators, and investors in climate action, the irony of its existence and performance did not escape us. In September 2024, we joined the ranks of participants who struggled to navigate Manhattan traffic and narrow streets across the dispersed venues of Climate Week. We entered and exited promising climate conversations, only to have the wind knocked out of us each time we encountered Manhattan's glass towers of pure capital. Day 1 was a shocker, Day 3 almost comical, and by the end of the week, we longed for a space of less violent cognitive dissonance.

The Indian Ocean has been a space that wove in difference along with tumult. Whether in (climate) action or thought, between its unequal peoples and plans, the future imaginaries of the Indian Ocean must be guided by greater harmony and accord; features that make it an ocean that's hot, for the right reasons.

Aarthi Sridhar is a founder trustee at Dakshin Foundation, heading its *Communities and Resource Governance* programme focused on resource use, environmental justice and democratising knowledge.

Meera Anna Oommen is a founder trustee at Dakshin Foundation, heading its *Conservation CrossRoads* programme focused on emerging issues relating to climate change and human-wildlife conflict.

Prabha Mallya draws creatures, chaos, and curious things. Her work includes *The Wildings*, *Beastly Tales*, *The Jungle Books*, and stories in comics anthologies.

SAILING THROUGH CHANGE:

Climate communication for coastal communities

Author **Anirban Roy** | Illustrator **Karunya Baskar**

Coastal communities along the Indian Ocean are among the most vulnerable to climate change. Rising sea levels, intensifying cyclones, saltwater intrusion, and erratic weather are no longer distant threats—they are unfolding now, threatening homes, health, and livelihoods across the region. These changes are already disrupting food systems, freshwater access, and the economic foundations of coastal life.

The Indian Ocean is more than a geographic feature—it is a vital, life-sustaining force for millions across South and Southeast Asia, East Africa, and island nations. It supports marine biodiversity and underpins both small-scale livelihoods and broader regional economies. Yet despite its centrality, climate communication often fails to reach the communities that depend on it most.

Addressing climate change in the Indian Ocean region demands more than scientific data—it requires communication that is clear, locally grounded, and actionable. When

communities understand the changes unfolding along their coasts and within their marine ecosystems, they can adapt, participate in climate governance, and build resilience. Bridging the gap between climate science and lived experience is essential—so that those most affected are also the best prepared.

Coastal realities

For climate communication to be effective, it must begin with an understanding of the audience. Coastal communities bring deep-rooted knowledge, observations, and lived experiences that shape their understanding of the environments around them. Their perspectives are influenced by generational wisdom, cultural beliefs, and practical knowledge of coastal ecosystems. However, these insights are often overlooked in climate discussions, as communicators (such as trainers) sometimes assume they are starting with a 'blank slate'.

Instead of seeing coastal communities as passive recipients of scientific knowledge, climate communication should recognise and build on what they already know. Coastal communities have observed shifts in fish migration, changes in monsoon patterns, and worsening coastal erosion. Linking these first-hand observations to broader climate trends and technical notions can make climate communication more relevant, relatable, and actionable, effectively bridging the gap between scientific discourse, policy actions, and lived experiences.



Translating climate science

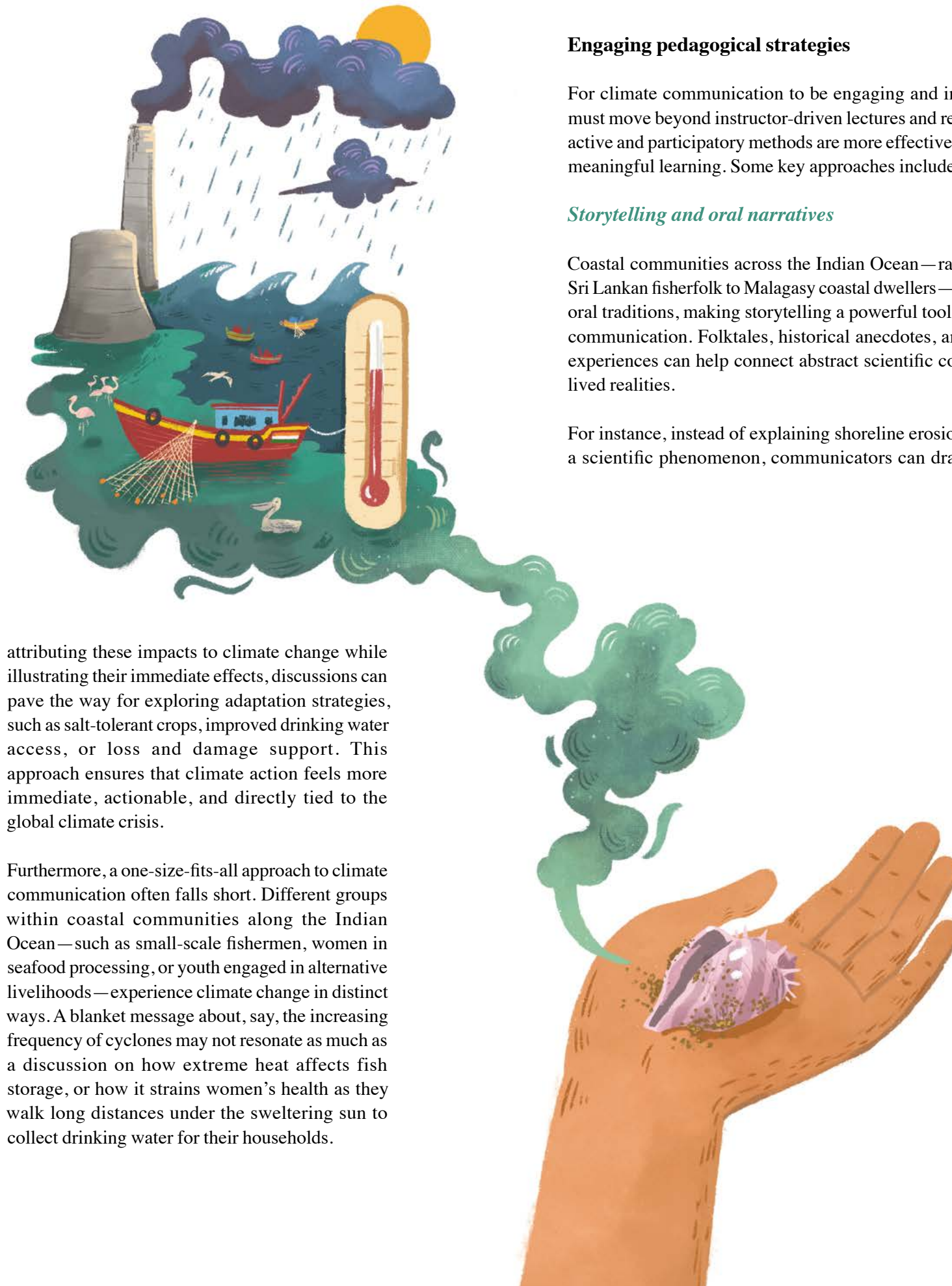
One of the major challenges in climate communication is the complexity (and sometimes incommensurability) of scientific language, particularly when discussing climate governance and adaptation strategies. Concepts like “carbon sequestration” or “global warming potential” often have no direct equivalents in the regional languages spoken by maritime communities along the Indian Ocean. Instead of relying on simplifying these concepts alone, climate communication could focus on how these changes are experienced in daily life.

For instance, rather than explaining ocean acidification with technical jargon, communicators can discuss its impact through observable changes in shellfish like oysters and mussels, whose weakened shells or declining numbers may signal environmental stress in coastal ecosystems, which in turn threatens the livelihoods of small-scale fisherfolk. These stories can open up discussions about possible causes and help relate these changes to broader climate processes like the carbon cycle in non-technical, accessible terms.

Another significant challenge in climate communication is the disconnect between abstract climate projections and the immediate priorities of coastal communities, who often focus on daily survival rather than long-term environmental risks. To make global climate debates locally relevant, it is essential to connect them to proximate problems such as changes in weather patterns, declining fish catch, saltwater intrusion into drinking water sources, and the increasing frequency of cyclones—while explicitly linking these to changes in global climate.

For instance, rather than presenting sea-level rise along the Indian Ocean’s shorelines as an abstract or isolated concept, communicators can discuss how this global phenomenon directly affects everyday life. Rising global temperatures, driven by greenhouse gas emissions, are causing polar ice caps to melt and oceans to expand—leading to higher sea levels. This rise increases the inland reach of saltwater, contaminating drinking water sources and gradually reducing the productivity of coastal lands.

Similarly, declining fish catch may not only be due to over-fishing but also to shifting ocean temperatures and acidification—both consequences of climate change. By clearly



attributing these impacts to climate change while illustrating their immediate effects, discussions can pave the way for exploring adaptation strategies, such as salt-tolerant crops, improved drinking water access, or loss and damage support. This approach ensures that climate action feels more immediate, actionable, and directly tied to the global climate crisis.

Furthermore, a one-size-fits-all approach to climate communication often falls short. Different groups within coastal communities along the Indian Ocean—such as small-scale fishermen, women in seafood processing, or youth engaged in alternative livelihoods—experience climate change in distinct ways. A blanket message about, say, the increasing frequency of cyclones may not resonate as much as a discussion on how extreme heat affects fish storage, or how it strains women’s health as they walk long distances under the sweltering sun to collect drinking water for their households.

Engaging pedagogical strategies

For climate communication to be engaging and impactful, it must move beyond instructor-driven lectures and reports. Interactive and participatory methods are more effective in ensuring meaningful learning. Some key approaches include:

Storytelling and oral narratives

Coastal communities across the Indian Ocean—ranging from Sri Lankan fisherfolk to Malagasy coastal dwellers—have strong oral traditions, making storytelling a powerful tool for climate communication. Folktales, historical anecdotes, and personal experiences can help connect abstract scientific concepts and lived realities.

For instance, instead of explaining shoreline erosion purely as a scientific phenomenon, communicators can draw on local

accounts of once-thriving fishing spots that have vanished due to coastal degradation. Along Kenya’s coastline, fisherfolk in Lamu recall how their fishing grounds have shrunk due to mangrove loss and rising sea levels. In the Maldives, older generations remember the ocean as an endless source of beauty and abundance. Today, that very ocean threatens their existence—rising sea levels have caused saltwater to seep into freshwater sources, making groundwater unfit for cooking, watering plants, or growing food.

In India’s Sundarbans—one of the world’s largest mangrove forests—where rising sea levels and increasing salinity threaten livelihoods, older residents recount how freshwater ponds once supported fisheries and agriculture but are now turning brackish, forcing communities to adapt. Meanwhile, in coastal Bangladesh, communities share stories of how tidal floods have become more frequent and intense, inundating homes, contaminating drinking water, and forcing people to elevate their homes or migrate seasonally.

Stories of past cyclones in Odisha—such as Cyclone Phailin in 2013 and Fani in 2019—and how traditional knowledge helped people prepare, can make climate risks feel more immediate while preserving indigenous wisdom. By framing climate change through familiar narratives, communities can connect emotionally to the issue, making it more relevant and actionable.

Audio-visual instructional methods

Audio-visual methods can enhance climate communication by engaging audiences more effectively than traditional blackboard-driven sessions. Tools like infographics, animated videos, and data visualisations simplify complex climate concepts, while interactive approaches—such as virtual simulations, remote-sensing images, and 3D models—make them more tangible.

For instance, along the coast of Mozambique, a participatory activity where community members sketch their village's shoreline as they remember it from childhood, then compare it with satellite imagery, can spark meaningful conversations about disappearing beaches, shifting tides, and the urgent need for adaptation strategies.

In the Seychelles, drone footage capturing coral reef degradation due to warming seas visually underscores the impact of ocean acidification, deepening public understanding of climate-induced marine changes. Similarly, in Madagascar, where coastal erosion is a mounting concern, time-lapse videos of receding shorelines help communities grasp the gradual yet alarming pace of change, reinforcing the urgency of conservation and adaptation. These immersive approaches not only foster deeper understanding but also inspire proactive planning for coastal resilience.

Hands-on and experiential learning

Active participation could strengthen climate understanding by making scientific concepts more tangible. In many coastal settings, engaging communities in simple and hands-on monitoring activities can serve as powerful tools to connect climate variability with local realities.

For instance, in regions where fish species exhibit seasonal variation or repeated spawning visits, community-kept logs can help track ecological patterns over time. In low-lying agricultural zones affected by saline intrusion, participatory soil testing may raise awareness of changing environmental baselines. Similarly, in areas experiencing erratic rainfall or declining groundwater levels, maintaining community diaries of rainfall and water table fluctuations can support long-term understanding of climate-driven shifts in coastal water security.

These participatory approaches not only build local knowledge but foster meaningful community engagement in climate adaptation efforts. Extending this further, rather than simply explaining the role of mangroves in coastal protection, communities might better grasp their importance through direct observation and collective reflection. In contexts like Bangladesh's Sundarbans or Odisha's Bhitarkanika region, guided visits to areas with varying degrees of mangrove degradation could help participants observe differences in shoreline stability, water clarity, and fish presence—offering insights into how mangroves might function as natural buffers against erosion and storm surges.



Likewise, in parts of East Africa such as Zanzibar, involving coastal communities in planting and monitoring mangrove saplings—alongside dialogue on their role in the carbon cycle—could nurture deeper connections between ecosystem restoration and climate resilience.

Community-led dialogues

Climate knowledge should be co-created with local communities to ensure relevance and inclusivity. Organising discussions where fisherfolk and farmers, especially women, share their observations helps ground climate communication and adaptation strategy within lived experiences. These local insights can then be linked to broader climate science, fostering a sense of ownership and encouraging practical solutions.

For example, in Oman, Cyclone Gonu (2007) severely damaged desalination plants, leading to widespread water shortages and exposing coastal communities' vulnerability to climate-induced water scarcity. In Somalia, rising temperatures are believed to have accelerated fish spoilage, directly affecting small-scale marine fisheries. Along Pakistan's southern coast, women engaged in drying and processing

fish struggle to preserve their catch due to extreme heat, leading to economic losses. Meanwhile, in coastal Tamil Nadu, caregivers are noticing a rise in heat-related health issues, particularly among the elderly and children.

By integrating these lived experiences with scientific knowledge, climate communicators can help communities develop locally relevant strategies—such as improved water conservation, climate-resilient fishing practices, and targeted health interventions.

Beyond external expert-driven strategies

For climate communication to be truly effective, it must be rooted in equity and mutual understanding. Often, a major constraint to effective climate communication is the perception that climate knowledge is 'external'—originating from scientists, policymakers, or NGOs, rather than being grounded in the lived experiences of the community. This disconnect can lead to scepticism or disengagement from coastal communities. The way forward is through shared learning—where climate knowledge is not simply delivered, but co-created with those most affected who also possess expert knowledge of such changes and their impacts using local ecological knowledge.

To truly advance, climate communication in the Indian Ocean region must go beyond merely 'raising awareness' to driving meaningful collaborative action. Participatory approaches—where communities themselves record and communicate environmental shifts, share traditional knowledge-based insights across locations,

and engage in collaborative solution-building—help ensure that responses are both locally relevant and scientifically accurate.

By fostering trust and prioritising collective learning, we can bridge the dichotomies of knowledge systems, transforming climate adaptation into an inclusive, sustained effort rather than an imposed directive. Ultimately, when climate action is embedded within community-driven knowledge systems, adaptation becomes not just a response to change, but a pathway to resilience, autonomy, and long-term empowerment.

Anirban Roy is a doctoral researcher at ATREE exploring how rights-based governance influences socio-ecological outcomes and advances forest management in India.

Karunya Baskar's work as a visual designer spans across storybooks, educational material, and branding projects. She is currently also a nature educator at Palluyir Trust, Chennai.

Why do I attend climate COPs?

Author **Priyadarshini Karve** | Illustrator **Shraddha Mandale**

But first, what is a COP? The Conference of the Parties (COP) is an annual meeting of all countries that are parties to the United Nations Framework Convention on Climate Change (UNFCCC). And the UNFCCC is an international treaty adopted in 1992 to address climate change. It provides the framework for international cooperation on climate action, and the COP is the “supreme decision-making body of the Convention”.

The COP’s main goals are to assess global progress in reducing greenhouse gas emissions, adapt to the impacts of climate change, and provide finance, technology, and capacity-building support to help countries reduce their emissions and build resilience to climate change. I work on technologies that help with the first two goals, as well as being active in the climate change literacy space.

The annual conferences are an opportunity to review Parties’ progress against the overall goal of the UNFCCC to limit climate change and to negotiate new measures. In my time, I have attended several climate COPs and have often faced this question: is it really worthwhile attending these meetings?

Reality check

Civil society representatives register for COPs as ‘observers’. The original idea behind the concept was that civil society would act as a watchdog in these annual review and planning meetings and bring the voices of vulnerable and disenfranchised communities from across the world to the negotiations table.

There exist civil society networks with the sole purpose of following and trying to positively influence the UNFCCC negotiations. They do this all year round, not just at the time of the annual COP. Grassroot NGOs often do not have the bandwidth to do this, but try to convey their challenges and asks through such networks.

COP17 held in Durban, South Africa, in 2011 was the first one I attended. At the time, I headed a cooperative of NGOs that were spread across Asia and trying to bring carbon finance to grassroot level projects in the region.

It was while representing this international organisation that I encountered and connected with COP-attending Indian civil society for the first time. In 2011, the Indian government and civil society were on the same page about the international discourse on climate change. Every evening one of the Indian negotiators updated the Indian observers about the ongoing discussions.

In hindsight, I now think this was perhaps the first COP where civil society members across the board started becoming disillusioned with the UNFCCC process. A couple of years earlier at COP15 in Copenhagen, Denmark, global civil society representatives were present in large numbers, filled with positivity and hope. Barack Obama had recently become the US president



and was bringing the country back into climate action. The COP attendees fervently believed that he could and would motivate all developed countries to take bolder actions to solve the climate crisis and fulfill the commitments under the Kyoto Protocol—which was adopted in 1997 (but entered into force only in 2005) and set binding targets for industrialised countries and economies in transition to reduce greenhouse gas emissions.

But the COP15 declaration just contained platitudes with no real action agenda, and civil society members across the world felt betrayed. The next COP in Cancun, Mexico, in 2010 also did not reach any consensus on the pathway post-Kyoto Protocol, although a green climate fund did get established.

At COP17 global civil society had to finally come to terms with the facts that the Kyoto Protocol was a failure, financial commitments were being made but not fulfilled, and no global consensus seemed possible on the way forward. It was also obvious that even though the protocol was ‘legally binding’, there were not going to be any ‘penalising’ consequences for developed countries who failed to meet their commitments.

On the other hand, developing countries were now being pressured to primarily take on the burden of emission reductions. The message was loud and clear—the most powerful governments of the world were simply not interested in genuinely addressing climate change.

Alarm bells ringing

Life went on for me with my teaching and outreach work, but I got pulled into the world of global climate negotiations again, when I had an opportunity to attend COP24 in 2018. It was held in Katowice, Poland, and this time I was representing an Indian civil society organisation that had been an observer since COP1.

I noticed several changes compared to COP17. First, by this time the Paris Agreement—another legally binding treaty, with the goal of limiting global warming to “well below 2°C above pre-industrial levels” and ideally to cap it at 1.5°C—had been signed (2015) and ratified (2016), but had not yet officially come into force.

However, history had repeated itself, with the US pulling out from yet another global climate agreement. Second, participants from Indian civil society no longer seemed to enjoy a camaraderie with the Indian government negotiators.

Third, I saw that observers were no longer mostly civil society, but increasingly for-profit organisations—some enterprises in the renewable energy, waste management, and other sectors, but a disturbingly large number of fossil fuel companies. It was also ironic that Katowice was a coal mine city—the COP venue was a stadium built on the site of an old coal mine, and the Polish head of state declared in the inaugural address that they would not give up coal in the near future.

I have attended the last three COPs—Sharm-el-Sheikh, Egypt (2022), Dubai, United Arab Emirates (2023), and Baku, Azerbaijan (2024). All these locations were fossil fuel-driven economies. While negotiators haggle over the emission reduction and financial targets of the Paris Agreement, the presence of a large number of fossil fuel company executives is now normalised. The Indian government delegation no longer acknowledges Indian civil society presence, but embraces representatives of the Indian business ecosystem instead. And for civil society organisations, COP is increasingly just a means to interact with like-minded people across the globe, to form new connections and possibly initiate new efforts to deal with their own climate-changed realities.

Silver lining

The 2025 meeting (COP30) will take place in Belém, Brazil. Greenhouse gas emissions have steadily increased through the past three decades, although the rise would have been more rapid without the UNFCCC process. Vulnerable communities, such as those in the small island nations and coastal regions of the Indian Ocean, are suffering more and more hardships, but whatever little financial and technical support they are getting, would not exist without the UNFCCC. While it is valid to question the relevance of UNFCCC and COPs, we also must ask—what other mechanism is there to achieve any kind of international cooperation to deal with this global crisis?

Each COP I attended exposed me to different perspectives and solutions, and ways to cope with the stress and frustration commonplace in this sector. I forged friendships with folks from different countries, and found the inspiration and strength to keep going. I came back from every COP with new ideas, and new resolve. These encounters positively influenced my own work, and therefore the lives of those touched by my work.

Climate change is a global crisis. As we grapple with climate-induced challenges locally, it helps to place these struggles in an international context, and to see ourselves as a part of a global community trying to survive. The annual COPs help keep this community hopeful. This may not ‘solve’ the climate crisis, but it does help with ‘coping’ with the outcomes of the crisis. And that is reason enough for me to keep attending climate COPs.

Priyadarshini Karve has developed and disseminated clean biomass energy technologies and innovative climate change education tools in a professional career spanning 25 years.

Shraddha Mandale is a multi-awarding winning visual artist whose work has been showcased around the world. She loves to turn her curiosity into illustrations that explore the art of living.





Is it possible to balance climate action, equity, and social justice in blue carbon governance?

Author **Sisir Kanta Pradhan**
Illustrator **Athulya Pillai**

Blue carbon refers to the carbon dioxide stored within vegetated coastal and marine ecosystems, such as mangroves, saltmarshes, and seagrass meadows. The term first emerged in the United Nations Environment Programme 2009 report titled *Blue carbon: The role of healthy oceans in binding carbon*.

Studies show that although blue carbon ecosystems only constitute only 2 percent of the ocean area and 5 percent of the global land area, they are significant natural carbon sinks, accounting for nearly 50 percent of all carbon buried in marine sediments. The carbon removal efficiency per unit of the blue carbon ecosystem is supposed to be five times higher and its absorption capacity three times faster than tropical forests.

Blue carbon ecosystems as nature-based solutions have the potential to address both climate mitigation and adaptation challenges at relatively low cost, while delivering a range of co-benefits for

people and nature. But while there is a strong acknowledgement of the importance of conservation and governance by scientific communities, policymakers, market players, and proximate community groups, these ecosystems are fast degrading.

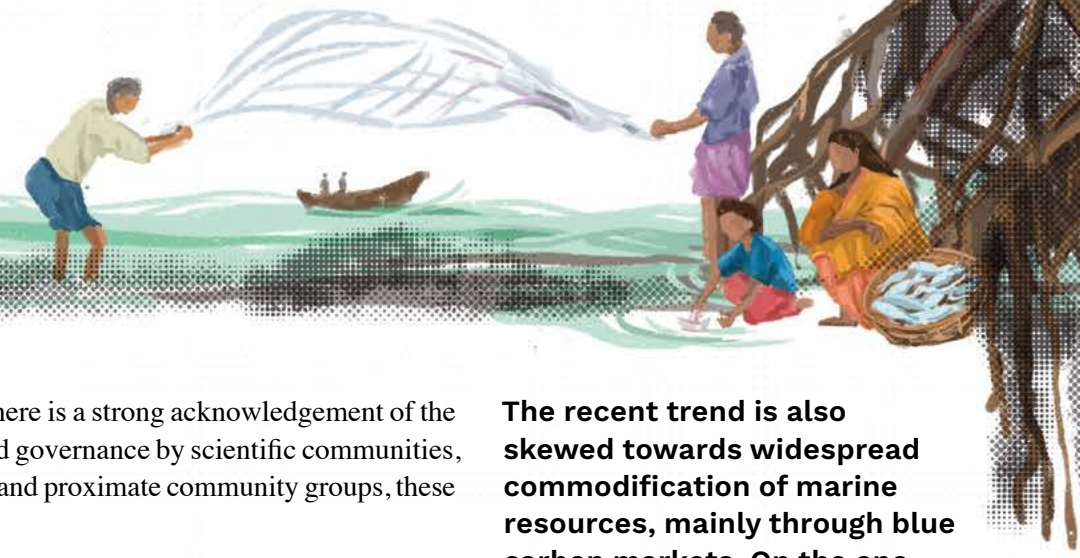
It is estimated that more than 50 percent of saltmarshes, 35 percent of mangroves and 29 percent seagrass meadows have been lost since the mid-20th century. The loss is attributed to climate-induced impacts, such as sea level rise and extreme weather events, as well as coastal development action. When these ecosystems are degraded, they not only fail to act as carbon sinks, but also contribute to carbon emissions by releasing stored carbon into the atmosphere. With a global annual loss of blue carbon ecosystems between 0.7 to 7 percent annually, it is projected that these ecosystems are releasing between 0.15 and 1.02 billion tons of carbon into the atmosphere each year, contributing significantly to anthropogenic climate change.

Recently blue carbon has received enormous global attention for climate action. The 16th climate COP (Conference of the Parties) in 2010 specifically accorded high importance to blue carbon ecosystems in this context. Subsequently, international and national policy instruments—including Nationally Determined Contributions, which are national climate action plans under the Paris Agreement, with the aim of limiting global warming to well below 2°C above pre-industrial levels—place stronger emphasis on blue carbon opportunities.

¹**Commoditisation** is a term that refers not just to the commodification of an entity (adding a price to a product), but involves processes of its standardisation coupled with a focus on interchangeability across different producers and buyers.

The recent trend is also skewed towards widespread commodification of marine resources, mainly through blue carbon markets. On the one hand, initiatives patronised by environmental conservation organisations and private sector groups, such as Blue Carbon Buyers Alliance, are advancing an exclusionary conservation agenda. On the other hand, large-scale investments through Blue Economy initiatives are altering existing social-ecological relationships within these blue carbon systems.

This article outlines two broad contours of blue carbon governance that include: (1) complexities arising out of the **commoditisation**¹ of blue carbon areas, with an exclusive focus on carbon in global trade (2) changing social-ecologi-



cal relationships in terms of distributional, procedural, and recognitional justice issues for local communities (see footnote on p17).

The carbon tunnel vision trap

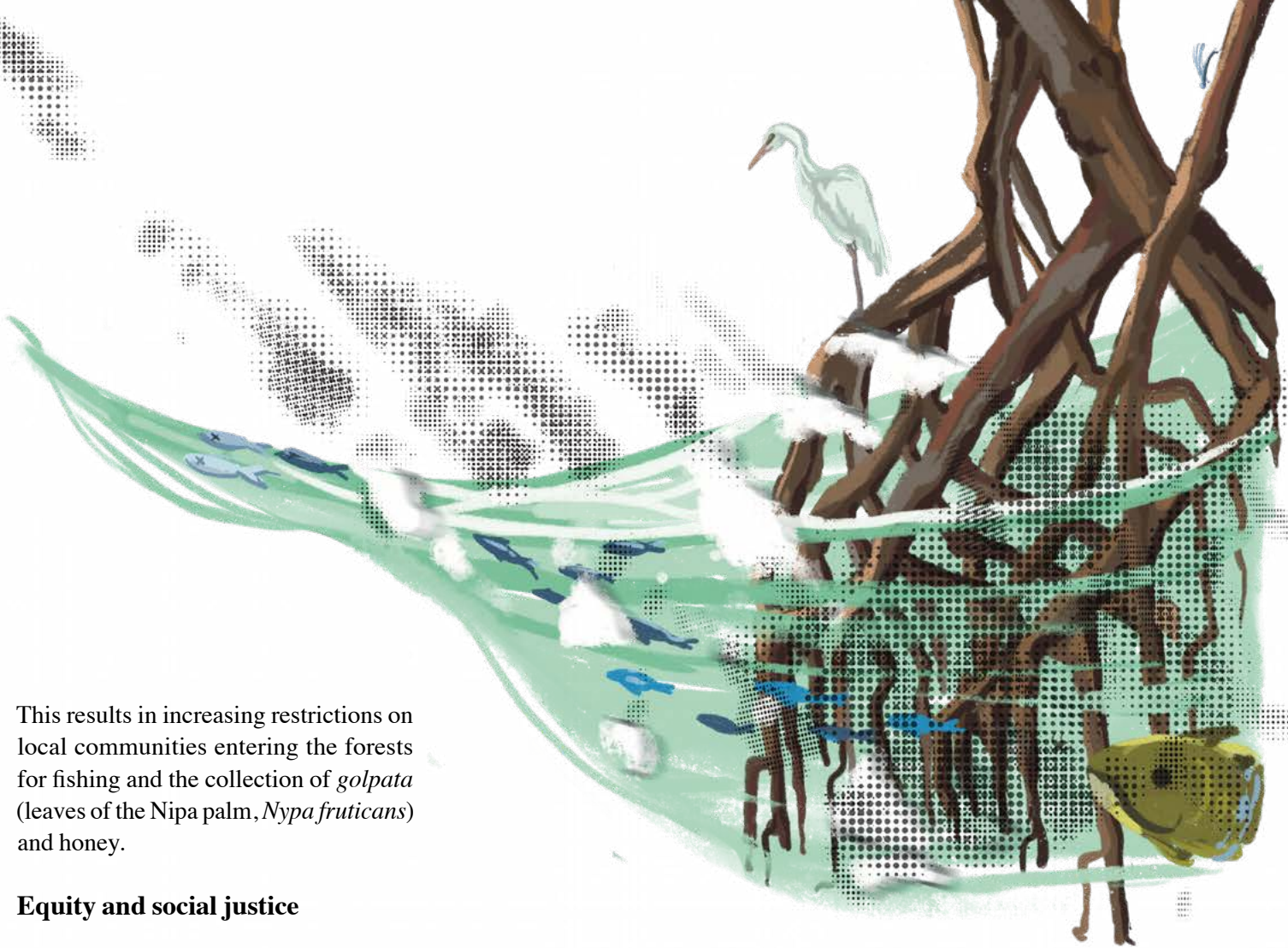
The financialisation of ecosystem services, especially of aggregate carbon values through the carbon market, is one of the dominant pathways to promoting climate action. The product value chain approach with a buyer-centric market system is plagued with competing interests and power imbalances in favour of buyers and system facilitators, and is characterised by misuse by actors who are not the stewards of the blue carbon resources. Markets are also unclear about the true valuation of co-benefits such as coastal protection, disaster proofing, and local livelihoods associated with blue carbon systems.

“Carbon tunnel vision” also limits the capacity to design and deliver cross-sectional climate action with a holistic view of biodiversity conservation, habitat protection, human rights, and well-being considerations. It deepens the trap of scientific, sectoral decision-making which at times lies at cross-purposes with other dimensions of climate adaptation and mitigation action.

There has also been a growing interest in formulating legal mechanisms that commodify, monetise, maximise, and merchandise the marine environment’s carbon sequestration services, as well as a justified growing concern over these proposals. There are plenty of incidents where this reductionist view of climate action is generating serious social-ecological consequences. And while there is a great thrust on geo-engineering climate solutions in marine spaces, the impacts on coastal systems such as fisheries, seagrass areas, and mangrove forests are yet to be evaluated.

Greenwashing is quite common in the absence of appropriate mechanisms for proper valuation of blue carbon resources, including its co-benefits. In their 2024 study, Achakulwisut et al. state emphatically that it is time to move beyond the “carbon tunnel vision” demonstrated in widespread greenwashing through so-called carbon neutral oil and gas projects. Their scholarship highlighted the serious negative impacts of these projects on biodiversity, fisheries and blue carbon habitats, alongside the violation of human rights in Latin America, Africa, and North America.

Similarly, there is ample evidence of forest fishers in the Sundarbans facing “double marginalisation” from fortress conservation in marine protected areas, accentuated by extractive blue carbon projects.



This results in increasing restrictions on local communities entering the forests for fishing and the collection of *golpata* (leaves of the Nipa palm, *Nypa fruticans*) and honey.

Equity and social justice

Blue carbon ecosystems are spread across areas where coastal communities, small-scale fishers and Indigenous Peoples live. These diverse peoples directly rely on these resources for livelihoods, food and nutritional security, and well-being. These systems are where different land and aquatic resource tenures/rights intersect and underpin the sustenance of global aquatic food systems. Despite a proclaimed ‘focus on social equity’ as part of broader Blue Economy discourse, much of the attention on blue carbon and the ocean (or blue) economy currently focuses on aspects of economic viability, ecological sustainability, and technological innovation. There is little attention given to issues of **procedural, distributional and recognitional justice**². At worst, it represents an expansion of green colonialism.

accessing areas). In fact, none of this guidance even acknowledges **transformation rights** (the ability to change the land—area and resources—so that it has a different use).

Further market mechanisms such as the long **carbon credit retirement timeframe**³, limitations of transaction length (which determines the delivery obligations placed on local communities), and ambiguity and lack of transparency in penalty clauses for protection lapse, further weaken tenure rights and tilt the power in favour of carbon market actors.

According to Global Atlas of Environmental Justice (EJAtlas), environmental defenders, especially from Indigenous and other marginalised groups, face high rates of criminalisation and physical violence across different geographies of the world. Incidents of criminalisation of non-timber forest product collection in Sundarbans, timber collection for firewood, and fishing by small-scale fishers in marine protected areas which are potential blue carbon markets, cause rising tension between traditional users of resources and blue carbon proponents.

The literature also suggests that the complexities of blue carbon ecosystems are not simple to address. Social science scholars argue that recognition of tenure in the early stage of a blue carbon project

A global scan of technical guidance documents on blue carbon markets, their governance, and investment, undertaken by a group of scholars led by Sarah Lawless, reveals a superficial consideration of tenure aspects of small-scale fishers. Of the documents they reviewed, some recognise access and management rights of the local communities to certain extent. However, very few recognise **withdrawal rights** (the right to withdraw or harvest resources within the area to which tenure extends) and **exclusion rights** (where rights-holders lawfully exclude or ban others from using certain resources and

²**Procedural justice** refers to the level of participation and inclusiveness of decision-making, and the quality of governance processes. **Distributional justice** can be defined as fairness in the distribution of benefits and harms of decisions and actions to different groups. Merely procedural and distributional justice will not serve their purpose unless combined with recognitional justice. **Recognitional justice** provides for the acknowledgement of and respect for pre-existing governance arrangements as well as the distinct rights, worldviews, knowledge, needs, livelihoods, histories, and cultures of different groups in decision-making.

³**A carbon credit retirement** timeframe refers to the period of permanent removal from the carbon registry and restriction of further circulations.

is important. However, the formalisation of tenure—unless founded on principles of deliberation, community partnership, co-production, recognition of customary and full rights to resources, and addressing historical inequalities—may not result in fair and distributional justice in favour of coastal communities and local fishers.

While procedural, distributional and recognitional justice concerns are quite evident, there are some positive examples that are more optimistic about improved community agency in the governance of blue carbon systems. For instance the Vonga Blue Forest Project in Kenya demonstrates a collaborative approach with legislation recognising community co-management and a greater appreciation of community livelihood co-benefits and biodiversity conservation. Similarly, the community-based management of seagrass and mangrove ecosystems in the Philippines, promotes blue carbon ecosystem management through traditional governance practices and the active involvement of local communities and fisherfolk associations.

Paradigm shift

The growing interest in the transformation of blue carbon ecosystems into marketable carbon assets represents a profound shift in how these resources are valued and governed. These governance transitions are not merely technical adjustments but entail significant redistribution of wealth and decision-making power. Rather, they raise fundamental questions about who controls, benefits from, and has access to coastal resources that have traditionally supported local livelihoods through fishing, tourism, and cultural practices.

Current blue carbon market frameworks exhibit significant inadequacies with their failure to appreciate complex tenure systems intersecting with formal and informal governance arrangements, and a lack of equitable benefit sharing and the persistence of the carbon tunnel

vision. The market structure often fails to account for traditional resource tenure systems and the customary rights of fishers and coastal communities. This carries the risk of disrupting existing social-ecological relationships, which often manifest as reduced food security, loss of income, cultural erosion, and even displacement from ancestral territories and increased threat to conservation.

The ethical challenges of blue carbon markets are exacerbated by power asymmetries between the global actors who design these systems and the local communities expected to implement them. There is an absolute reliance on scientific knowledge about carbon sequestration, and technical requirements for monitoring, reporting, and verification often exceeding local capacity without substantial external support. These structural inequities suggest that without significant reconfiguration, blue carbon markets risk reinforcing rather than addressing existing patterns of environmental injustice.

Like other nature-based climate solutions, blue carbon requires the transformation of social and cultural relationships—between private and public actors, local and global finance, and scientific and other knowledge systems. There is a need to move beyond superficial community engagement to concrete actionable approaches. Common phrases include “establishing partnerships”, “improving community knowledge”, and “undertaking stakeholder engagement”—terms that lack specificity regarding implementation mechanisms, power-sharing arrangements, or measurable outcomes.

The shift in market behaviour and blue carbon governance requires institutional innovation and policy reform. The academic and policy communities must also address the disconnect between blue carbon initiatives and the substantial body of knowledge on community-based natural resource management developed over decades. Effective engagement strategies should draw on proven approaches from related fields, such as community forestry, co-managed fisheries, and Indigenous conservation territories, rather than treating blue carbon as an entirely novel domain requiring new engagement paradigms.

Sisir Kanta Pradhan, PhD, is an academic practitioner with expertise in climate, resource governance and tenure issues, working across South Asia and Africa with over 28 years of experience.

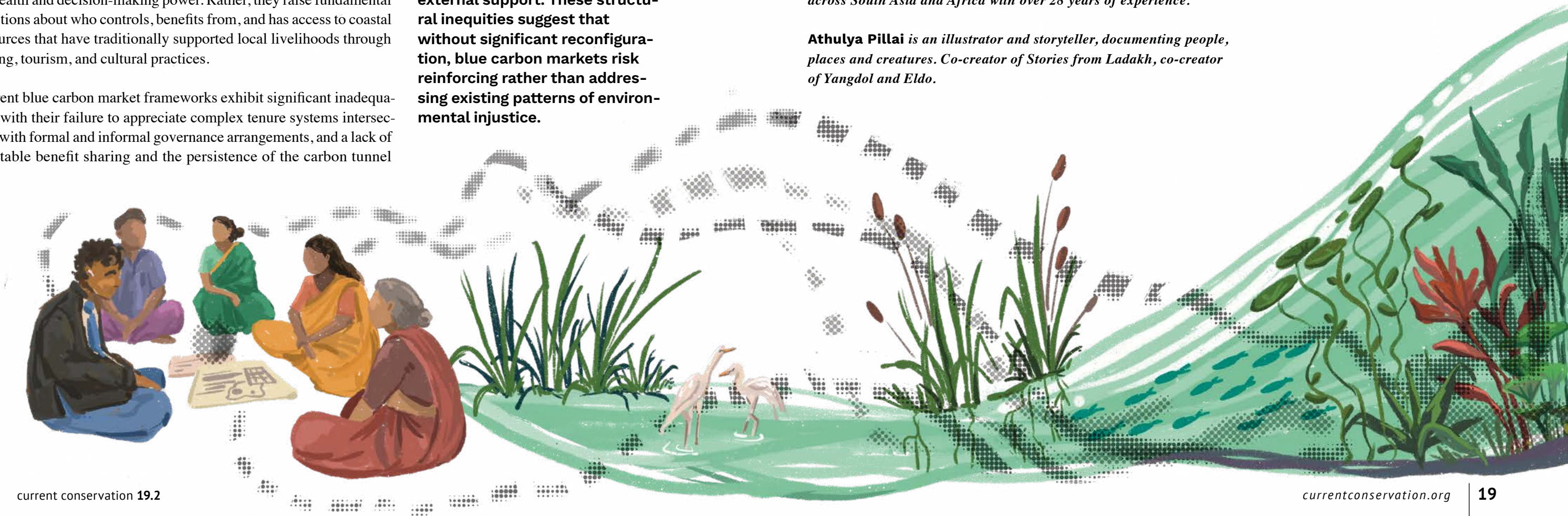
Athulya Pillai is an illustrator and storyteller, documenting people, places and creatures. Co-creator of *Stories from Ladakh*, co-creator of *Yangdol and Eldo*.

Further Reading

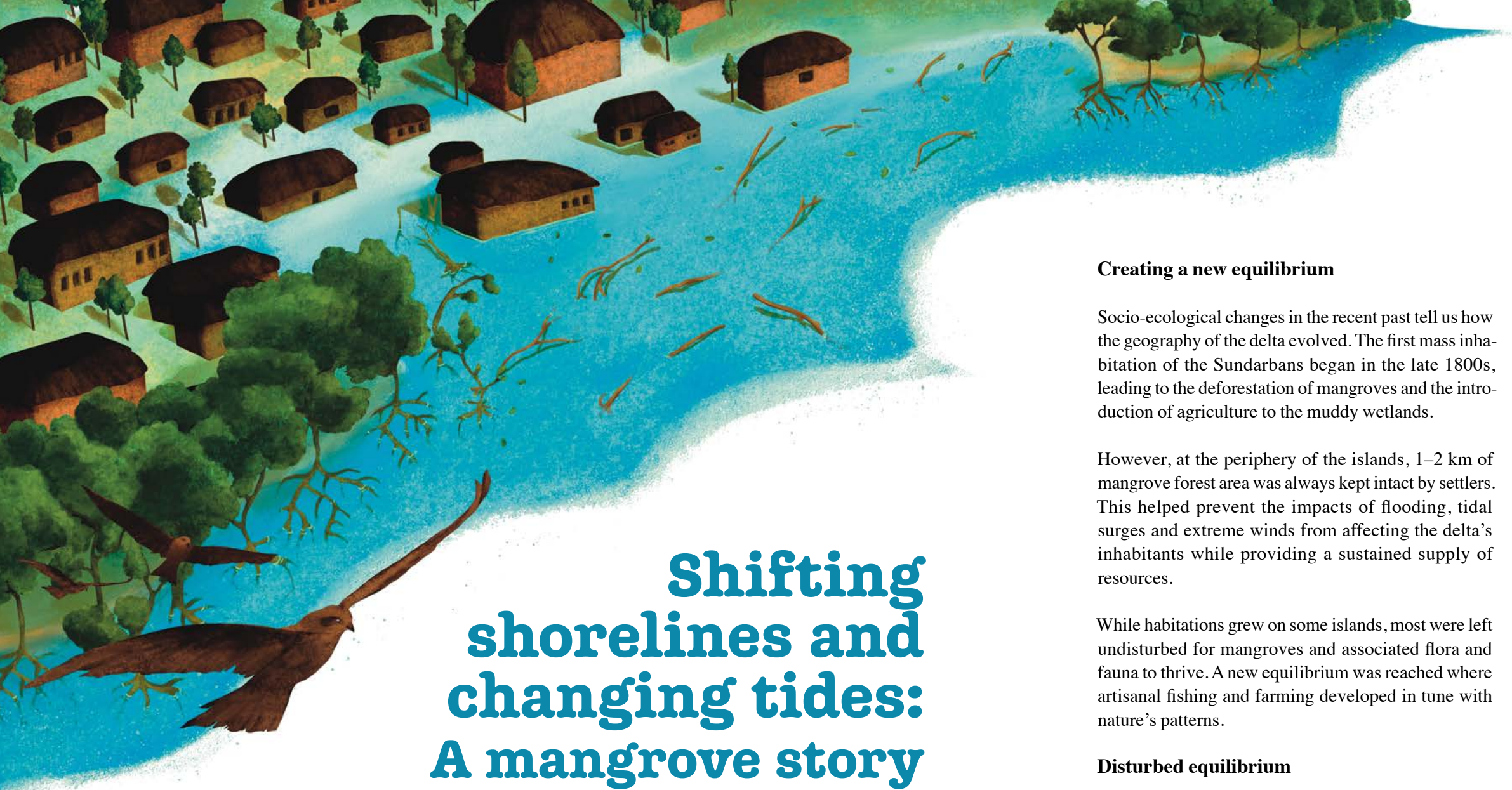
Achakulwisut, P., P. C. Almeida and E. Arond. 2022. It's time to move beyond “carbon tunnel vision”. *SEI Perspectives*. <https://www.sei.org/perspectives/move-beyond-carbon-tunnel-vision>. Accessed on April 25, 2025.

Atchison, J., R. Foster and J. Bell-James. 2024. Blue carbon as just transition? A structured literature review. *Global Sustainability* 7: e27. <https://doi.org/10.1017/sus.2024.24>.

Vierros, M. 2017. Communities and blue carbon: the role of traditional management systems in providing benefits for carbon storage, biodiversity conservation and livelihoods. *Climatic Change* 140(1): 89–100. <https://doi.org/10.1007/s10584-013-0920-3>.







Shifting shorelines and changing tides: A mangrove story

Author **Radhika Bhargava Gajre**

Illustrator **Pooja Sreenivasan**

**“Ekul bhangе okul gore,
Eta nodir khela”
(One side erodes, one side grows,
that is the river’s play)**

These lines about the Bengal Delta, penned by the renowned Bangla poet Kazi Nazrul Islam, play in my mind as I walk on a mud-paved path along the salty and turbid Matla River, overlooking mangroves on one side and a flooded village on the other.

The fluvial-tidal Bengal Delta is where the 10,000-km² expanse of the Sundarbans mangrove forest comprising about 250 islands is located, straddling India and Bangladesh. The delta was formed by the erosion and accretion of a rich load of sediments brought by the Ganga, Brahmaputra, and Meghna Rivers originating in the Himalayas.

The delta shaped by these sediments is home to the largest contiguous mangrove forest, full of rich biodiversity and endemic species like the Ganges river dolphin (*Platanista gangetica gangetica*), the northern river terrapin (*Batagur baska*), and the only mangrove forest to host a tiger (*Panthera tigris tigris*). The sediments settling in the Bengal Delta and those flowing out to the Bay of Bengal and into the Indian Ocean tell us about the Sundarbans’ past, present, and future.

Creating a new equilibrium

Socio-ecological changes in the recent past tell us how the geography of the delta evolved. The first mass inhabitation of the Sundarbans began in the late 1800s, leading to the deforestation of mangroves and the introduction of agriculture to the muddy wetlands.

However, at the periphery of the islands, 1–2 km of mangrove forest area was always kept intact by settlers. This helped prevent the impacts of flooding, tidal surges and extreme winds from affecting the delta’s inhabitants while providing a sustained supply of resources.

While habitations grew on some islands, most were left undisturbed for mangroves and associated flora and fauna to thrive. A new equilibrium was reached where artisanal fishing and farming developed in tune with nature’s patterns.

Disturbed equilibrium

The equilibrium of periodic erosion and accretion that Kazi Nazrul Islam recited in his poem, and that early settlers learned to live with, is now disturbed by a combination of new anthropogenic activities. Despite strict forest protection since the 1950s and being tagged as a World Heritage Site, the Sundarbans are witnessing widespread environmental degradation from maritime transportation (for industrial raw material, fishing, and tourism), upstream dams, and a range of industrial factories in its midst.

Maritime transportation causes changes in river hydrology and creates wave wake, which increases erosion and pressures on biodiversity due to noise and water pollution. This has led to mangroves—coastal protectors, key actors in climate change mitigation, and environmental regulators—losing their ability to withstand change and its impacts.

Mangroves are known to be adaptable and resilient. These abilities helped them grow in a harsh tidal environment and adapt to salt water and frequent inundation. Mangroves in the Sundarbans found a rhythm to dance to—the balanced beats of erosion and accretion; until it was disrupted by human interventions that interfered with the sedimentation processes. Once disturbed, mangroves started losing ground. The mangrove area decreased with increasing erosion and lack of sediment settlement where new mangroves could grow.

My doctoral research showed that since 1985, the Sundarbans have lost about 137 km² of forests due to shoreline erosion alone. Additionally, increased erosion led to changes in species composition, altered biophysical characteristics, and increased vulnerability to extreme weather impacts. Today, shoreline erosion is also the second largest cause of mangrove loss globally, following deforestation for commodities. A combination of loss of mangrove cover, ecosystem degradation, and ongoing anthropogenic impacts on sedimentation has led to a reduced protective function of mangroves in the Sundarbans.

The islands’ geography responded to this disturbed equilibrium. The 1–2 km buffer of mangroves around the islands no longer existed. Coastlines exposed to the river, like the mud-paved path I walked on, became commonplace. Houses, ponds, and farmland no longer had the protection of mangroves; they were now directly exposed to the muddy river.

“We were better off. It was only after the land loss that things turned out this way. With passing generations, we are losing prosperity. We do not have much left. We are scared that one day when we have nowhere to go, we will erode just like our motherland,” said one coastal dweller and fisher in Fokirkona, Bangladesh, back in 2021.

The mud-paved path was created, repaired, and sustained using mangrove mud by the villagers for many decades. Recently, cement, stones, and bricks replaced mangrove mud, in the name of coastal protection.



But these new materials contrast with the geography of the delta. In the muddy, wet and mangrove-rich Sundarbans, they could not withstand the impact of the sea and winds or match the rhythm of the tides, and eventually collapsed.

However, as they collapsed, they caused flooding of the islands and took away farmland, ponds, front yards, and parts of or whole houses with them. The cement embankments are the new age coastal adaptations, first designed in the Netherlands, for the Netherlands' geography. Whether or not these embankments protected the Dutch coastlines, they are now being popularly marketed and funded by international NGOs to be deployed in coastal West Bengal and Bangladesh as "climate change adaptation measures".

Climate change adaptation is supposed to be a response that ameliorates or safeguards one from experiencing the harmful impacts of climate change. To call the cement embankments this is flawed from many angles.

First, blaming an intangible notion like climate change for the recent disequilibrium hides the impact caused by locally-induced human pressures, and creates a sense of dystopia. Second, selling 'solutions' that not only fail to protect shorelines, but actually increase vulnerability while decreasing the resilience of both people and nature, should be termed a 'maladaptation'.

Living in disequilibrium

I was also curious to know why the concrete embankment, which fails to protect the shorelines and causes flooding, land loss, and transportation disruption, continues to be rebuilt. The repeated rebuilding has become the favoured measure of "coastal adaptation" for several actors. While the funding to support livelihoods and disaster risk reduction in a poverty-stricken and disaster-prone area is sorely lacking, funding for such maladaptive structures keeps flowing.

Take the case of Hemnagar, bordering India and Bangladesh along the Raimangal River, where multiple cycles

of embankment construction, collapse, and reconstruction has rendered the majority of its population landless. The locals recognise the shortcomings of the embankments. However, their reliance on these maladaptive structures for sustenance is increasing.

For instance, Sheena *didi*, a resident of Hemnagar, has lost her house, farmland, and ponds to multiple cycles of embankments. Mangrove restoration is not a solution, as the changed ecogeomorphology of the coastline will not support mangrove plantations. Now that the current embankment is in shambles, she faces frequent flooding even in the dry season. With the next bout of embankment reconstruction, she awaits a further loss of even her small, thatched-roof shack, right next to the embankment. The locals understand the fleeting presence of these so-called 'hard' structures. Still, in lieu of a preparedness plan or support for one, the landless villagers have no choice but to rely on the unfulfilled promise of embankments.

One solution does not fit all

Mangrove shorelines are dynamic, and environmental stressors impact different parts of the shoreline differently based on their histories. Considering the different characteristics of the shoreline that I studied, I concluded that the adaptation to mangrove shoreline erosion needs to align with the shoreline's geography or physical characteristics. Not addressing the root causes of mangrove shoreline erosion, the biophysical processes along the shoreline, or the socio-political aspects of shoreline protection, will result in failed adaptations and trigger a negative feedback loop that exacerbates poor resilience of the shoreline and shoreline-dwelling communities.

In the case of the Sundarbans, I realised that the coastal adaptation initially designed for the Netherlands failed to provide support and triggered a rebounding feedback loop, triggering further damage and altering the local ecogeography. Although the near future of the coastlines in the Sundarbans is uncertain, with sound mangrove restoration, management and protection, the shorelines in the Sundarbans can still be made resilient. Upon sharing my research and scoping for solutions with the local villagers in India and Bangladesh, they responded in unison: "Our Shorelines, Our Solution."

Coastal adaptations must be customised to specificities of shorelines, including local socio-economic factors. The inhabited villages where mangroves are present should be protected, the villages where mud embankments are present should be fortified with mangrove restoration. For shorelines where embankments have been introduced, extensive support for increasing disaster preparedness and the overall resilience of the local communities should be a priority. Finally, on the uninhabited islands, mangroves should be left undisturbed and protected.

Mangroves have an inherent ability to protect coastlines, adapt to changes and mitigate climate change. With intentional, ethical, and inclusive management, the equilibrium in the Sundarbans can be restored. Such that, one day, the locals would recite Kazi's poem, not as satire but in admiration of their local geography.

Further Reading

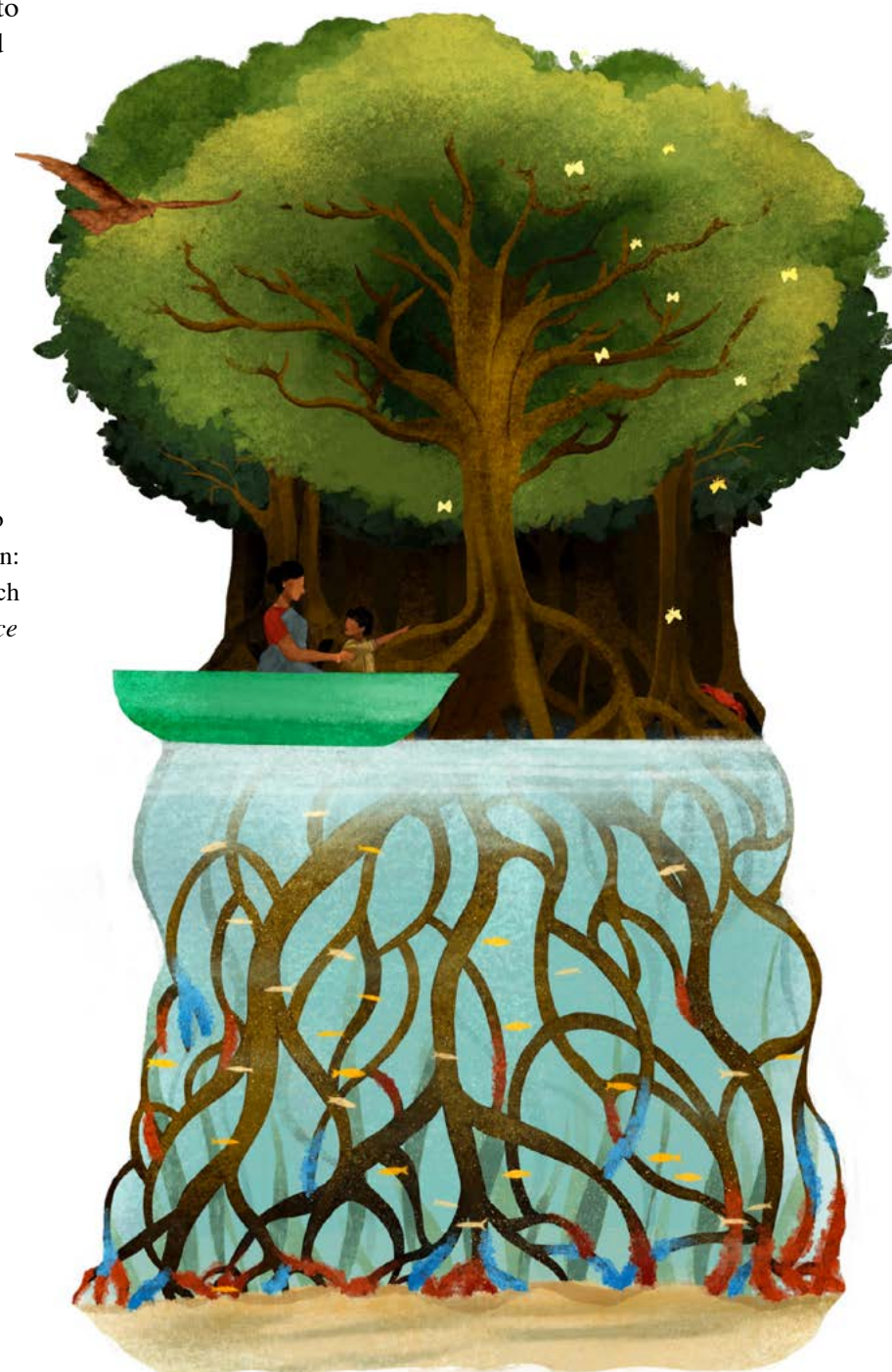
Bhargava, R., D. Sarkar and D. A. Friess. 2021. A cloud computing-based approach to mapping mangrove erosion and progradation: Case studies from the Sundarbans and French Guiana. *Estuarine, Coastal and Shelf Science* 248: 106798. <https://doi.org/10.1016/j.ecss.2020.106798>.

Bhargava, R. and D. A. Friess. 2022. Previous shoreline dynamics determine future susceptibility to cyclone impact in the Sundarban mangrove forest. *Frontiers in Marine Science* 9: 814577. <https://doi.org/10.3389/fmars.2022.814577>.

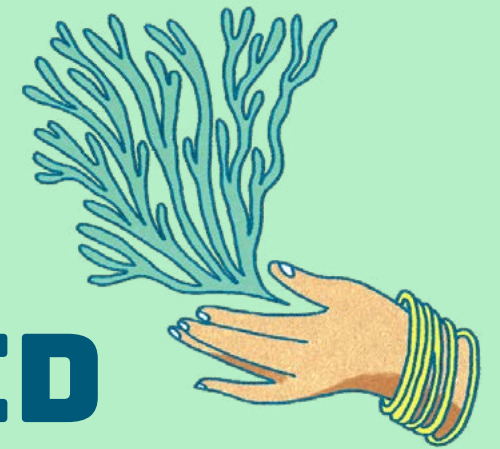
Dewan, C. 2021. *Misreading the Bengal Delta: Climate change, development, and livelihoods in coastal Bangladesh*. Seattle: University of Washington Press.

Radhika Bhargava Gajre is a transdisciplinary coastal geographer working on climate change adaptation and mitigation from a geospatial, social, and physical science angle.

Pooja Sreenivasan is a Bangalore-based artist and illustrator. Her work captures surreal experiences of life, filled with the subtleties of emotion we feel but often forget.



BETWEEN THE SEA AND THE WEED



Authors **Surya Prabha K. and Sunil D. Santha**
Illustrator **Hitesh Sonar**

Commercial seaweed farming is the new oceanic frontier in the blue economy era. Marine plants like seaweed have great potential in combating global warming and climate change by sequestering carbon and restoring ecosystems. Seaweed absorbs carbon dioxide through photosynthesis, and its cultivation can sequester up to 1,500 tons of carbon dioxide per km² annually.

Seaweed also contributes to long-term blue carbon storage when decomposed or buried in sediments. While an increase in atmospheric carbon dioxide could lead to ocean acidification, seaweeds can mitigate its impact by using carbon dioxide for growth, helping to stabilize pH levels. Furthermore, seaweed farms create habitats for marine life, enhance biodiversity, and help mitigate coastal erosion, thereby strengthening resilience against climate change.

Underwater farms

Estimates from the Food and Agriculture Organisation of the United Nations show that approximately 35.8 million tonnes of world algae production (including seaweeds and microalgae) was contributed by 54 countries/territories, with 97 percent of the output coming from cultivation. While China, Indonesia, Korea, Japan, and the Philippines have emerged as lead players in commercial seaweed cultivation in Asia, African countries along the western Indian Ocean, such as Tanzania, Kenya, Madagascar, Mozambique, and Mauritius, are also known for seaweed production.

In India, Gujarat and Tamil Nadu coasts are known for their seaweed diversity and abundance. Abundant seaweed beds are also found along the coasts of Mumbai, Ratnagiri, Goa, Karwar, Varkala, Vizhinjam, Pulicat, and Chilika. Studies show that there is high scope for scaling up commercial seaweed farming on the coasts of Karnataka, Maharashtra, Goa, Kerala, Lakshadweep, Andhra Pradesh, Odisha, and West Bengal.

The Tamil Nadu coast—particularly the Gulf of Mannar and Palk Bay—is a rich biodiversity hotspot for seaweed. In the context of declining fish production and uncertainties in fisheries-based livelihoods, commercial seaweed farming is an alternative livelihood source for many small-scale fishing families along Tuticorin and other parts of the Coromandel Coast, and more specifically along the Gulf of Mannar Biosphere Reserve on the southern coast of India.

Documents published by the Central Salt and Marine Chemicals Research Institute (CSMCRI) and oral histories with local communities show that PepsiCo entered into a formal agreement with CSMCRI for developing seaweed farming technology in 2000.

The pilot project commenced in February 2001, when the state government granted PepsiCo access to 1 km of waterfront for seaweed cultivation in Munaikkadu, in the Ramnad district of Tamil Nadu.

By 2003, the project expanded its scope through the test trial of 100 floating bamboo rafts for cultivating elkhorn sea moss (*Kappaphycus alvarezii*)¹. At the same time, the project began to endorse contract farming involving local community members and self-help groups. After the tsunami in 2004, seaweed farming was envisaged as a key strategy to rehabilitate tsunami-affected fishers in the southern districts of Tamil Nadu.

Today, firms like AquAgri, Sea6 Energy, and Pssgt Nextgen Export Company are the key competitors in the seaweed value chain. Some of these firms also engaged in socially innovative processes such as registering fishers, providing them seedlings on credit, and deducting costs from earnings. In collaboration with institutions such as CSMCRI, these firms offer training and capacity-building programmes to seaweed farmers to boost production and deal with emergent crisis situations such as extreme weather events or pest attacks. Through the analysis of narratives and life stories of selected fishers-turned-seaweed farmers located in the outskirts of Tuticorin city, we can understand the impacts of the new materials and ideas around seaweed in shaping their everyday lives. We interviewed 15 fishers-turned-seaweed farmers and observed their daily livelihood practices closely.

Fishers to farmers

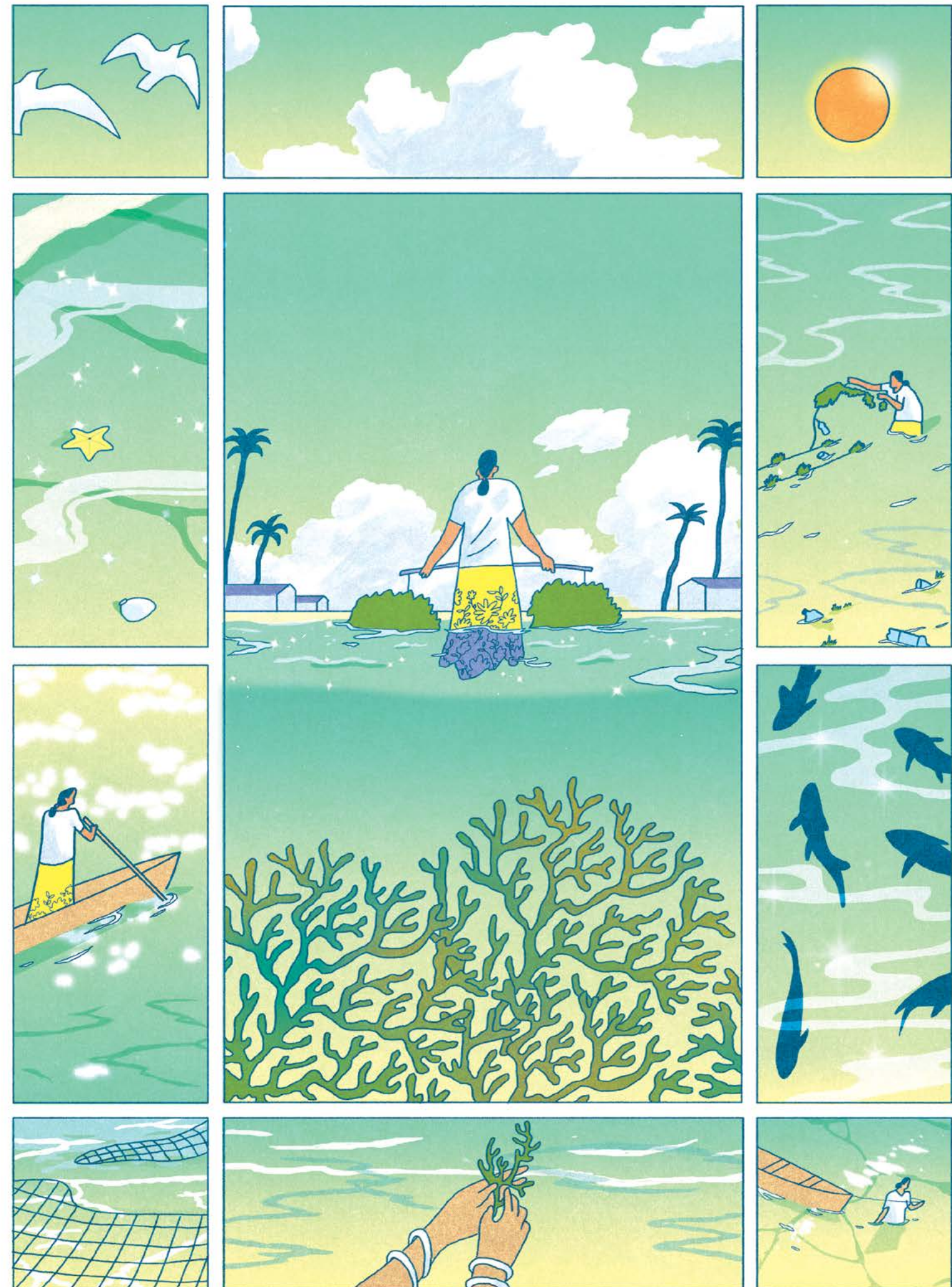
Born into families of fishers, the people we spoke to relate to the ocean based on the knowledge shared by their elders and others who are intimately familiar with the ocean. The nature-culture entanglements reflected in terms of their knowledge, relationships, and livelihood practices with the ocean inspire these people to hope for, take risks, and engage persistently with an entrepreneurial spirit. For Murugan, a middle-aged fisher-turned-farmer, the ocean is an encyclopedia that we need to closely observe and peruse to enable sustainable living. “If the wind blows in the right direction, the rains arrive on time, and if the waves remain calm, then we can succeed in seaweed farming.”

For Ajitha, a 32-year-old woman, seaweed farming as a livelihood opportunity emerged when her father shifted from fishing to seaweed farming. In her view, it is the tides that ensure the sustenance of all beings—for aquatic organisms in the sea and people on land. She observes that it is a pure business enterprise for private firms. Nevertheless, for her, it is a means of survival and another way of forging connections with the ocean and her late father. She continues, “The sea has provided for my family, and I have devoted my life for them (sea, seaweed, and family).” For some people, “the sea is their lifeline, companion, and teacher”; for others, the sea is more than a livelihood asset, “a spiritual connection linked to our existence”.

The last two decades have been difficult for these fishers, as there has been a considerable decline in fish catch due to factors such as overexploitation, ocean warming, and extreme weather events. Recalling days of both plentiful catch and empty nets, they say, “Fishing these days has become like gambling. As fish stocks declined, some of us ventured into selling fish in the retail market, but we failed, and losses mounted. A few others shifted to clam collection. During that time, CSMCRI introduced us to seaweed farming, which in a sense became our last hope.”

Gradually, they set up their seaweed farm using inputs such as seeds, ropes, and plastic bottles. Also, they were excited to learn new things about the seaweed. As fisher-turned-farmer Thangapandi remarks, “I have been fortunate to observe how different species grow in various locations. It is fascinating to learn how nature operates.” Nonetheless, they had to endure the harsh sun, confront the unpredictable sea, and adapt to newer farming techniques.

¹*Kappaphycus alvarezii* is a tropical red alga native to the Indo-Pacific region. Much has been written about the invasive characteristics of this species, which is known for its rapid growth, high adaptability, and ability to outcompete native organisms. While *K. alvarezii* is the commercial variety of seaweed cultivated in the farms, native varieties of *Gracilaria edulis* and *Sargassum* species are also collected from the ocean.



In their own words, “Seaweed farming requires patience and precision. We tie fresh seeds to ropes with plastic bottles and lay them in the water. After 25-30 days, we harvest. It sounds simple, but nature decides everything,” referring to the rough seas, unpredictable rains, and fluctuating temperatures. Due to strong winds and fungal infestations in the raft (a shell-type fungi, which fishers locally call as *kotrasi*), they had to shift from bamboo rafts to the monoline method. They also tried the tube method without much success. Thangapandi says, “It is not just about planting and harvesting. You must continuously monitor tides, check for pests, and always be alert for sudden weather changes.”

For women like Selvi, work starts before sunrise, managing their household and workers. Selvi is a homemaker and businesswoman, managing finances and ensuring fair prices for the fish catch her husband brings to the harbour. Though her husband is an experienced fisher, he struggles with numbers. “My husband goes fishing but does not know math or accounting,” she says. “So, I handle the auction at the harbour.” She ties seaweed, prepares meals, and oversees farming during the seaweed planting season. “If there is no work on our plot, I go elsewhere,” she said. According to her, seaweed farming has provided some financial security. “The money we get is higher than from fishing,” she noted.

Combined earnings range between INR 20,000–25,000 (USD 236–295) a month. Entrepreneurs like Murugan have invested in a machine to process seaweed into liquid fertilizer, expanding their market reach to Gujarat. “With the machine, I now earn about INR 80,000 (USD 945) a month. I never imagined this when I struggled with fishing,” he proudly added. However, Murugan is among the few successful seaweed farmers in the community, while many others are still struggling to establish a secure livelihood base.

Not all rosy

Ocean warming and climate change fuel uncertainties such as the quick spoilage of seaweed. Fishers also note, “The heat in this area has always been high, but it has increased recently. Some fish species are also no longer found here.” Unlike earlier days, weather prediction remains difficult despite technological advances. Further, the fishers observe that the trends to intensify seaweed production throughout the year depletes the reefs by depriving them of their nutrient supply.

Some fishers remark that seaweed farming can only be a supplementary income and cannot replace fisheries as a primary source of livelihood. Earlier, while they were into full-time fishing, community solidarity enabled fishers on this coast to navigate crises together. However, with the diversification into seaweed farming, a sense of individualism predominantly manifests through competition and jealousy among people. Despite mutual dependence, rivalries sometimes lead to acts of sabotage, such as cutting ropes of competitors’ seaweed lines to disrupt harvests.

There are also several barriers, such as market access, pricing, and poor subsidies. Our research participants share that everyday interactions with government and private stakeholders are often complex for a community with a sense of autonomy and occupational freedom. Though private companies provide essential buy-back systems and farm inputs, these are often met with strict sanctions and expectations. Private firms control pricing and market access, constraining their opportunities to sell seaweed independently.

“It is frustrating because we do all the work but have the least control over pricing. They give us just enough to survive but not enough to thrive,” a seaweed farmer said. Buyers prefer to deal with private firms for bulk or wholesale purchases. When asked about loans and subsidies from the government, he responded bitterly, “Even fishermen struggle to get financial help. Who will think about seaweed farmers?”

To summarise, though seaweed farming has emerged as an alternative livelihood source for fishers, climate uncertainties, market barriers, and shifting community relations add new dimensions to their everyday livelihood struggles. Amidst all these challenges, they are still hopeful that the ocean will support them and take care of their needs, as she used to do before the seaweed’s arrival.

Further Reading

CSIR-CSMCRI. 2019. *Scope of seaweed farming in India*. Bhavnagar: CSIR-Central Salt and Marine Chemicals Research Institute. <http://dx.doi.org/10.13140/RG.2.2.10001.07520>.

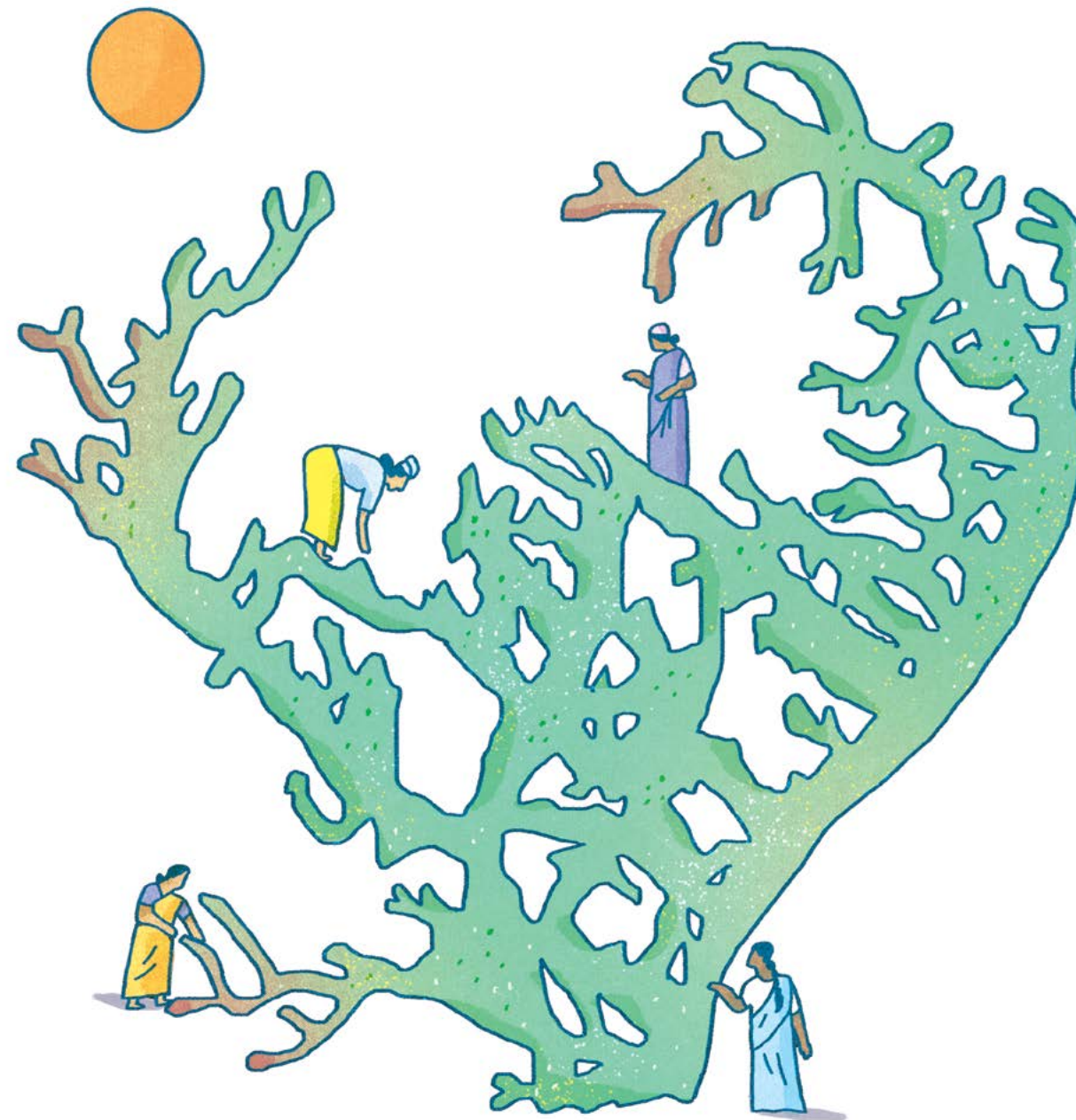
Doumeizel, V. 2023. *The seaweed revolution: How seaweed has shaped our past and can save our future*. London: Hero.

Froehlich, H. E., J. C. Afflerbach, M. Frazier and B. S. Halpern. 2019. Blue growth potential to mitigate climate change through seaweed offsetting. *Current Biology* 29(18): 3087–3093.e3. <https://doi.org/10.1016/j.cub.2019.07.041>.

Surya Prabha K. is an aspiring social worker and researcher passionate about exploring marinescapes and narratives rooted in lived experiences. She is a student at the Centre for Livelihoods and Social Innovation, Tata Institute of Social Sciences (TISS), Mumbai.

Sunil D. Santha is a distinguished academic and social work educator at TISS Mumbai. His work focuses on sustainable livelihoods and climate change adaptation.

Hitesh Sonar is an illustrator and graphic artist from Mumbai. He has worked on various projects from book illustrations, magazines, to editorial illustrations and animation backgrounds.



On the vanishing shore

Author **Pavitra Vasudevan**
Photographers **K. Nagamma and Ch. Pratima**
English translation **K. Bhawna**

The end of the road to old Podampeta leads to an abandoned house that opens directly onto the ocean—as you cling to the empty door frame. Old Podampeta was once a small fishing village on the eastern coast of India. And this is just one house among three lanes of derelict houses along an eroded stretch of coastline, which have collapsed from strong tidal action and coastal erosion over the past two decades. After 2007, most families in Podampeta were relocated to settlements further inland, one of which is known as New Podampeta.

This dilapidated house on which I’m perched, located in the Ganjam district of Odisha, has the best view. At different times of the day, you can see the setting sun, *dungis* (traditional fishing boats) dotting the water or fisherfolk going to cast their nets.

During our fieldwork in Ganjam, my colleagues Bhawna, Pratima, Nagamma, Lalita, Gauri, and I often discuss the dynamic shores we walk. Our conversations intertwine personal histories, the changes that seem to be the only constant, and the mental health impacts of a changing climate.

These discussions weave threads of hope, loss, grief, and small everyday acts of resistance that we witness in the Noliya caste—a large community that fishes across the open shores of southern Odisha and Andhra Pradesh.

As I look beyond the broken window in this house, I reflect on how mental health and climate change are interconnected in ways that may not be immediately obvious. Both share the same invisible threats—the kind that creeps in without warning and disrupts lives. They also exacerbate social, political, and economic marginalisation, resulting in poverty, unemployment, migration, and hoarding of power by the powerful.

One of the most significant challenges prevailing in both these discourses is their Eurocentric, expert-led ideology that often neglects the nuanced, complex lived realities of the people who are most affected. This approach tends to focus on scientific theories and solutions, sidelining traditional ecological knowledge and everyday experiences. However, our fieldwork revealed how the people of these stories and shores, who live with the daily threat of climate impacts, have their ways of coping and responding.

In our conversations, we asked ourselves how to shift away from this dominant, pathologising, doomsday narrative and focus on the lived experiences of people facing uncertain futures. One expression we heard repeatedly in Ganjam was “*Samudram mamalni thinesshundi*” (the sea will eat us). Even in the face of this impending crisis, we continue to witness small, quiet acts of persistence, community cohesion, resilience, hope, and adaptation. These actions, although not grand or heroic, can be powerful responses towards the preservation of the ‘self’ in the face of distress, and we bring to you some of the narratives that have made it possible for hope and grief to coexist.

I wish to see the sea every day

“We used to see the sea when we woke up, when we used to live in old Podampeta. Ever since the place was consumed by the sea, we have had to move. We do not see the sea in the morning, and I think of those days when we woke up to her.

“Even the fishermen, irrespective of whether they go fishing or not, want to go and see the ocean. There might be days when the catch is bad or good, but they go. Things have changed; there is no place to play. I keep worrying about not being able to see the sea. There is a belief that as long as we see the sea, nothing will happen to us.”

– Hadi, a resident of Ganjam



To contain her fury

“Once, the Neelamma temple stood at a safe distance from the shore, a sacred space where the fishers gathered and prayed before they ventured into the sea. Their prayers are carried by the wind, their faith as deep as the ocean itself. We believe Neelamma contains anger, and her presence is a shield held against the fury of the sea.

“But the sea, restless and relentless in her mood, slowly swallowed the temple many years ago. The land beneath our prayers disappeared, as it did with the erosion. Our people refused to let their goddess be lost to the waves. We rebuilt her shrine—this time, standing at the edge of the waters, face-to-face with the ocean’s mood. Now Neelamma does not retreat. She stands guard, watching, listening with the fishers—calming the sea whenever it rises in anger.”

– Ramudu, an elderly fisherman



Searching the fading shores

“There was a time when *nalilu* (mole crabs *Emerita asiatica*) were everywhere, scattered across the shore, slipping between waves. Children chased them with delight, their hands scooping them up. Fisherfolk used them for bait, and families cooked them into meals—they were abundant.

“But now, the *nalilu* are gone. The shoreline has shifted, the sea has changed, and with it, they are difficult to find. Very few of them dart between the waves. The loss is not just of *nalilu*, but of familiarity, of a way of life slipping away like the tide. Still, we search. Even if it takes longer, even if we find fewer.”

– Lokanatha, a young fisher, and Ganesh, a young coastal dweller



Scorched in the heat

“During the summer months, it is not easy to be on the beach. Drying fish is not for a single person. We usually take turns with the buying, processing, and vending. We also take turns to rest. When one of us is sick, the profits are still shared with them. We don't usually leave any women from the group—we share everything: profits, burdens, and work.”

– Mangamma, an old dry-fish processor

In the dunes

“The dunes were more than a playground in our childhood. They protected us from big cyclones and the eroding shores. We are alive today because some of them stood in the way of these changes. They held back the sea, slowed the erosion, and protected the land we call home. But now, look around—there is nothing left. The children still come to play, but the ground beneath them has changed. We ask for walls to be built and casuarina trees to be replanted to weather the storms.”

– Nachimi, a coastal dweller



Holding on

The first time I (Pavitra) visited Arjipalli — another village in the Ganjam district—a young woman had died by suicide, and sorrow hung thick in the air. Many hushed stories were shared as the cause, but the intertwined truth was never to be found. The village felt heavy, the kind of quiet that follows grief settling into every corner.

We walked to the edge of the road, where the dunes rose gently against the shoreline dotted with *Purbapurasalu gudi* (temples for the fisher-folks' ancestors and family deities). I was told that before setting out to sea, the fishers come there, praying for safe passage and for their knowledge to stay sharp when the waters test them.

And in that oppressive air, we found a thread of belief—something to steady us for the daunting voyage ahead. At that moment, standing together in the face of invisible but deeply felt distress was enough. Enough to remind us we weren't alone, enough to make space for grief, and enough to begin thinking of ways forward.

Pavitra Vasudevan is a mental health professional, and **K. Bhawna** is a public health professional. They work with Dakshin Foundation, India, at the intersection of mental health, environment and resilience.

K. Nagamma and Ch. Pratima are photographer-storytellers from Ganjam, Odisha. They are former Coastal Grassroots Fellows, and they document marine fishing lives focused on climate and development stories.

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10



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The geopolitics of climate change in the Indian Ocean Region

Authors **Dhanasree Jayaram and Haritha S. Narayanan**

Illustrator **Ipsa Jain**

The Indian Ocean Region (IOR), spanning from the east coast of Africa to the west coast of Australia, contains around 36 countries and a population of approximately 2.5 billion. The IOR has been a critical crossroads of international trade for centuries and remains so. The security and stability of its shipping lanes and trade routes—passing through the Straits of Hormuz, Bab el-Mandeb, and Malacca, among others—are not only regional issues but issues of global importance.

However, aside from its economic and geopolitical significance, the IOR is confronted with an intensifying environmental and climate crisis, with geopolitical and geoeconomic implications. The Indian Ocean is warming faster than any other ocean globally, leading to sea level rise and extreme weather-related disasters.

Increasing pollution levels, ecological catastrophes, and the mounting effects of climate change are increasingly entwining the fates of Indian Ocean states. These common challenges risk destabilising the region's ecological balance and future prosperity, necessitating immediate concerted action and creative solutions.

Climate impacts

The Indian Ocean is estimated to be warming between 1.7 and 3.8°C, faster than what is anticipated. If greenhouse gases (such

as carbon dioxide and methane) are not rapidly decreased, the ocean may continue to warm at an unprecedented and accelerated rate for the rest of the century. Changes in the Asian monsoon circulation and rainfall and marine ecosystems are among the main risks and vulnerabilities brought on by climate change.

Other risks and vulnerabilities include increased intensity of tropical cyclones, inundation of low-lying coastal areas, shoreline erosion, and saltwater intrusion, and degradation of coral reefs and fisheries due to acidification. These effects pose serious threats to livelihoods, as well as to economic, food, and health security.

Rising sea levels threaten the very existence and statehood of low-lying islands such as the Maldives and Mauritius, while coastal erosion and saltwater intrusion endanger agriculture and freshwater resources in most countries in the region. Climate vulnerabilities are driving displacement and migration, as communities lose livelihoods and homes, particularly in coastal areas. In Bangladesh, for instance, displaced communities are increasingly moving to cities, straining urban resources and infrastructure.

Already existing geopolitical tensions—such as fishing disputes owing to fisherfolk transgressing extraterritorial waters, and illegal, unregulated, and unreported fishing—could be further exacerbated by climate change-induced depletion and/or migration of fish stocks. On the geoeconomic front, climate change-induced disasters could damage critical infrastructure such as ports, energy installations, and telecommunications along the coasts, thereby affecting trade, supply chains, and economies.

Not all IOR countries are prepared enough to implement carbon markets that are increasingly becoming a global norm in trade and commerce, as evidenced by the European Union's Carbon Border Adjustment Mechanism. This presents a fresh set of structural, material, and institutional challenges for these countries.

Climate-induced land loss from rising sea levels and coastal erosion could strain overall maritime governance, by affecting existing maritime boundaries and Exclusive Economic Zones—an area of the ocean, generally extending 200 nautical miles beyond a nation's territorial sea, within which a coastal nation has jurisdiction over natural resources.

The risks posed to coastal critical infrastructure call for increased investments in resilience and adaptation that will require global and regional cooperation. However, this may also result in increased geopolitical and geoeconomic competition between major powers that could use climate change as an instrument to create influence in the region's climate-vulnerable countries.

For example, under the China-Indian Ocean Region Forum on Development Cooperation, China proposes to launch the China-Indian Ocean Region Disaster Prevention and Mitigation Alliance and a climate information and early warning system project, among others. It is also gradually considering ramping up investments in renewable energy

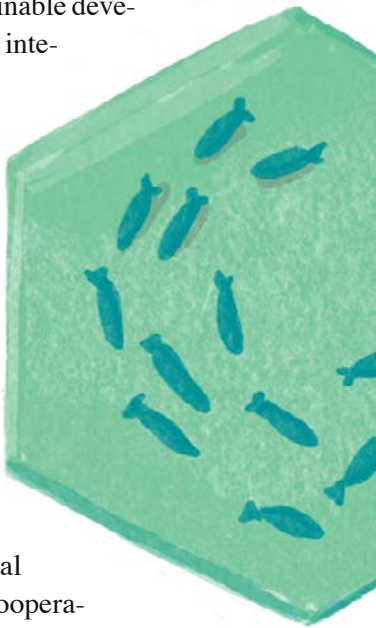
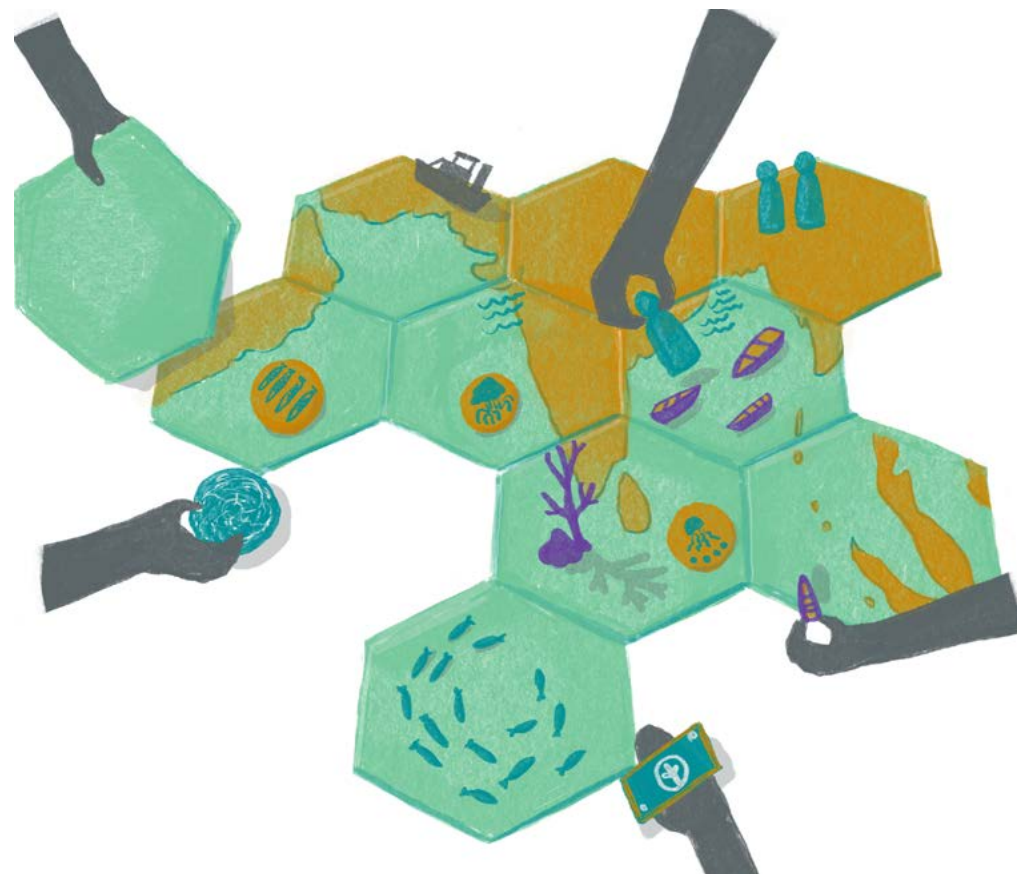
projects in countries such as the Maldives and Bangladesh. India is also looking to enhance its clean energy partnerships with its IOR neighbours, including Sri Lanka and Mauritius.

India's role in regional cooperation

As a key player in the region, India can lead efforts in climate diplomacy, fostering cooperation to protect shared resources and ensure a stable, sustainable future. The country's Security and Growth for All in the Region (SAGAR) vision prioritises climate resilience, ocean governance, and disaster preparedness. It aims to build littoral countries' capabilities aligning with SAGAR's principle of promoting sustainable development and deeper regional integration through joint efforts. However, there are gaps in infrastructure modernisation (like ports), regional connectivity, and execution (due to lack of financial and infrastructural resources).

Similarly, India is one of the leading nations in the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), which has identified climate change and environment as a key sector of cooperation. India is the lead country for the security sector that also features energy and disaster management as sub-sectors. These are closely intertwined with climate change risks and action, which provides ample scope for designing and implementing collaborative solutions that are not necessarily restricted to military-to-military cooperation alone, with India having already spearheaded many initiatives such as the Indian Navy-led Humanitarian Assistance and Disaster Relief (HADR) operations and exercises.

Apart from leading BIMSTEC Disaster Management Exercises in 2017 and 2020 and a tri-services





HADR exercise in 2021, the Indian National Centre for Ocean Information Services provides cyclone forecasts and tsunami alerts to other countries in the Bay of Bengal region, enhancing regional capacity to respond to disasters.

The Indian Ocean Rim Association (IORA) is another platform which promotes regional cooperation on security, trade, disaster resilience, and sustainable development. With 23 member states and 11 Dialogue Partners, the platform consists of many countries that are highly vulnerable to climate change. India's initiatives within IORA include championing the blue economy,

renewable energy, capacity building, marine biodiversity conservation, and climate resilience. India is expected to take over as its next chair in 2025, as the IORA commemorates its 28th anniversary. The country will focus on addressing key concerns related to resource constraints, ocean governance, and disaster risk reduction.

Despite the existence of these regional organisations committed to climate action, there are several gaps in implementation. Many of them have a fragmented and siloed approach towards climate action. For instance, in BIMSTEC, disaster management falls under the security sector with India as the lead, whereas other issues concerning climate impacts and action fall under the Environment and Climate Change Sector, of which Bhutan is the lead. For effective climate action and disaster risk reduction, these two sectors require effective coordination.

Even when institutional mechanisms are in place, bilateral differences, political and/or economic turmoil/instability, project delays and cost overruns, mutual disparities in sharing the burdens of climate action, and the lack of

reliable and sustainable financial channels impede effective climate cooperation. It is important for any regional organisation to have a joint assessment of vulnerabilities and requirements in order to attract the right type of funding for the most urgent climate concerns.

One of the ways in which India is looking to fill the financial and technological gap is to engage in diverse models such as triangular cooperation that can enhance climate action by enabling cost-effective and context-specific technology and knowledge transfer to developing countries while leveraging industrialised countries' institutional, technical, and financial capabilities. This is particularly being promoted through multilateral platforms such as the International Solar Alliance and Coalition for Disaster Resilient Infrastructure for advancing the solar sector and enhancing disaster resilience, respectively. These platforms can be leveraged to boost regional cooperation in the Indian Ocean Region as well, considering there is a huge gap in realising their goals due to regional fragmentation.

The IOR is a theatre of geopolitical, geoeconomic, and geostrategic competition, marked by large military presence and regional fragility. Amidst these tensions, climate cooperation under frameworks such as SAGAR, BIMSTEC, and IORA is the way forward. India's efforts to project itself as the voice of the Global South would be significantly boosted by more regional climate initiatives in its maritime neighbourhood.

Dhanasree Jayaram is a Senior Assistant Professor, and **Haritha S. Narayanan** is a PhD candidate. They work at the Department of Geopolitics and International Relations, Manipal Academy of Higher Education, India.

Ipsa Jain is a scientist turned science communicator. She makes images, zines and books about science and society. She experiments with paper, data, education, and communities.

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