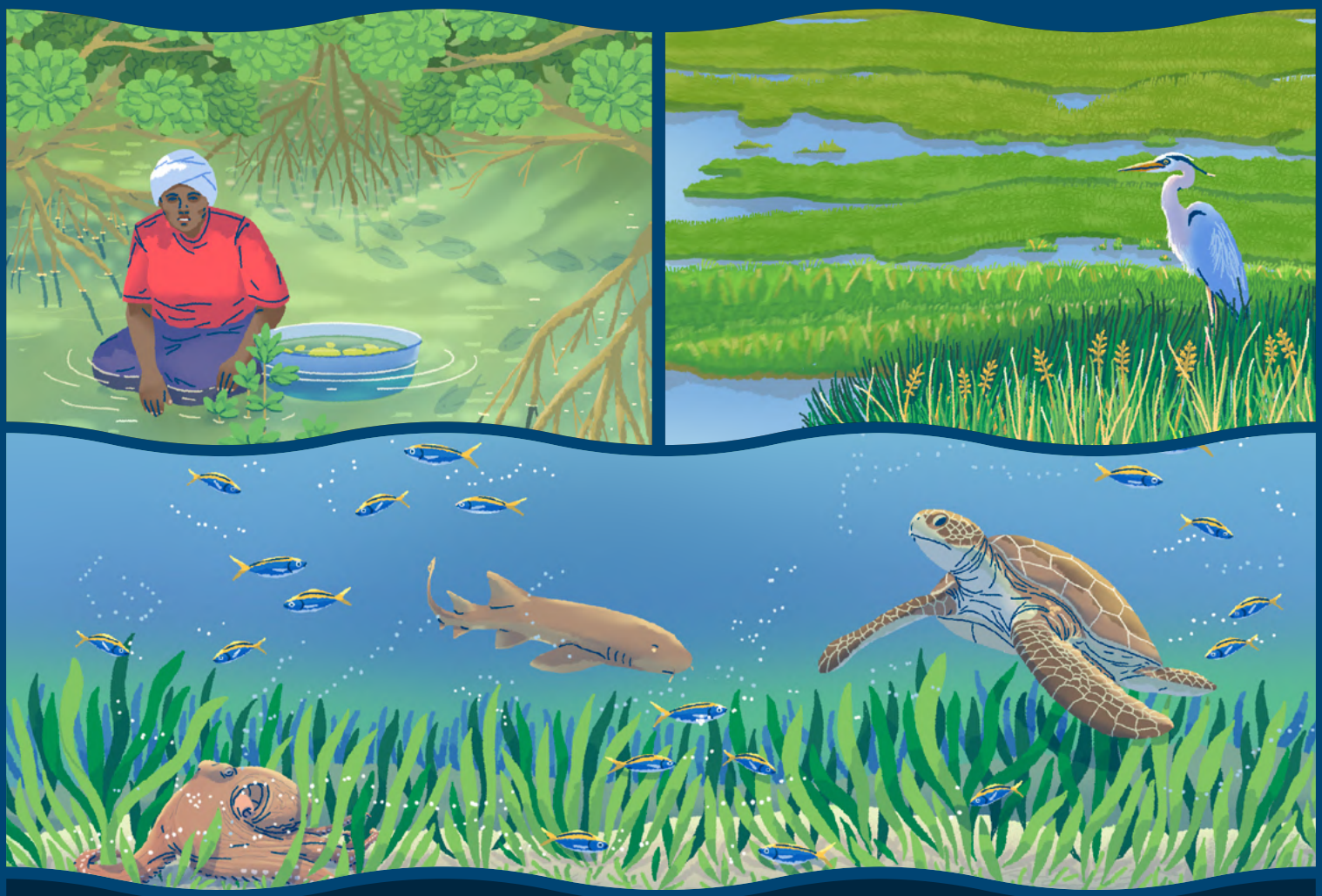

UNLOCKING BLUE CARBON DEVELOPMENT

INVESTMENT READINESS FRAMEWORK FOR GOVERNMENTS

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The finding, interpretations, and conclusions expressed in this document are those of the authors and do not necessarily reflect the view of the Executive Director of the World Bank, the governments they represent, or the counterparts consulted during the study process. Any factual errors are the responsibility of the team.

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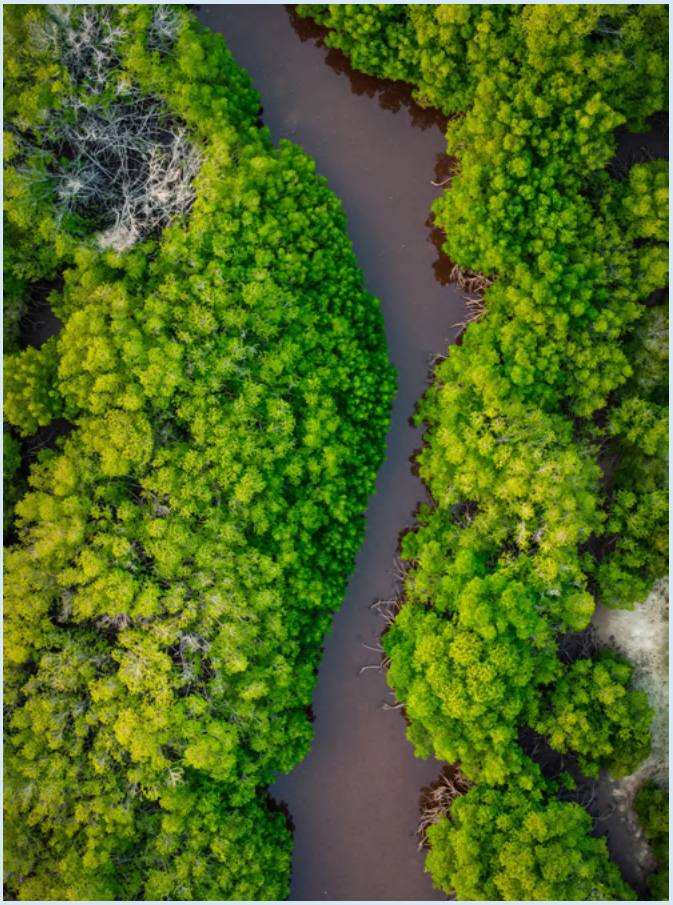
Abbreviations

ACMI	Africa Carbon Markets Initiative
ACR	American Carbon Registry
AFOLU	agriculture, forestry, and land use
ARR	afforestation, reforestation, and revegetation
BCAF	Blue Carbon Accelerator Fund
BC	Blue Carbon
BCE	Blue Carbon ecosystem
BNCFF	Blue Natural Capital Financing Facility
CAR	Climate Action Reserve
CBD	Convention on Biological Diversity
CCB	Climate, Community, and Biodiversity Standard
CDM	Clean Development Mechanism
CO_2	carbon dioxide
COP	Conference of the Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CPF	Country Partnership Framework
CPI	Climate Policy Institute
CSA	climate smart agriculture
CVF	Climate Vulnerable Forum
CWON	Changing Wealth of Nations
CZMAI	Coastal Zone Management Authority and Institute
DOE	designated operational entity
EAFM	ecosystems approach to fisheries management
EEZ	exclusive economic zone
EIA	environmental impact assessment
EnABLE	Enhancing Access to Benefits while Lowering Emissions
ENACT	Enhancing Nature-based Solutions for Climate Transformation Initiative
ERPA	emissions reduction purchase agreement
ESL	extreme sea-level
EU ETS	European Emissions Trading Scheme
FAO	Food and Agriculture Organization
FCLP	Forest and Climate Leaders' Partnership
FCPF	Forest Carbon Partnership Facility
FREL	forest reference emissions levels
G7	International Group of Seven
GBF	Kunming-Montreal Global Biodiversity Framework
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	greenhouse gas
GIZ	German Agency for International Cooperation
GMA	Global Mangrove Alliance
GMW	Global Mangrove Watch
GS4GG	Gold Standard for the Global Goals
IBRD	International Bank for Reconstruction and Development
ICAO	International Civil Aviation Organization
ICZM	integrated coastal zone management
IPCC	Intergovernmental Panel on Climate Change
IPLC	indigenous peoples and local communities
IUCN	International Union for Conservation of Nature
LEAF	Lowering Emissions by Accelerating Forest Finance
LOI	letters of intent
LULUCF	land use, land-use change, and forestry
ha^{-1}	per hectare
km^2	square kilometers
MOA	memorandum of agreement
MPA	marine protected area
MRV	measuring, reporting and verification
NBSAP	National Biodiversity Strategy and Action Plan
NDC	Nationally Determined Contribution
NGO	non-governmental organization
ODA	official development assistance
OECD	Organization for Economic Co-operation and Development
Pg	petagram (1015g)
PES	payment for ecosystem services
PFP	project finance for permanence
RBCF	results-based carbon finance
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SBTi	Science-Based Target Initiative
SCALE	Scaling Climate Action by Lowering Emissions
SD VISta	Sustainable Development Verified Impact Standard
SDG	Sustainable Development Goals
SIDS	small island developing states
TASA	Turneffe Atoll Sustainability Association
tCO_2e/tCO_2eq	tons of carbon dioxide equivalent
Tg	teragrams (1012g)
UN REDD	United Nations Collaborative Initiative on Reducing Emissions from Deforestation and Forest Degradation
UNEA	United Nations Environment Assembly
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
VCMI	Voluntary Carbon Market Integrity Initiative
VCS	Verified Carbon Standard
VM0007	REDD+ Methodology Framework
VM0033	Methodology for Tidal Wetland and Seagrass Restoration
WMB	We Mean Business Coalition
WWF	World Wildlife Fund

Preface: Blue Carbon as an Opportunity

The role of coastal ecosystems in climate change mitigation has inspired the concept of Blue Carbon markets, where projects restoring or conserving these ecosystems generate "credits" based on the tonnes of carbon captured and stored.

The credits are then sold to global buyers such as businesses that want to offset their own carbon emissions or, alternatively, seek a contribution to climate mitigation beyond a claim of climate neutrality, resulting in a variation of the carbon credit framework - Blue Carbon finance. It establishes markets to buy and sell emission credits, generating financial incentives for preserving and restoring the underlying coastal natural assets. These projects are helping countries and companies meet climate change commitments, by reducing greenhouse gas emissions while safeguarding the marine environment.



Propelling Blue Carbon to its full potential in support of countries' blue economy efforts, however, will require further steps to foster investment readiness and attract the public and private capital that the projects need. These require a comprehensive framework of conditions that enable successful carbon investing, including more precise and reliable measuring, as well as reporting and verifying of carbon dioxide equivalents and better accounting. Recent climate COPs have highlighted the urgency of accelerating climate change mitigation efforts which includes expanding climate credit finance. This urgency has been recognized by the WBG through various upstream analytics and capacity building, including the recent complementary IFC report "Deep Blue", which focuses on the role that private investment plays in facilitating mitigation efforts.

Through the Blue Carbon Readiness report, the WBG is supporting the development of a practical framework to guide Bank client countries and their governments in catalyzing and scaling up public and private sector investment in coastal Blue Carbon. The WBG in supporting client readiness to catalyze and bring coastal Blue Carbon to the scale needed recognizes many challenges still exist. Many of the

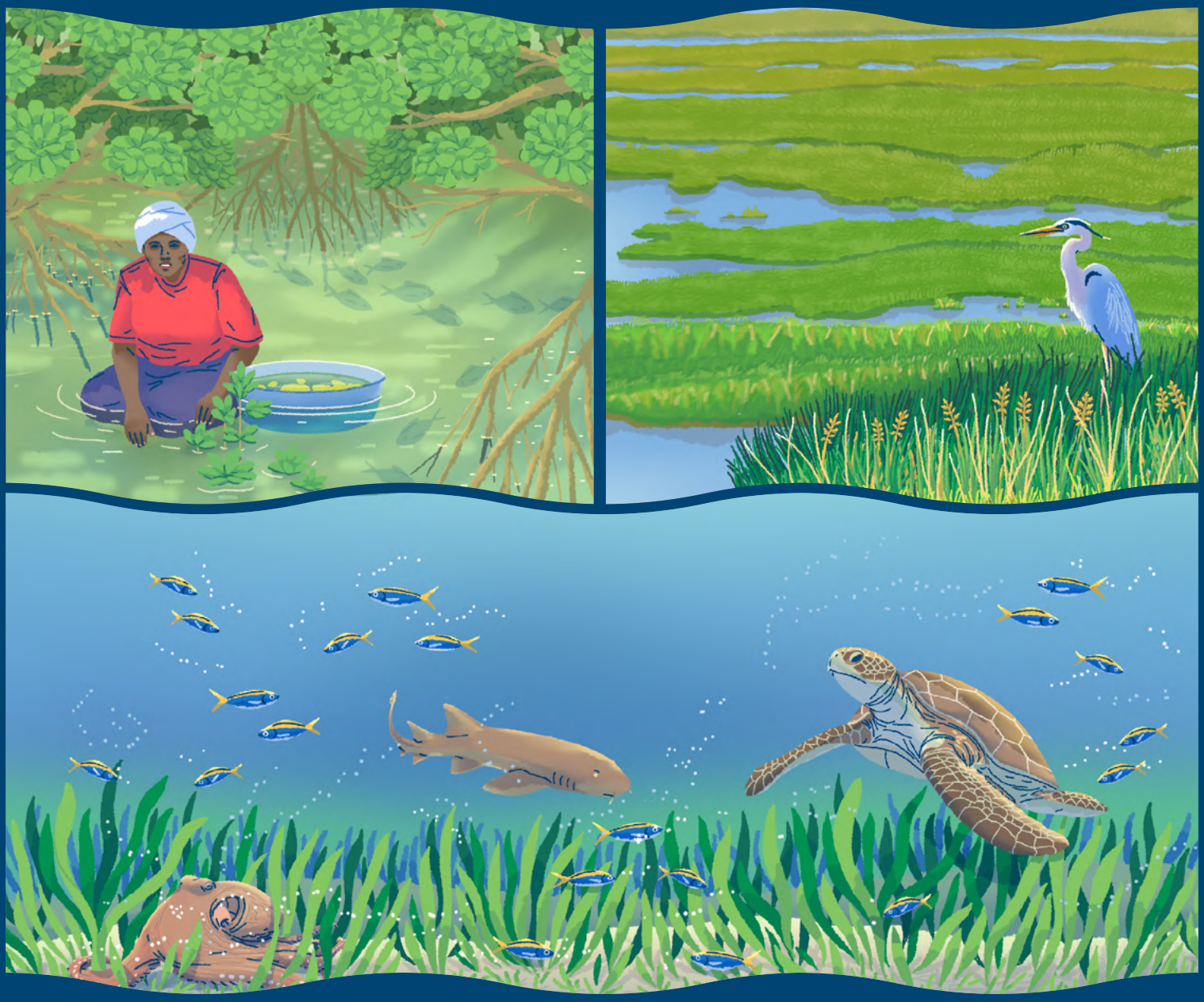
world's natural coastal assets, especially mangrove, seagrasses, and salt and tidal marshes are very efficient at sequestering carbon in the biomass and in the soil and have a vital role in mitigating climate change. Yet there are many areas where these critical ecosystems are being degraded or destroyed by development, logging, and pollution, globally average coverage is declining 1 to 3 percent annually. These losses also result in more carbon released into the atmosphere, driving temperature rise and climate change. The degradation and loss of mangroves, seagrasses, and tidal marshes is also preventing these ecosystems from continuing to absorb and store carbon.

Enhancing these coastal ecosystems has benefits beyond the sequestering of carbon, including reduction in flooding and erosion, storm protection, increased food security, improved livelihoods for women and indigenous groups, and biodiversity maintenance and improvement. The many co-benefits mean that Blue Carbon financing initiatives can bolster multiple sectors, including tourism, fisheries, and energy, and therefore reduce poverty in emerging economies.

The WBG's experience in developing innovative and emerging finance instruments, makes it the ideal institution to describe the conditions needed to catalyze and scale up Blue Carbon. The WBG's experience in deploying concessional and non-concessional finance and structuring blended mechanisms for nature and climate change, provides many lessons learned for client countries wanting to generate finance for the Blue Economy. The parametric insurance scheme to protect small-scale fishers from climate events in the Caribbean can be a model for developing novel insurance models that benefit from the natural coastal protection provided by BCEs. The WBG anticipates through this report to generate greater uptake of Blue Carbon investments, which will enhance global public goods related to climate, and biodiversity benefits.

The report is intended for government services and for cross-sectoral attention within government structures. While its focus is on promoting Blue Carbon readiness and identifying pathways for action and funding from all sources, especially the private sector, it is not an investment guide for the private sector, or an assessment of the exact place Blue Carbon interventions hold within the field of private investment for nature. Instead, the authors hope that this report encourages governments to identify with the Blue Carbon cause and promote it in key areas of knowledge, policy, and finance.

This report was commissioned by the World Bank with financial support from PROBLUE, an umbrella multi-donor trust fund administered by the World Bank that supports the sustainable and integrated development of marine and coastal resources in healthy oceans.



Executive Summary

The purpose of this paper is to provide a practical framework to guide governments in catalyzing and scaling up public and private investment in Blue Carbon as part of their blue economy development.

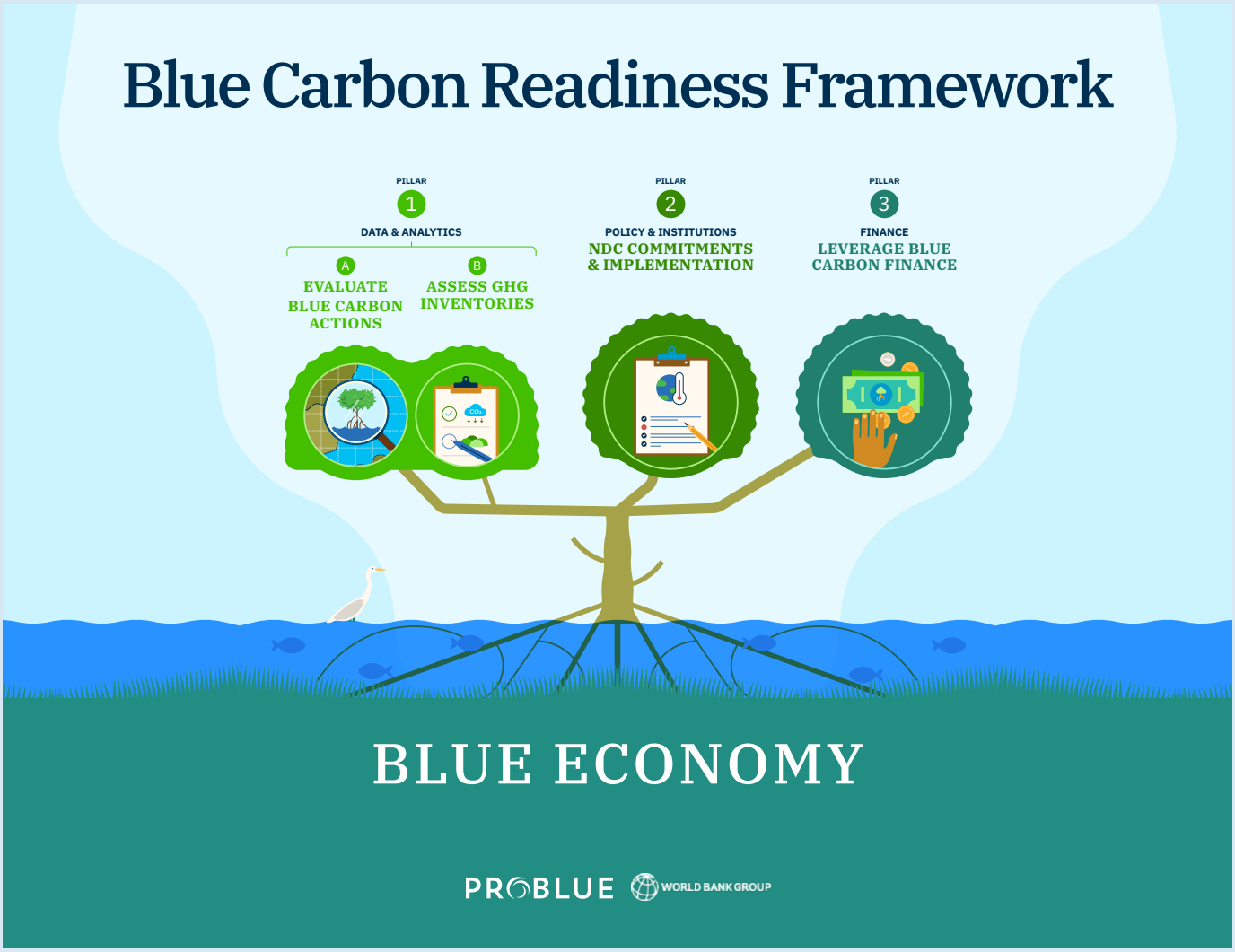
It does this by describing in detail a Blue Carbon Readiness Framework, a step-by-step, well-illustrated guide with simple checklists. Client countries can use the illustrations and checklists to determine their readiness to catalyze and scale up investment in blue carbon credit finance. The Blue Carbon Readiness Framework consists of three pillars:

Pillar 1 : **Data and Analytics**

Pillar 2 : **Policy and Institutions**

Pillar 3 : **Finance**

Figure 1 The Blue Carbon Readiness Framework consists of three pillars



"The first chapter, Scientific Basis for Action on Blue Carbon Ecosystems (Pillar 1)" focuses on the latest scientific knowledge providing the impetus for action.

It includes a comprehensive description of the ecosystem services provided by BCEs and the rationale for the actionable status of established BCEs (mangroves, seagrass beds, and wetlands) as well as emerging BCEs. The first section describes the ecological, economic, and social importance of BCE services, especially for sequestering carbon. It also highlights the threats and drivers of degradation and discusses recent trends to address degradation and restore these ecosystems. This section also provides the basis for evaluating blue carbon actions and for assessing GHG inventories within the readiness framework.

Mangroves, seagrass beds, and coastal wetlands are part of the established wetlands inventory category for reporting requirements to the United Nations Framework Convention on Climate Change (UNFCCC) and are eligible for blue carbon credit schemes. Some marine ecosystems, such as kelp beds and mudflats, are progressing towards becoming actionable for reporting to the UNFCCC, ultimately within a carbon credit scheme. Others, such as coral reefs, oyster reefs, and marine fauna are currently considered non-actionable. A lack of scientific information on these BCEs is limiting and constraining their actionability and inclusion.

Blue carbon investments are among the most effective climate solutions available. Restoring one hectare of mangrove forest has, on average, a mitigation output more than five times higher than that of a similar area of restored terrestrial forest. Seagrass restoration compares to terrestrial restoration at a factor of 3:1, and seagrass conservation at a factor of almost 2:1. For saltmarsh interventions (restoration and conservation), the ratio is almost 2:1.

Restoration and conservation are two widely used practices to capitalize on the potential of blue carbon as a means of addressing and preventing degradation. The established and emerging BCEs provide a multitude of ecosystem services, from flood protection to fish nurseries, which add to the carbon sequestration value. Expressed in monetary terms, carbon sequestration and storage by mangrove, salt marsh, and seagrass ecosystems has been valued at roughly US$ 190 billion per year (about $ 580 per person in the US) in terms of global blue carbon wealth.

Coastal ecosystem degradation threatens the prospects of realizing the significant potential of the three key BCEs. Over 50 percent of the world's original salt marshes were lost during the twentieth century. As much as 35 percent of mangroves were lost due deforestation in the 1980s and 1990s, and researchers estimate that 25 percent of total global seagrass beds have been lost. Often upland and seaward drivers of degradation are linked, compounding the intensity and effects of BCEs losses.

Efforts over recent decades demonstrate that degradation can be addressed and prevented through restoration and conservation efforts in emerging and industrialized countries. These efforts require substantial financial resources that depend on the scale, scope, and nature of the needed efforts. In many cases, however, BCE restoration is relatively less expensive than engineering works. Funding these efforts requires public and private sector financing, with blue carbon credit markets as one source of finance.

The second chapter, "Building a Policy and Institutional Environment for Blue Carbon (Pillar 2)," provides policy anchor points for client countries to set objectives and pathways to catalyze and scale up blue carbon investments.

Each country's commitments to mitigate climate change are different. This chapter can inform decision makers on the best international policy commitments, especially the Nationally Determined Contributions (NDCs) that ground many blue carbon investments. A number of international instruments, such as the UNFCCC and Paris Agreement, include NDCs as core commitments to addressing climate change.

Many international commitments have resulted in greater inclusion of BCEs in GHG accounting. The IPCC "2013 Wetland Supplement" and its updates is an example. The supplement provides guidance to account for GHG emissions and removal of established BCEs. Conversely, it also informs or guides client countries on the GHG mitigation actions that can be included in GHG accounting. This chapter and the Readiness Framework help to show client countries how they can ensure their BCEs are included in GHG inventories and are part of the accounting process.

The Paris Agreement commitments capitalize on potential opportunities to generate co-benefits, such as meeting Sustainable Development Goals (SDGs) from blue carbon actions. Co-benefits-generation is an additional incentive to invest in blue carbon. Currently, many of the co-benefits generated are from BCE projects or projects that reduce fuel use. Emerging BCEs, as well as carbon fluxes between components of marine ecosystems, are currently not eligible for such benefits.

Governments are increasingly designing REDD+ (Reducing Emissions from Deforestation and Forest Degradation) **projects and toolkits to include mangroves. However, by restricting their REDD+ accounting to above-ground biomass only, the enormous below-ground carbon sink underlying mangroves is missed.** Including mangroves in forestry agencies can contribute to this missed opportunity. Nevertheless, the global REDD+ infrastructure provides rich models and templates for intervention that are helpful for the planning and design of blue carbon interventions.

The Convention on Biological Diversity (CBD) COP15's Kunming-Montreal Global Biodiversity Framework (GBF) vastly increased conservation and restoration targets, including for coastal and marine ecosystems, and notably for BCEs. The Framework's Special Trust Fund to support developing countries in achieving their conservation targets is an additional anchor point for client countries to invest in blue carbon. Together with other climate-change-related policy commitments and disaster-related policies such as the Sendai Framework, synergies are possible.

The third chapter, "Mobilizing Finance for Blue Carbon (Pillar 3)," provides the entry points for client countries to pursue the public and private financing needed for blue carbon investments.

This chapter reviews the different forms of financing:multilateral funding, results-based carbon finance, private philanthropy, and private finance (project development, and carbon markets).

It describes the different forms of funds within each of these finance types, the conditions to access such funds, broad eligible activities, and monitoring and reporting obligations. This Pillar describes stable investment parameters for the private sector, including with respect to carbon finance such as defining and allocating carbon rights, creating mandates for carbon trading, and presenting models for community involvement and benefit sharing. The chapter ends with an interesting discussion on trends in blue carbon pricing, opportunities for emissions trading under the Paris Agreement, and emerging financing approaches.

Chapter 4, "The Blue Carbon Readiness Framework," provides a harmonized response for governments to tap their full blue carbon potential by combining technical, institutional, regulatory, and financial aspects.

Adopting such a comprehensive response will help countries shift to a more productive and resilient Blue Economy that gives stability to natural habitats and predictability to the private sector. This chapter consists of effective illustrations, supplemented by checklists, to guide the reader through the process of assessing blue carbon readiness. The process follows a pillar-by-pillar approach, with a series of questions that guide governments on next steps or areas on which to focus actions and investments. Practical and actionable recommendations for governments are proposed to improve readiness and to help accelerate blue carbon investments.

Figure 2 Summary of Blue Carbon Readiness Framework pillars and recommendations

PILLAR 1

Data and Analytics

- **Recommendation 1:** Strengthen country capacity to develop GHG inventories for above and below-ground carbon.
- **Recommendation 2:** Promote the use of ecosystem valuation in decision making.

PILLAR 2

Policies and Institutions

- **Recommendation 3:** Strengthen existing national institutional structures, and design specific policies that facilitate the implementation of blue carbon commitments.
- **Recommendation 4:** Adopt integrated planning and a blue carbon strategy to enhance local benefits.
- **Recommendation 5:** Leverage partnerships between governments, the private sector, international financing institutions, and philanthropic organizations to help address the systemic risks stemming from BCE loss and influence global agendas.

PILLAR 3

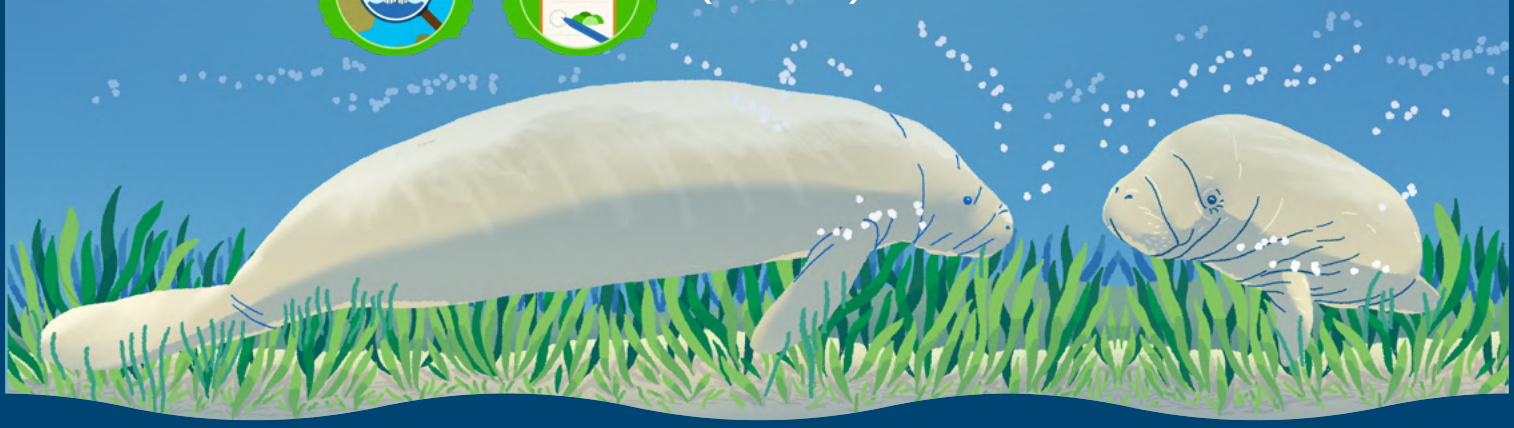
Finance

- **Recommendation 6:** Adopt a holistic approach to mobilizing finance.
- **Recommendation 7:** Access international grant funding for blue carbon readiness.
- **Recommendation 8:** Promote public-private partnerships (PPPs) for blue carbon market development.

CHAPTER

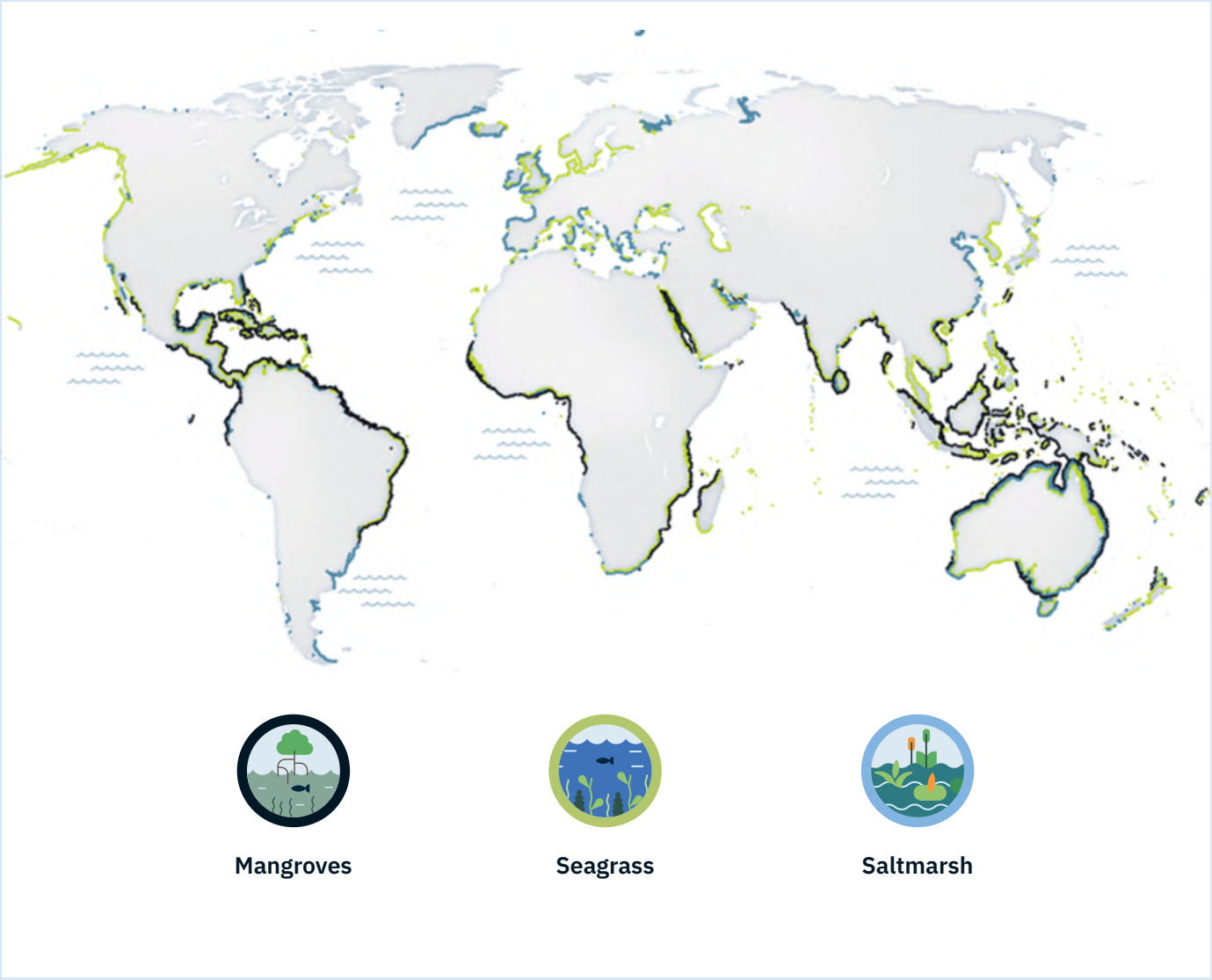
1 The Scientific Basis for Action on Blue Carbon Ecosystems

(Pillar 1)



Though their geographic extent does not rival terrestrial counterparts, coastal ecosystems store carbon at the highest rates per unit area (McLeod et al. 2011; Pendleton et al. 2012). They are **capable of capturing and burying carbon at a faster pace than tropical forests** (Duarte et al. 2021; Donato et al. 2011). Coined "blue" due to the ocean's proximity, Blue Carbon refers to the atmospheric carbon dioxide ($CO_{2)}$ captured by coastal ecosystems during growth and stored in deep soils and living plant material. When the term was introduced some 15 years ago, the aim was to raise awareness about limiting and reversing ongoing degradation of BCEs—primarily mangroves, salt marshes, and seagrass beds. Today, the term is widely used in management, scientific, and policy settings alike, to reference ecosystem services and SDGs such as climate mitigation and resilient communities (Laffoley and Grimsditch 2009; Murdiyarso et al. 2009). Blue Carbon is a global phenomenon, with all continents and climate regions boasting Blue Carbon habitats (see Figure 3).

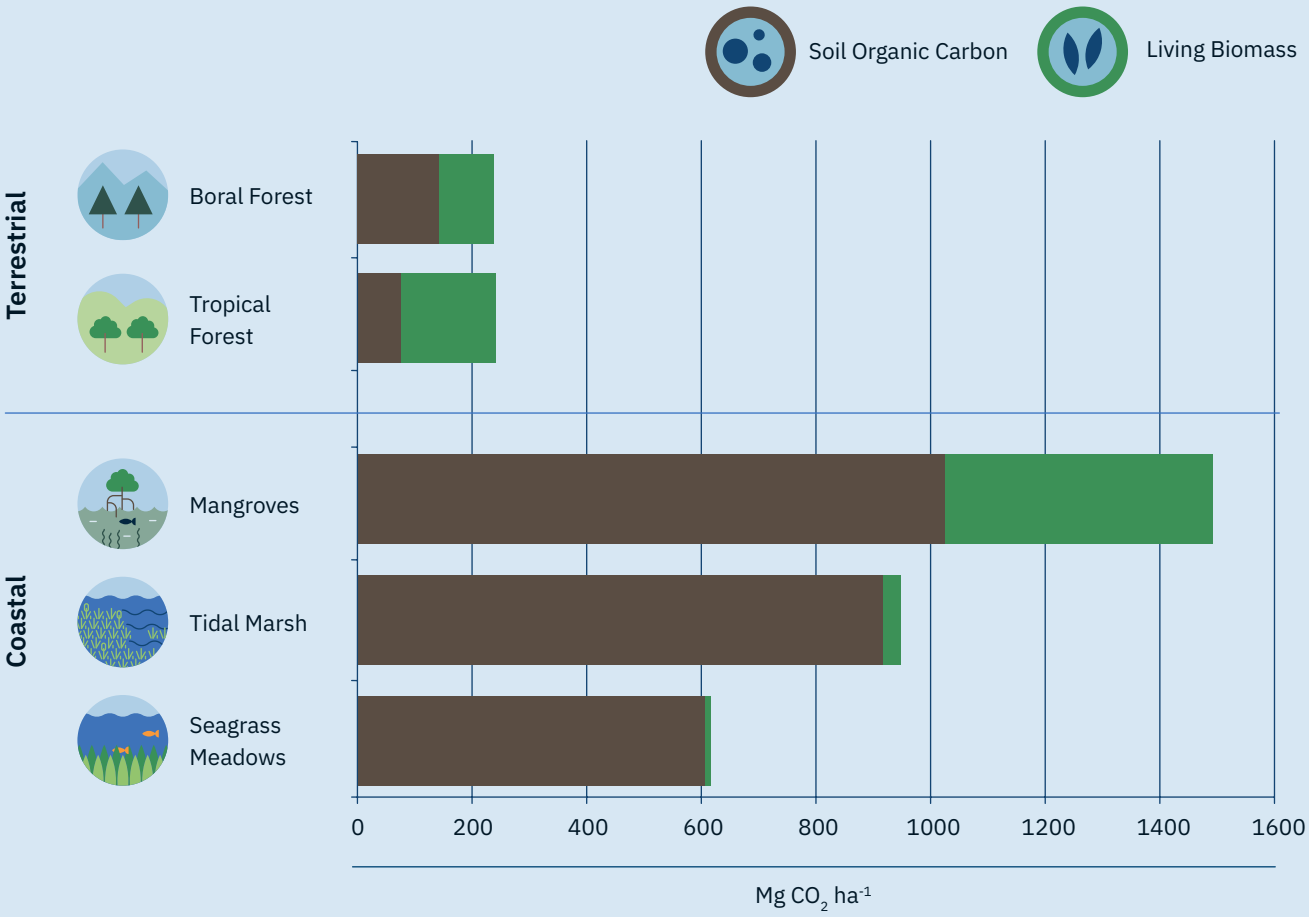
Figure 3 Global distribution of established Blue Carbon ecosystems



Source: UNEP World Conservation Monitoring Center (UNEP-WCMC13) (2021)

The bulk of BCE carbon (50 percent to 99 percent) is stored in the soils. These carbon stores can be up to 6 meters deep and hundreds to thousands of years old. If undisturbed, they are considered long-term carbon sinks (McLeod et al. 2011). According to estimates (Pendleton et al. 2012), carbon storage in the top meter of soil is equivalent to 1,030 megagrams (Mg) of CO_2 equivalent per hectare (Mg CO_2eq ha^{-1}) for estuarine mangroves, 920 Mg CO_2eq ha^{-1} for tidal marshes, and 520 Mg CO_2eq ha^{-1} for seagrass meadows. Adding the carbon in the plants, the mean carbon storage is in the range of 1,500; 950; and 600 Mg CO_2eq ha^{-1} for mangroves, tidal marshes, and seagrass meadows, respectively (see Figure 4).

Figure 4 Comparison of the potential for sequestering carbon, between coastal and terrestrial forests



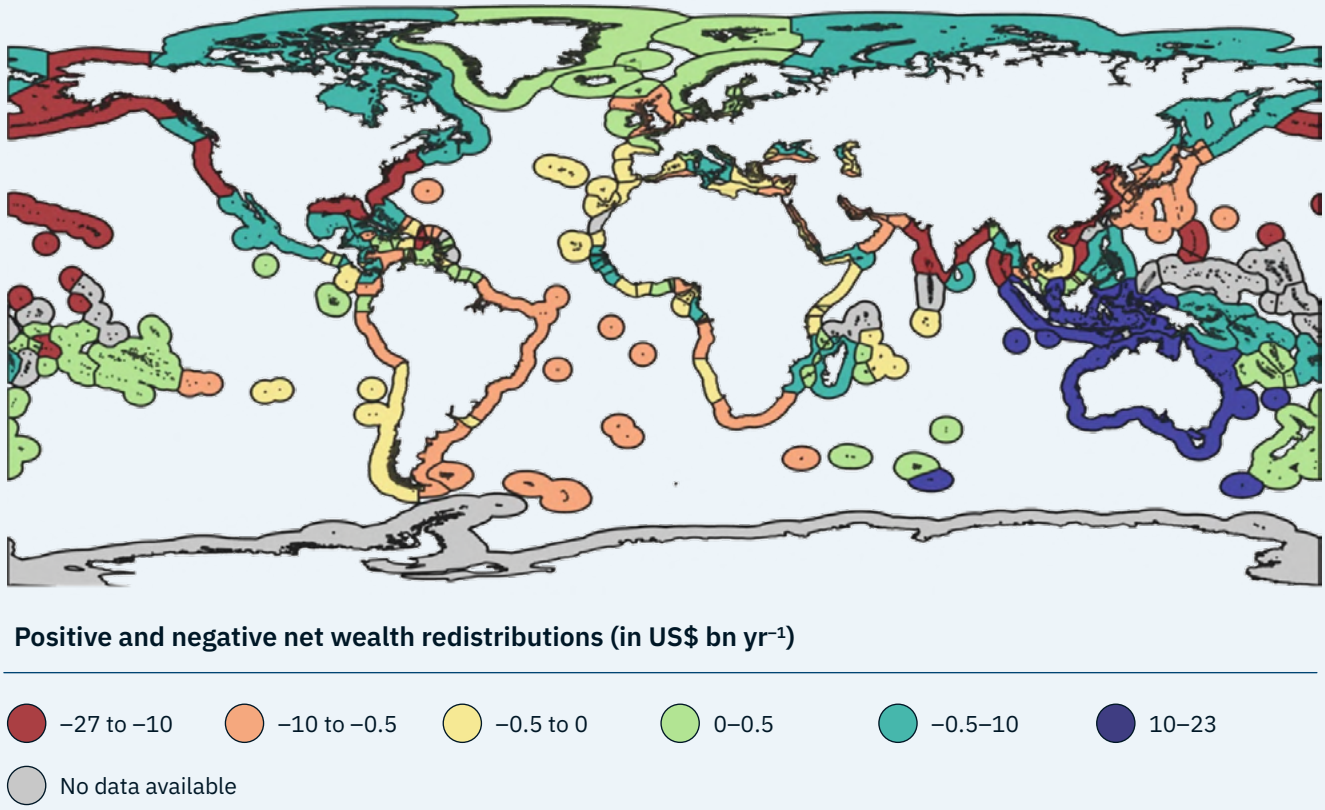
Source: Blue Carbon Initiative

On a local and global scale, BCEs are of critical importance for biodiversity and humanity, and the management and protection of BCEs has a disproportionately large impact on vulnerable communities, as well as on climate change mitigation and adaptation measures (McLeod et al. 2011; Leal and Spalding 2022; Lovelock and Duarte 2019; Goldberg et al. 2020).

Expressed in monetary terms, carbon sequestration and storage by mangrove, salt marsh, and seagrass ecosystems has been valued at roughly US$ 190 billion per year (about US$ 580 per person in the US) in terms of global Blue Carbon wealth. This is based on a global mean social cost of carbon of US$ 640.30 per ton of CO_2 emitted (Bertram et al. 2021). In an analysis of the economic damage caused by each additional ton of CO_2 emissions released into the atmosphere, and the economic benefit of removing a ton of CO_2, Australia (US$ 22 billion), Indonesia (US$ 12 billion),

and Cuba (US$ 6 billion) emerged as the three countries that generate the largest positive net blue wealth contribution for other countries. Myanmar, the Philippines, Mexico, Papua New Guinea, Guinea Bissau, and Russia follow, with each contributing about US$ 4 billion to US$ 6 billion net (see Figure 5).[1]

Figure 5 Blue Carbon wealth redistribution (in US$ billion per year).



Source: Blue Carbon Initiative

1 The valuation focuses on carbon and does not account for additional ecosystem services provided by Blue Carbon habitats. The analysis is also limited to the established Blue Carbon habitats (that is, mangroves, salt marshes, and seagrass beds) leaving emerging Blue Carbon habitats for future study.

1.1 Established Blue Carbon Ecosystems

When the term "Blue Carbon" was first introduced, it was intended to include all carbon-rich coastal and marine ecosystem types, not just established BCEs (Nelleman et al. 2009; Laffoley and Grimsditch 2009). The science around other coastal and ocean systems and their relevance for climate change mitigation and adaptation has improved considerably in recent years, and some of these ecosystems may be on their way to actionability and inclusion as BCEs (see Figure 6). Actionability is widely understood to involve the following (Pidgeon et al. 2021):

SCALE:
The scale of GHG removals or emissions is significant;

LONGEVITY:
The ecosystems can store the CO_2 sequestered long-term;

THREAT:
Anthropogenic impacts on the ecosystems are leading to CO_2 emissions;

VIABILITY:
Sustainable management of the ecosystems to reduce CO_2 emissions or enhance existing carbon stocks is viable and practical; and

KNOWLEDGE:
The science behind these findings is sufficiently robust.

The actionability conditions make various coastal ecosystems—coral reefs, oyster reefs, and marine fauna—*non-actionable*. It is noted that "actionability" in this context refers to climate mitigation interventions and does not extend to what are primarily climate adaptation, biodiversity, or other interventions. For several ecosystems, science is not established enough to decide on actionability. This is particularly true for benthic sediments, but also for mud flats and phytoplankton. Nonetheless, experts are increasingly optimistic that macroalgae (notably kelp and seaweed), benthic sediments, and mud flats are on the path to actionability as emerging BCEs.

Mangroves, salt marshes, and seagrass beds are considered established or "actionable" BCEs, meaning that they fall into an established inventory category of wetlands under the reporting requirements of the UNFCCC. Established Blue Carbon ecosystems are also eligible for Blue Carbon crediting instruments (see Figure 6).

Figure 6 Actionable Blue Carbon Ecosystems (Climate Change Mitigation Policy).

		Significant GHG scale	Long-term CO_2 storage	Gains / losses from anthropogenic impacts	Manageability (loss control, enhancement)	Actionability	Annual Mitigation Potential (in $GtCO_2$)
 Established Blue Carbon ecosystems (IPCC recognized)	Mangroves	■■■	■■■	■■■	■■■	Yes	0.06-0.73
	Salt marshes	■■■	■■■	■■■	■■■	Yes	0.0–0.1
	Seagrass	■■■	■■■	■■■	■■■	Yes	0.28–0.37
 Emerging Blue Carbon ecosystems (not yet recognized by IPCC)	Macroalgae (Kelp forests & seaweeds)	■■■	■■■	■■■	■■■	Likely	0.34
	Benthic sediments	■■□	■■■	■■■	■■□	Likely	0.4–1.1
	Mud flats	■■□	■■□	■■■	■■□	Likely	0.02
 Other systems (no mitigation potential)	Coral reefs	■□□	■□□	■□□	■□□	No	N.A.
	Oyster reefs	■□□	■■□	■□□	■□□	No	N.A.
	Phyto-plankton	■■■	■■□	■■□	■□□	No	N.A.
	Marine fauna	■□□	■□□	■■■	■□□	No	N.A.

Source: Adapted from Lovelock and Duarte (2010) and Pidgeon et al. (2021). Figures on annual GHG mitigation potential from Claes et al. (2022)

This guidance is not compulsory for parties to the UNFCCC, but its use is encouraged by the Paris Rulebook. This is the set of implementing provisions for the Paris Agreement, adopted as part of the 24th session of the UNFCCC Conference of the Parties (COP24) held in Katowice, Poland, and re-endorsed at COP25 (Madrid, Spain), and COP26 (Glasgow, UK).[2] The established BCEs have also been found eligible for Blue Carbon crediting instruments, and they are central to various initiatives that kicked off at the most recent UNFCCC and CBD negotiation sessions—COP27 and COP15, respectively (see below, Chapter 2).

Mangroves

Seagrasses

Salt marshes

1.1.1 Mangroves

Mangroves are among the most carbon-rich tropical forests. Some estimates suggest mangroves and salt marshes can store on average between 6 to 8 megagrams (about the weight of a school bus) CO_2 equivalent per hectare (Mg CO_2e ha-1) annually—roughly two to four times as much as mature tropical forests. Often occurring at the boundary between land and sea, mangroves are salt-tolerant trees which thrive worldwide in coastal zones within tropical and subtropical latitudes.

2 The relevant decisions have been formally adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA). The body mirrors the Conference of the Parties to the UNFCCC but is legally separate.

Distribution and trends

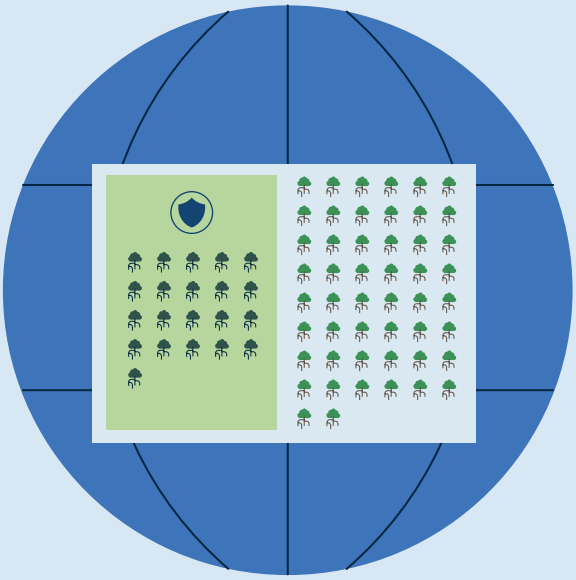
Just 15 countries represent roughly 75 percent of the global mangrove area (Friess et al. 2019). A global study assessing changes in mangrove area and carbon stocks between 2000 and 2012, calculated a global mangrove carbon stock of 4.19 petagrams of carbon (Pg C) in 2012, with Indonesia, Brazil, Malaysia, and Papua New Guinea accounting for 50 percent of the stock (Hamilton and Freiss 2018). Deforestation trends have seemingly decreased since the early 1900s, from a mighty 2 percent or more in annual losses to a—still substantial—0.4 percent. Most of today's emissions occur in Southeast Asia, though hotspots in deforestation occur in Latin America and Africa.

Global mitigation opportunities

Globally, 42 percent of mangroves exist within protected areas recognized by the International Union for Conservation of Nature (IUCN). Global Mangrove Watch (GMW) has published its goals to halt further loss and restore 400 thousand hectares of mangroves by 2030 (Leal and Spalding 2022). Strengthening engagement with local governments and communities, and integrating policy action, will be key steps in ensuring further mangrove protections.

42%

of mangroves exist within protected areas



Restore

400,000

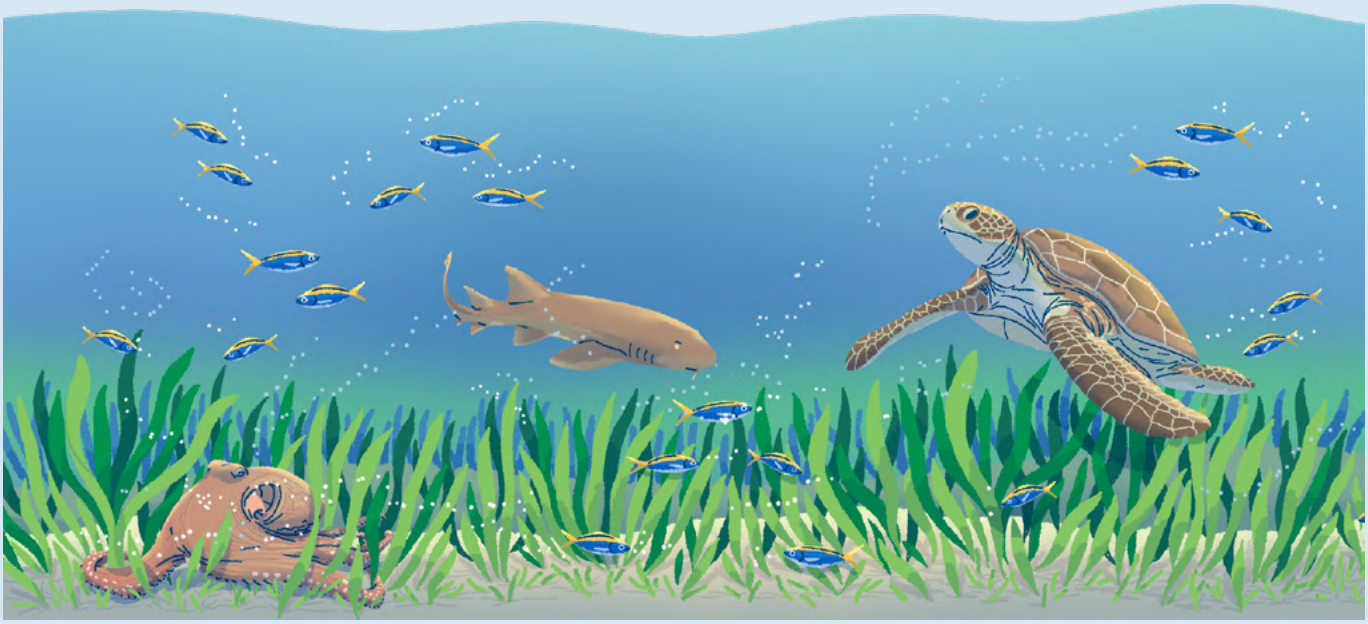
hectares of mangroves by 2030

Conservation opportunities

Between 50 million and 130 million tons of CO_2 (t CO_2) annually may be removed from the atmosphere. is equivalent to taking between 11 million and 28 million cars off the road for an entire year.

Restoration opportunities

Between 10 million and 600 million tons of CO_2 (t CO_2) annually may be removed from the atmosphere. That is equivalent to taking between 2 million and 130 million cars off the road for an entire year.



1.1.2 Seagrasses

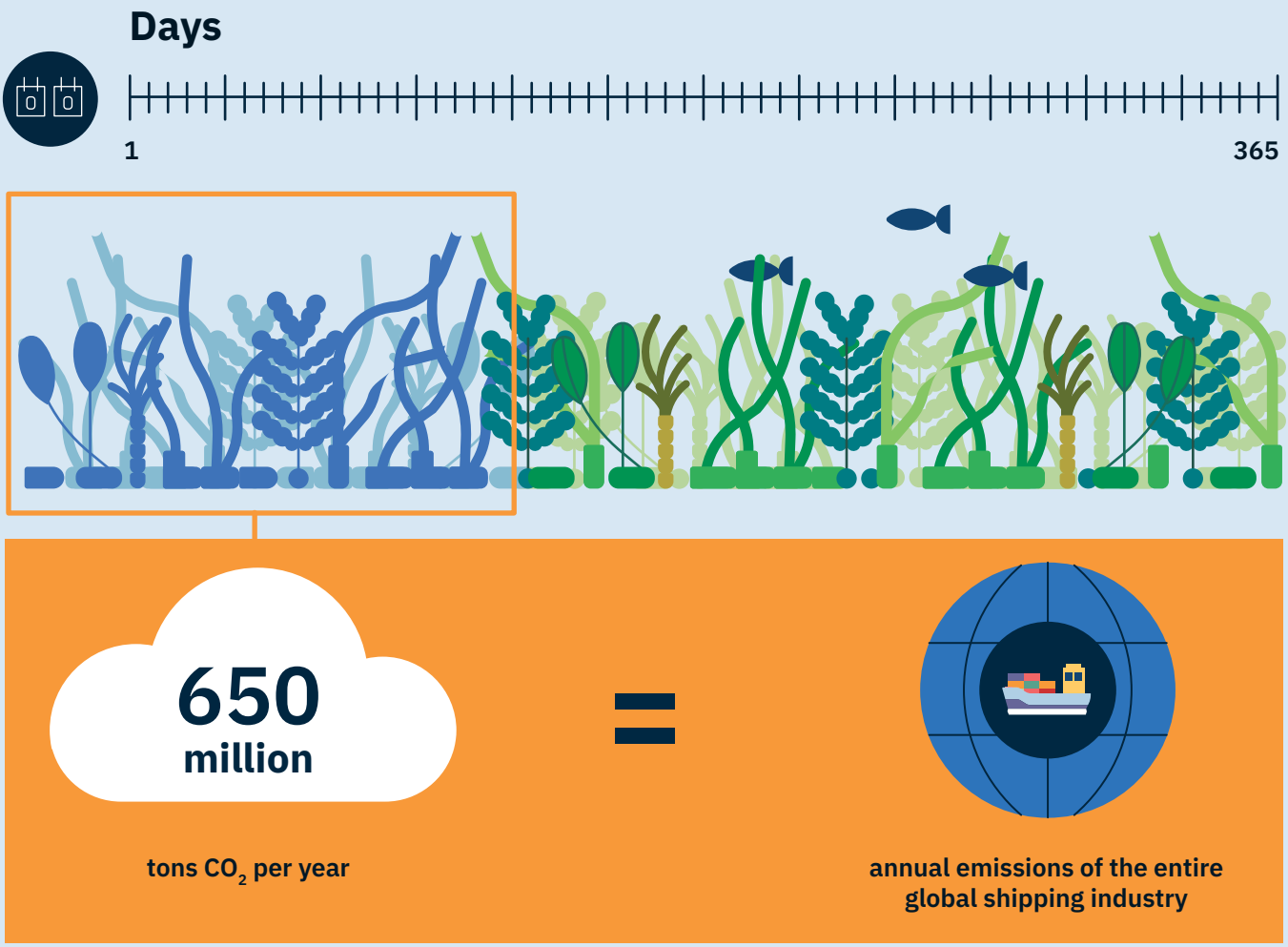
Seagrasses can store up to twice as much carbon per hectare as terrestrial forests. Seagrasses are underwater plants that accumulate carbon, the majority of which is stored in soils that can measure up to 4 meters deep. With meadows found from subpolar to tropical climatic zones (Duarte et al. 2005), seagrasses represent a significant carbon sink in the global carbon cycle, so combating climate change. They also play a role in supporting food security; enriching biodiversity; purifying water; protecting coastlines; and battling disease. Seagrass meadows are often the largest in estuaries and bays where harbors and cities are conjoined.

Distribution and trends

Seagrass meadows cover an estimated area of between 30 million to 60 million ha (Oreska et al. 2019), though modeling studies of potential seagrass area hint that this may be a substantial underestimation (Jayathilake and Costello 2018). The World Atlas of Seagrass (Green et al. 2003) highlights Australia as having the most extensive areas (9.63 million ha), followed by Indonesia (3 million ha) and the Gulf of Mexico (1.94 million ha). Seagrasses are spread across the Coral Sea countries, along East Africa and elsewhere. On a global scale, seagrasses are estimated to store 15.4 to 72 billion tons CO_2 equivalent—an amount roughly equal to the annual emissions of 900 million to 16 billion cars on the road. The estimated annual emissions from seagrass degradation are 150 million tons CO_2 (Duarte et al. 2005; Pendleton et al. 2012). In many cases, global maps of seagrass area and area change are incomplete or poorly resolved, which in turn limits accurate estimates of global seagrass carbon stocks (Oreska et al. 2019). Lack of detailed baseline data—such as maps of historic coverage— and globally patchy carbon stock data are other key obstacles to overcome (Fourqurean et al. 2012).

Global mitigation opportunities

Global loss of seagrass is proceeding at a rapid pace. These losses represent potential emission of 650 million tons CO_2 per year (Hoegh-Guldberg et al. 2019). According to the United Nations Environment Programme (UNEP), this is an amount roughly equivalent to the annual emissions of the entire global shipping industry (UNEP 2020).



Conservation opportunities

Between 130 million and 160 million tCO_2 annually may be removed from the atmosphere. That is equivalent to taking between 28 million and 35 million cars off the road for an entire year.

Restoration opportunities

Between 150 million and 210 million tCO_2 annually may be removed from the atmosphere. That is equivalent to taking between 32 million and 46 million cars off the road for an entire year.

1.1.3 Salt marshes

Salt marshes are tidal ecosystems formed by accumulation of mineral sediments and organic material, and are regularly flooded with salt water at high tide. The soil, which can be several meters deep, contains almost all the carbon in salt marshes ecosystems.

Distribution and trends

Tidal marshes have not been systematically mapped globally, though technology exists to do so. A total estimate of the extent of 5,495,089 ha is provided by Byrd et al. (2019). Tidal marshes are found largely outside of the tropics, with those in the United States (1,723,410 ha), Canada (111,274 ha), Europe (356,947 ha) and Australia (1,325,854 ha) enjoying a relatively high level of regulatory protection. For these countries, inventories of change exist. Argentina (118,870 ha), Mexico (272,527 ha), and Russia (700,719 ha) host major extents of tidal marsh, with lesser degrees of protection. Southern Brazil and Uruguay (37,858 ha) hold extents of marshes within estuaries. China once had extensive areas of tidal marsh; however, over 95 percent of these marshes have been converted for rice cultivation, aquaculture, and development.

Global mitigation opportunities

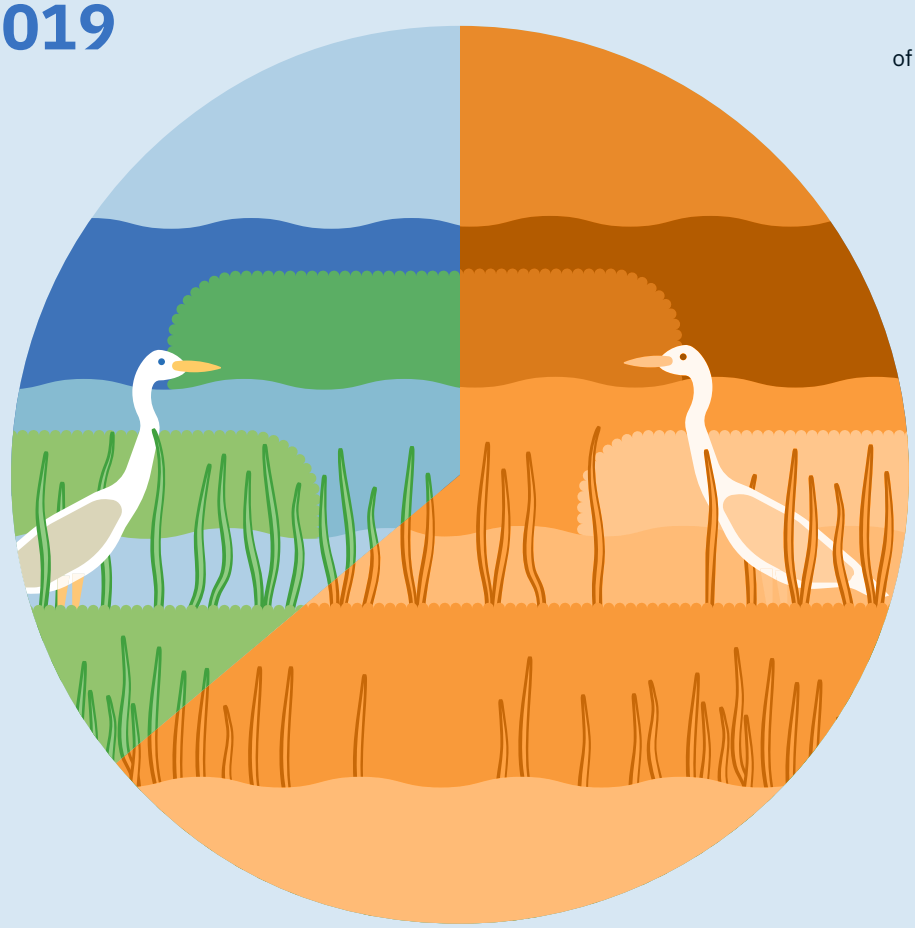
Between 2000 and 2019, an area of salt marsh equivalent to two soccer fields was lost every hour, totaling roughly 1,453 square kilometers (km^2) globally. The United States and Russia accounted for 64 percent of global salt marsh loss during this period. The net loss of salt marsh during this period released 16.3 teragrams of CO_2—an amount equivalent to the annual emissions of approximately 3.5 million motor vehicles.

Between

2000-2019

64%

of global salt marsh loss



Conservation opportunities

Between 40 million and 60 million tCO_2 annually may be removed from the atmosphere. That is equivalent to taking between 9 million and 13 million cars off the road for an entire year.

Restoration opportunities

Between 30 million and 40 million tCO_2 annually may be removed from the atmosphere. That is equivalent to taking between 6.5 million and 9 million cars off the road for an entire year.

1.2 Emerging Blue Carbon Ecosystems

1.2.1 Benthic sediments

If left undisturbed, benthic sediments hold vast amounts of carbon on geologic timescales—from thousands to millions of years (Estes et al. 2019). Globally, seafloor sediments are believed to store nearly twice as much carbon as the top meter of terrestrial soils (Atwood et al. 2020). In fact, the amount of carbon stored by benthic sediments within exclusive economic zones (EEZ)—the 200 nautical mile area (from the coast) for which coastal nations hold special rights—is roughly the same as the amount stored in the high seas (Atwood et al. 2020).

Distribution and trends

To date, no maps have been produced on the global distribution of benthic sediment extent or change in extent over time. However, a 2019 study used machine learning to predict and map global seafloor carbon stocks (Lee et al. 2019), and a 2020 study quantified global benthic sedimentary carbon stocks at a resolution of one kilometer (Atwood et al. 2020). Despite the uptick in research into this emerging BCE, direct observations of benthic sediments are sparse, and spatially explicit estimates of global benthic sediment carbon stocks are lacking (Atwood et al. 2020; Lee et al. 2019).

Global mitigation opportunities

The widespread practice of bottom trawling disturbs the ocean floor, releasing stored carbon and disrupting the capacity for future storage. While uncertainties remain on how to quantify the impact of bottom trawling and dredging on atmospheric CO_2 contributions (Pidgeon et al. 2021), recent assessments have been forthcoming. Currently, only around 2 percent of benthic sediment carbon stocks are in highly or fully protected areas (Atwood et al. 2020). Yet studies suggest that protecting roughly 4 percent of the ocean floor, primarily within national waters, could eliminate 90 percent of the risk of carbon disturbance from bottom trawling (Sala et al. 2021). Prioritization frameworks are being developed, with several calling for a globally coordinated effort towards marine conservation for climate mitigation (Sala et al. 2021; Hutto et al. 2021). No information on emission reductions through conservation or restoration is currently available for this ecosystem.

1.2.2 Coastal mud flats

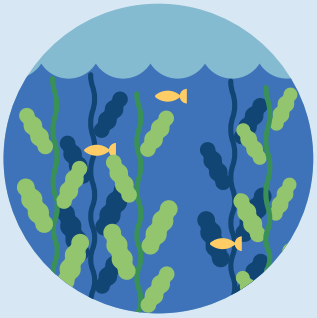
Coastal mud flats—also known as tidal flats—generally have higher carbon sequestration capacity when compared to vegetated coastal ecosystems. Coastal mud flats are formed by the slow accumulation of sediment left behind by rivers and tides. They commonly occur in sheltered areas along coastlines, such as lagoons, estuaries, and bays.

Distribution and trends

Research suggests that tidal flats across the globe occupy an area of roughly 127 thousand km^2. For comparison, this is an area roughly equal to that of mangroves (81 to 137 thousand km^2), less than the known area of seagrasses (160 thousand km^2), but far greater than that of salt marshes (41 thousand km^2) (Chen and Lee 2022). Coastal mud flats are found across wide latitudinal ranges, but nearly 70 percent occur in Asia, North America, and South America (Murray et al. 2019). Natural- and human-driven stressors have resulted in a 16.02 percent reduction (> 20 thousand km^2) in the extent of global tidal flats since 1984 (Murray et al. 2019). Rates of loss are particularly high in East Asia, where increased urban development is at a high (Chen and Lee 2022).

Global mitigation opportunities

On the assumption that the rate of tidal-flat loss over the past three decades persists, and that all disturbed carbon is re-mineralized, the annual loss of carbon from mud flat sediments would be 4.8 teragrams of carbon (Tg C), which is equivalent to emissions of 17.6 Tg CO_2 to the water column and atmosphere (Chen and Lee 2022). No information on emission reductions through conservation or restoration is currently available for this ecosystem.



1.2.3 Macroalgae: kelp forests and seaweeds

Macroalgae have a wide reach. They can be found from the intertidal zone across most coastlines, out to the deepest depth of the world's oceans. Macroalgae such as kelp forests and seaweed rely on the process of photosynthesis to store carbon in their living tissues. Upon death, macroalgae can sink to the ocean floor, where cold temperatures and lack of oxygen promote potentially long-term carbon sequestration (Duarte et al. 2022).

Distribution and trends

Global estimates of macroalgae distribution and area carry high levels of uncertainty. However, huge growth in research surrounding macroalgae has refined regional understanding of macroalgal extent (Duarte et al. 2022). Refined distribution models (which predict the occurrence of macroalgal extent) have been used to predict regional extent but are not yet effective at global scales. Refinement at regional scales has made it possible to estimate carbon stocks of macroalgae in several regions. Improved understanding of the area and changes in the global extent of macroalgae are important means of estimating the role and impact this ecosystem has on global carbon cycling and CO_2 emissions or removals. For example, a recent study found that the kelp forest of Australia's Great Southern Reef sequesters 30 percent of national Blue Carbon sequestration and around 3 percent of the global Blue Carbon budget annually (Filbee-Dexter and Wernberg 2020).

Global mitigation opportunities

Technologies surrounding the cultivation and sinking of seaweed as a means of sequestering carbon are still in their early development as potential CO_2 removal strategies (CDR) (Ocean Visions and MBARI 2022). No information on emission reductions through conservation or restoration is currently available for this ecosystem. However, in late 2022 Ocean Visions and the Monterey Bay Aquarium Research Institute released a framework intended to guide and accelerate the comprehensive science needed to determine the actionability of seaweed (Ocean Visions and MBARI 2022).

1.3 Drivers of Degradation

Coastal ecosystems have suffered from exceptional degradation in the past. More than 50 percent of the world's original salt marshes were lost during the twentieth century (Barbier et al. 2008; Duarte et al. 2009; Xin et al. 2022) and estimates for loss of mangroves due to deforestation by the 1980s to 1990s are reported to be as high as 35 percent (Friess et al. 2019). Global seagrass data remains incomplete, but researchers have estimated that—in relation to the historical baseline—25 percent of total global seagrass beds have been lost (Waycott et al. 2009). Drivers of degradation for these and other coastal ecosystems can occur inland (known as upland degradation), or along coastlines at the seaward boundary (known as seaward degradation). Often drivers of degradation are linked, compounding the intensity—and effects—BCEs experience (see Table 1).

Table 1 Primary drivers of degradation for Blue Carbon ecosystems

Driver	Primary Location		BCEs Impacted (Established)		
					
 **Logging**		Upland	Mangroves		
 **Coastal Development**		Upland	Mangroves	Salt marshes	Seagrasses
 **Commodities (agriculture, aquaculture)**	Seaward		Mangroves	Salt marshes	Seagrasses
 **Pollution**	Seaward	Upland	Mangroves	Salt marshes	Seagrasses
 **Fisheries (small & large)**	Seaward				Seagrasses
 **Climatic Changes (tropical stroms, sea-level rise)**	Seaward		Mangroves	Salt marshes	Seagrasses

Source: Compiled using data from Campbell (2022), Global Mangrove Watch (GMW) (2022).

Commodity-dependent economies can drive the loss of ecosystems. Coastal development includes buildings and infrastructure on land (this encompasses drainage of wetlands to reclaim land), and the build-out of port facilities such as shipping lanes and of terminals for offshore mining. Commodities vary regionally but broadly encompass agriculture, aquaculture, and timber. Commodities can further drive coastal development and lead to contamination of soils and water, both upland and seaward (see Box 1).

BOX 1

Commodity-driven mangrove losses in Southeast Asia

Covering some 3.3 million hectares in area size, the largest and most diverse mangrove ecosystems in the world are in Indonesia. Since 1985, however, the country has lost some 40 percent of its mangrove forests, creating GHG emissions in the range of between 70 and 210 m tCO_2e each year (Murdiyarso et al. 2018). Here, and across the Southeast Asian region, anthropogenic losses remain high (even though they have recently declined, mirroring global trends).

This is primarily due to widespread mangrove conversion to aquaculture and agriculture (Goldberg et al. 2020). Approximately 92 percent of all global commodity-driven losses (due to shrimp farming, as well as rice farming and palm oil cultivation) occurred in Southeast Asia. Just six nations—Indonesia, Myanmar, Malaysia, the Philippines, Thailand, and Vietnam—account for some 80 percent of losses in the region.

Commodity-driven losses in Indonesia have been decreasing. It has been noted that of all anthropogenic drivers, commodity-driven losses declined most substantially from 2000 to 2016, with a 77 percent decrease in total loss area. The reasons are not fully understood but this trend has been attributed to successful conservation efforts, as well as temporary market saturation (Goldberg et al. 2020)..

The slowing of the trend toward mangrove deforestation because of logging and timber extraction over recent decades (FAO 2020), has been cautiously attributed to successful conservation efforts in various—though not all—regions of the world (Friess et al. 2020). The finding is corroborated by the fact that continuous deforestation is highest where protection is the lowest; and it remains elevated, with agriculture, aquaculture, infrastructure, and urban development putting immense pressure on the ecosystems (Murray et al. 2022). Climatic changes—which broadly include hurricane intensity and frequency, as well as climate-change effects such as sea-level rise—have been one of the primary drivers of BCE loss in recent decades (Campbell et al. 2022; Leal and Spalding et al. 2022).

Compared to salt marshes and mangroves, seagrasses' sensitivity to drivers of degradation can be acute. Heatwaves, as well as poor water quality due to pollution or sedimentation, have caused widespread die-offs in certain regions. In addition, destructive fishing practices—including use of nets and anchors in shallow waters—can rip up and damage seagrass beds (Unsworth et al. 2022). When these ecosystems are degraded and converted, the carbon they store can be lost (Stuchtey et al. 2020). Studies estimate economic damages of US$ 6 billion to US$ 42 billion annually due to degradation of BCEs (Pendleton et al. 2012).

1.3.1 Addressing degradation

Restoration and conservation are two widely utilized practices in addressing and preventing degradation. The application of one practice over another depends on the status of the ecosystem in question. If the ecosystem is currently experiencing degradation, restoration is the most appropriate practice to employ. If the ecosystem is not experiencing any degradation but is currently threatened or could become endangered, conservation would be the primary practice to employ (see Box 2).

BOX 2

Defining restoration and conservation

Restoration is the practice of manipulating the physical, chemical, and or biological characteristic of a degraded ecosystem. The goal of restoration is to restore the natural, or historic, functions of the ecosystem.

Conservation s the practice of protecting and *preserving* characteristics and ecological functions of an ecosystem. The goal of conservation is to maintain the services and values the ecosystem currently provides. Restoration is a commonly used technique and method of conservation.

In recent decades, regional efforts to combat degradation have seen increased success. Policy approaches such as marine spatial planning (MSP); government conservation efforts through the creation of protected areas; community-based restoration with a focus on fishing communities; and advances in science have been utilized in an increasing number of projects, launched in both industrialized and developing countries (see Box 3).

Restoration of Blue Carbon habitats is an important part of this growing trend. Increasingly sophisticated restoration techniques include:

- Restoring hydrological conditions;
- Altering sediment supply;
- Changing salinity characteristics;
- Reintroducing or reforesting with native and diverse plant species;
- Improving water quality; and
- Improving management practices (see Table 2).

Table 2 Non-exhaustive list of actions to restore Blue Carbon ecosystems

Restoring hydrological conditions

- Remove tidal barriers
- Improve hydrological connectivity
- Restore tidal flow to wetlands
- Lower water levels on impounded wetlands

Altering sediment supply

- Use dredge material beneficially
- Divert river sediments to sediment-starved areas

Changing salinity characteristics

- Restore tidal flow to tidally restricted areas

Improving water quality

- Reduce nutrient loads and improve water clarity to expand seagrass meadows
- Recover tidal and other hydrological flushing and exchange
- Reduce nutrient residence time

Reintroducing native plant communities

- Re-seed or re-plant
- Repopulate with native species areas that were previously destroyed or degraded

Improved management practices

- Remove invasive species
- Reduce grazing
- Shift to sustainable aquaculture practices (e.g. mangrove-shrimp, mangrove-oyster)

Source: Developed for this product

BOX

3 Successes in reversing degradation

MANGROVE

In **Senegal,** roughly a quarter of the total surface area of mangroves in the country has been lost since the 1970s, as a result of drought and deforestation for timber (Livelihoods Fund, N.D.). As part of the largest mangrove restoration project in the world, the **Livelihoods Fund3** restored 7,920 hectares of mangroves in Senegal, with an estimated 500,000 tons of carbon offsets available by the time the project has reached completion.

In another **West African project, Mangrove Forest Management from Senegal to Benin** is working across nine coastal countries, providing local partners with small grants for mangrove restoration as well as alternative livelihoods training. Led by the International Union for Conservation of Nature (IUCN), with Wetlands International and 5Deltas, the project focuses on advancing mangrove restoration and the sharing of science in West Africa (Marice and Spalding et al. 2022).

A small town in central **Philippines** has completed a successful four-year mangrove restoration of 9.5 ha of abandoned fishponds. Involving thousands of community members, students, and government employees, the project showcased advances in restoration techniques, as well as the power of effective community engagement (Marice and Spalding et al. 2022).

One of the biggest mangrove restoration campaigns in the world, **Pakistan's Delta Blue** is a project located on the south-eastern coast of Sindh. Through a public-private partnership between the regional government of Sindh and a private investor, restoration and sustainable management of 350,000 ha mangroves is underway. More recently, the World Bank approved the **Mangroves for Coastal Resilience Project in Indonesia,** which is designed to support the government's National **Mangrove Rehabilitation Program.** This program aims to rehabilitate 600,000 hectares of mangroves by 2024.

SALT MARSHES

The number of salt marsh restoration projects has increased in recent years, though most projects are small. For example, the Indian Government has made efforts to restore marshland in **Chilika Lake, India,** and a project in the **Peruvian Paracas Bay** Area has undertaken salt marsh restoration.

There is growing awareness of restoration opportunities, not least because of the protective functions of healthy salt marshes in the face of increasing risks of sea-level rise. The **Mississippi River Delta Restoration Project (USA)** aims to restore the Delta's wetlands and rebuild its barrier islands to protect against storm surges, and is implemented on some 300,000 hectares. **The Humber Estuary Partnership Project (UK),** which seeks to restore natural habitat lost due to dredging and land reclamation, has an implementation scope of 10,000 hectares.

SEAGRASSES

Seagrass restoration is not yet widely practiced, even though researchers and experts at **Gulf of Mannar Marine Biosphere Reserve in India** have restored 14 acres of degraded seagrass on the seabed of the Gulf of Mannar region from 2011 to 2020, with a success rate if 85-90 percent. While the seagrass rehabilitation aimed at conserving the endangered dugong, it also enhances carbon storage in the soil and living biomass. The ecological functions of the rehabilitation sites were attained within two years as the rehabilitation sites look similar to natural seagrass areas in terms of seagrass cover and the density of associated biodiversity. It costs about Rs 8 to Rs 10 lakh per acre for planting, monitoring and maintaining.

3 https://livelihoods.eu/portfolio/oceanium-senegal/

1.4 Associated Costs of Addressing Degradation

It is difficult to provide average prices for Blue Carbon interventions. This is because of high variabilities in factors such as habitat, location, drivers of degradation, restoration needs, economic and logistical conditions, and so on. This is true even at the national level. For example, a seagrass restoration project in West Papua will have different cost factors from a seagrass restoration project in Sumatra.

As the number of Blue Carbon projects grows, and scientific experience accumulates, we are able to generate increasingly reliable (hard), project-specific data, primarily in the area of restoration. Real-cost assessments for coastal wetland restoration—including for restoration of mangroves and seagrass beds—show interesting trends. Reviewing hundreds of restoration projects in 2015, Bayraktarov et al. (2015) found that **the overall reported median and average costs for restoration of 1-hectare marine coastal habitat[4] were in the range of US$ 80,000 to US$1,600,000, respectively (2010 cost figures).** If both capital and operating costs are included, the real total costs are likely four times higher, increasing median costs to between US$ 150,000 and US$ 400,000/ha (Bayraktarov et al. 2015).[5] However, most marine and coastal restoration projects have focused on developed countries—in particular Australia, Europe, and USA. The authors estimate that, when accounting for the local value of the US dollar in developing nations, the cost incurred for restoration is up to 200 times lower. Furthermore, restoration costs for mangroves were found to be considerably lower (US $3,000 per ha).

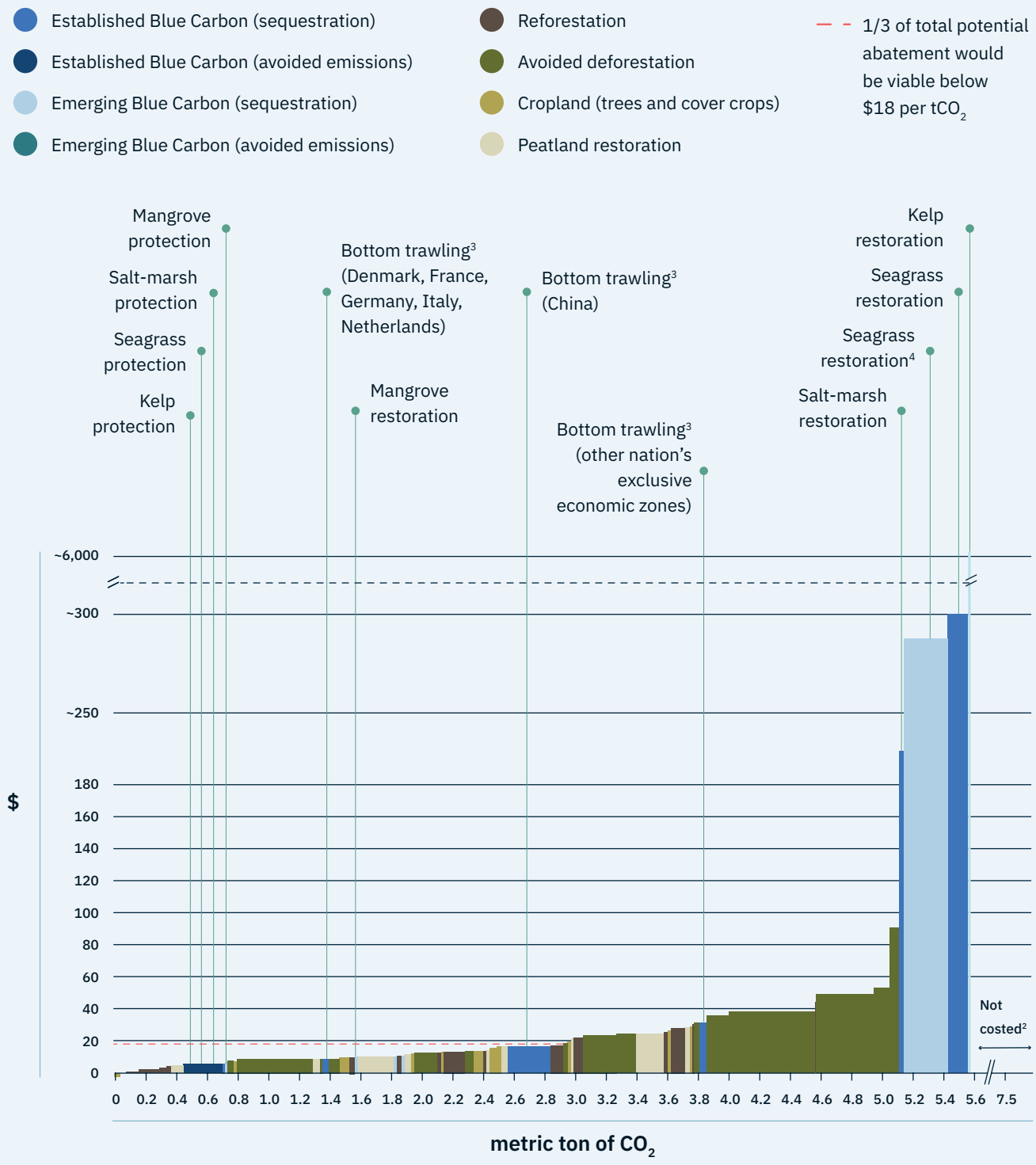
Conservation interventions, on the other hand, are regularly calculated at much lower rates. Bryan et al. (2020)—who base their analysis on research by McCrea-Strub et al. (2011), Vasconcelos et al. (2014) and Pendleton et al. (2014)—assume initial protection costs of between US$ 25 and US$ 232 per hectare, with annual maintenance costs of US$ 1 (not accounting for law enforcement and remedial actions). The large spread points to site-specific differentiation and the hard-to-control opportunity costs of protection as opposed to conflicting land use. The cost of protection of mangrove forest within a marine protected area that does not permit land conversion, is very different from the cost of protection of areas that may be (legally) converted to agricultural or aquacultural use.

According to a recent report by McKinsey (Claes et al. 2022), **about one-third of total abatement opportunities worldwide would be viable below US$ 18 per tCO_2e.** The report translates these costs (with caveats) into costs per carbon credit (US$ per metric ton of CO_2e) (see Figure 7).

4 Marine coastal habitat is a category that includes Blue Carbon habitat but is wider in scope.

5 This is at 2010 cost figures.

Figure 7 Abatement cost curve, nature-based solutions, US$ per metric ton of CO2e



Source: McKenzie and Company, 2022

These figures broadly reflect studies for countries and regions deemed high opportunity for, firstly, the outstanding size of BCEs and, secondly, high levels of ongoing degradation. For instance, Jakovac et al. (2020) found that conserving remaining mangroves would prevent the release of up to 15.51 billion tCO_2eq. to the atmosphere and could be achieved at carbon prices between US$ 3 and US$ 13 per tCO_2 for 90 percent of remaining mangroves. Restoring mangroves can sequester up to 320 million tCO_2e globally. Carbon prices between US$ 4.5 and US$ 18 per tCO_2 could support the restoration of 90 percent of deforested mangroves—though these figures do not include opportunity costs from alternative land use (for aquaculture and infrastructure, for example).

1.5 Opportunities from Blue Carbon Protection and Restoration

Despite their potential complexities and high costs, Blue Carbon investments are among the most effective climate solutions available. Mangrove interventions specifically stand unrivalled for their climate mitigation density—that is, the average mitigation opportunity per hectare (see Figure 8).

Restoring 1 hectare of mangrove forest offers, on average, a mitigation output more than five times higher than the mitigation output generated by restoration of a comparable area in terrestrial forests.For conservation, the ratio is 4:1.

Seagrass restoration compares to terrestrial restoration at a factor of 3:1,

and seagrass conservation at a factor of almost 2:1.

For salt marsh interventions (restoration and conservation), the ratio is almost 2:1.

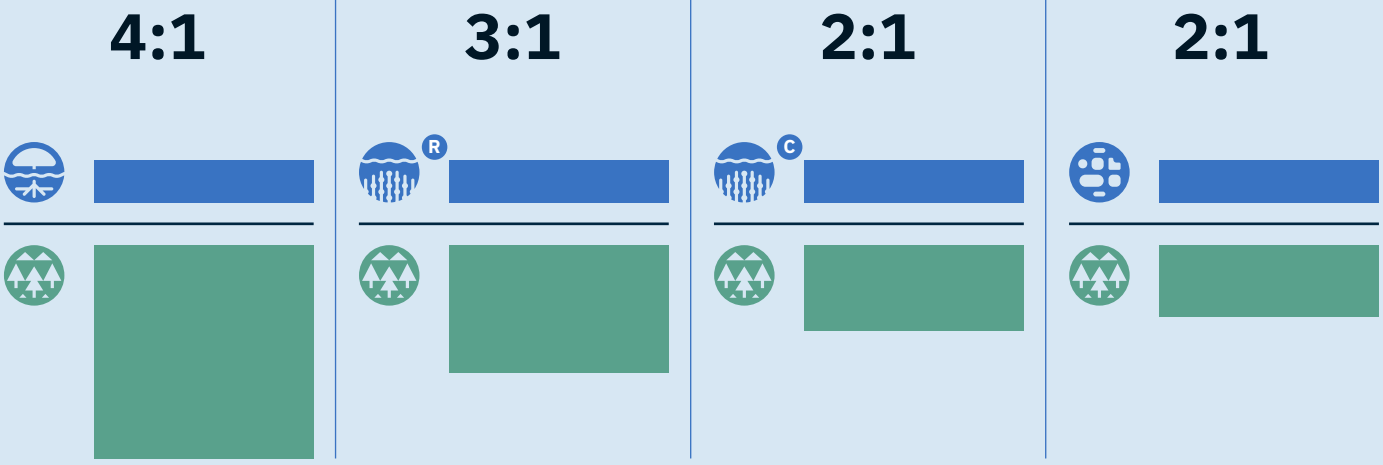
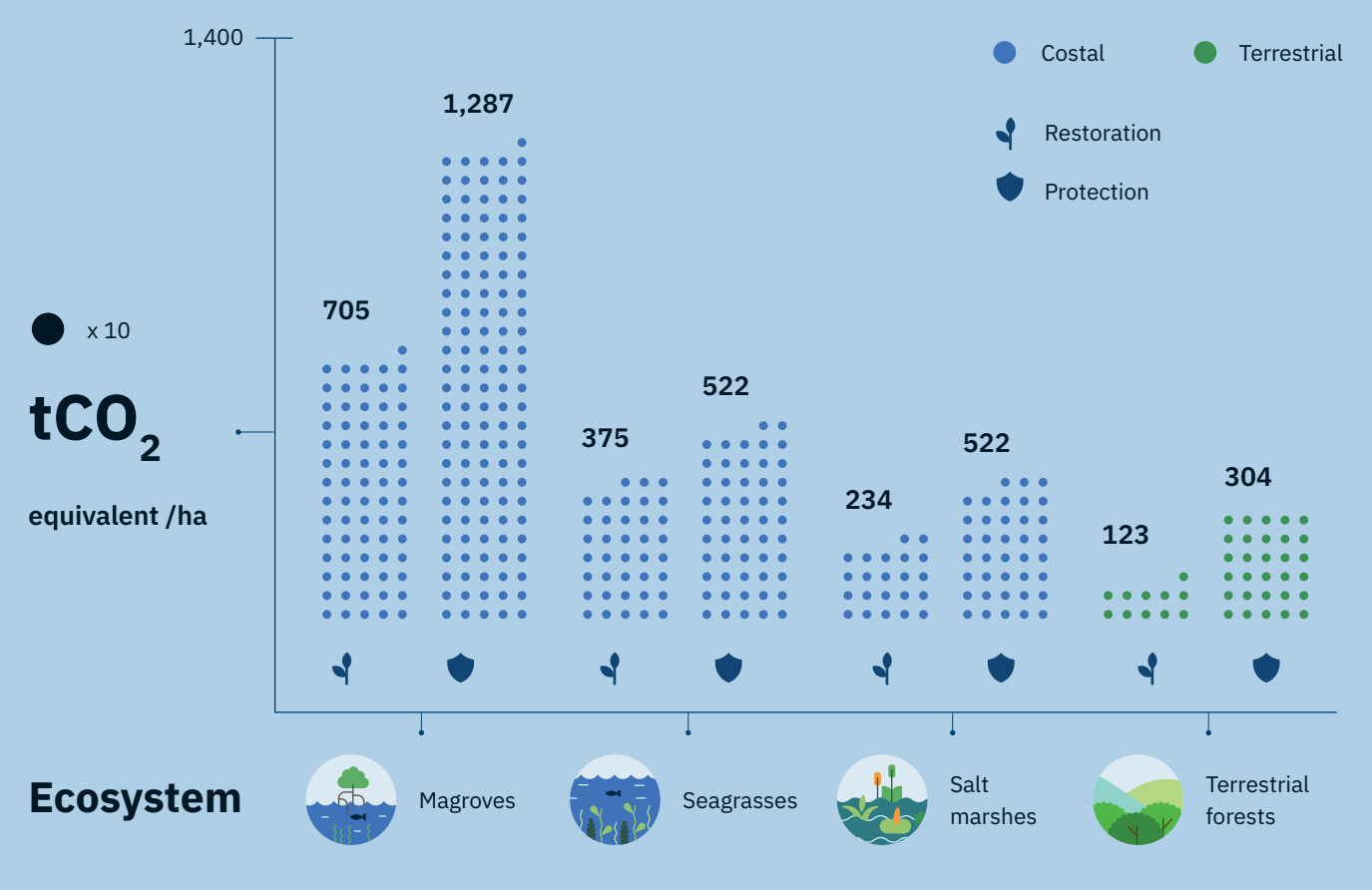


Figure 8 Average GHG mitigation density of Blue Carbon interventions, compared with average figures for terrestrial forests



Source: Underlying data is sourced from Claes et al. 2022; Roe et al. 2021; and Griscom et al. 2017. Adapted for this report

Looking beyond carbon, protection and restoration of BCEs benefits coastal communities in numerous ways—especially by strengthening climate resilience in the face of a warming planet and rising sea-levels. Blue Carbon ecosystem services include:

- **Provisioning** clean water, timber, fisheries;
- **Supporting** breeding and nursery habitats, biodiversity hot spots;
- **Regulating** protection from storms and floods, erosion control, carbon sequestration; and
- **Livelihood** support of local communities.

Blue Carbon habitats for fish stocks and for flood and storm protection hold significant value. In the case of mangroves, an estimated 4.1 million small-scale fishers globally rely on mangroves for fishing. In some countries (for instance Bangladesh and Nigeria), up to 90 percent of fishers fish predominantly in mangroves (Spalding et al. 2022). Mangroves' value with regard to the commercial fishing industry derives from their role as nursery habitats for many commercially important fish and shellfish.

Blue Carbon ecosystems have immense importance for climate change adaptation and disaster risk reduction plans. Coastal areas have been centers of population growth and economic development for centuries. Coastal hazards affect hundreds of millions of vulnerable people, important infrastructure, and economic activity, and cause significant losses to national economies. Risks are expected to increase as a result of population growth, sea-level rise, and other climate-change impacts (Global Risks Report 2019).[6]

Over the last two decades, climate-related disasters have accounted for 91 percent of recorded disaster events (United Nations Office for Disaster Risk Reduction 2017).[7] As climate change is likely to increase the intensity of coastal storms, mangroves, coral reefs, and coastal wetlands will increase in value, as they substantially reduce risks to critical economic infrastructure and help prevent loss of life (World Bank 2022)[8]. Unsustainable natural resource management and use, as well as land degradation, are underlying drivers of risk. Concurrently, disasters cause environmental impacts. Despite these challenges, nature is a solution—reducing risk as the sustainable use and management of ecosystems builds resilience.

Investing in nature through the restoration or conservation of ecosystems is increasingly understood to contribute to climate risk reduction and adaptation. Nature-based approaches to adaptation, and disaster risk management, are considered to be more sustainable, cost-effective, and ecologically sound alternatives for coastal adaptation (Losada et al. 2018).[9] In addition to BCEs' mitigation benefits, research on natural capital and its contribution to coastal protection has shown, for instance, that mangroves protect more than six million people from annual flooding and prevent additional annual losses of US$ 24 billion of productive assets (World Bank 2021).[10] Similarly, seagrasses contribute to coastal protection through the accumulation of sediment in their root systems (Ondiviela et al. 2014).[11]

Climate change adaptation and disaster risk reduction have similar aims and mutual benefits. Governments can tap into the multiple benefits that BCEs provide to achieve national policy commitments related to climate change adaptation and disaster risk reduction (see Box 4). The different services provided by Blue Carbon habitats are typically rendered cumulatively—that is, successful conservation and restoration activities typically deliver on all the benefits outlined, often at significant and incremental scale. In the Philippines, a study found that mangroves can reduce the damage from typhoons by 25 to 75 percent, depending on the density of the mangrove forest. In the Mississippi River Delta, a study found that marshes can reduce storm surge by up to 90 percent.

6 Global Risks Report. 2019. https://www3.weforum.org/docs/WEF_Global_Risks_Report_2019.pdf.

7 UNISDR (United Nations Office for Disaster Risk Reduction). 2017. "Economic Losses, Poverty and Disasters 1998-2017." https://www.undrr.org/publication/economic-losses-poverty-disasters-1998-2017.

8 https://thedocs.worldbank.org/en/doc/111a397e3cdec79a7f1ee6db6b329fb4-0020012022/original/WB-Nature-Based-221102-1838.pdf.

9 Losada, J. et al. 2018. "The global value of mangroves for risk reduction mangroves protect coastlines by decreasing the risk of flooding and erosion." 44. doi:10.7291/V9DV1H2S.

10 World Bank 2021. The Changing Wealth of Nations 2021: Managing Assets for the Future. Washington, DC: World Bank.

11 Ondiviela, B. et al. 2014. "The role of seagrasses in coastal protection in a changing climate". Coast. Eng. 87: 158–168. doi:http://dx.doi.org/10.1016/j.coastaleng.2013.11.005.

CASE STUDY BOX

4 Jamaica's Forces of Nature report: An integral assessment of the contributions of mangroves to coastal disaster risk reduction, adaptation, and climate mitigation[12]

This report supports the development agenda's growing interest in the inclusion of nature-based solutions (NbS) for disaster risk management. It also provides vital information for discussion on climate change adaptation and mitigation, insurance, and disaster-recovery decisions. Mangroves play a key role in protecting Jamaica from flood risks, and risk would be significantly increased if mangroves are lost.

- If the current mangroves were lost, the proportion of the Jamaican population facing annual flooding would increase by over 10 percent. This represents an additional 1,458 people, many of whom live in poverty.
- Damages to residential and industrial property would increase by nearly 24 percent, or by more than US$ 32.6 million annually, if mangroves were lost.
- One hectare of mangroves in Jamaica provides on average more than US$ 2,500 per year of direct flood reduction benefits from tropical cyclones.
- If considered over a 30-year period, the average benefits per hectare for a mangrove conservation or restoration project would exceed US$ 43,000 in coastal protection benefits alone.
- During a 200-year storm, mangroves reduce the number of people flooded and avoid damages by nearly 50 percent throughout Jamaica.
- More than 770 hectares of mangroves have been lost in Jamaica over the past two decades, but more than 70 percent of these could be potentially restorable.
- If Jamaica keeps its mangroves alive and healthy, they will continue to keep pace with tectonic subsidence and sea-level rise, and therefore continue to protect coastlines from storms/tsunamis.
- Soil carbon stocks were higher than the global average at all sites.
- Mangroves were found to reduce wave height between 36 percent and 55 percent, and to reduce wind speed between 64 percent and 80 percent.

Mangrove benefits for Jamaica go beyond flood reduction.

- Using global averages, 3.7 million tons of carbon are sequestered annually by Jamaica's mangroves.
- Mangroves contribute between US$ 5,218 (at Salt Marsh) and US$ 54,145 (at Portland Cottage) in mixed fisheries per hectare per year.
- Other currently untapped benefits include potential for high-end recreational fishing, low impact mariculture, and ecotourism.

12 World Bank. 2019. Forces of Nature: Assessment and Economic Valuation of Coastal Protection Services Provided by Mangroves in Jamaica (English). https://documents.worldbank.org/en/publication/documents-reports/documentdetail/357921613108097096/forces-of-nature

Case studies on restoration of mangroves have proved that restoration works. Mangrove destruction leads to a loss of nursery habitat, loss of food sources, loss of breeding ground and—often—increased sedimentation, which negatively impacts fish productivity by smothering fish eggs and reducing water clarity. In a case study from the Philippines, the loss of fish productivity was a startling 90 percent (Primavera et al. 1997).[13] If well-managed, restoration is feasible within a relatively short timeframe. Fish population and catch rates often improve significantly. For example, a study conducted in Indonesia found that actively restored mangroves provided important habitat for juvenile fish, and that the abundance and diversity of fish in the restored areas was similar to that in nearby natural mangroves.

1.6 Knowledge Gaps

Over recent years, considerable scientific progress has been made to consolidate our understanding of the planet's Blue Carbon ecosystems. However, important science gaps remain. They include research into habitats beyond the recognized coastal BCEs (mangroves, seagrasses, and salt marshes) to include macroalgae, benthic sediments, mud flats, and phytoplankton. There are also science gaps relating to the scope of Blue Carbon emission fluxes—including methane and nitrous oxide emissions—and the longevity of storage (permanence), as well as inter-connectivity across marine ecosystems (Williamson et al. 2022). Moreover, these gaps concern core information on geography and socio-economic factors. Many, if not most, countries lack robust information, especially on mapping and monitoring of seagrass beds and other BCEs (including their health) in their exclusive economic zones (EEZ). Nevertheless, countries are making progress in the collection of scientific data to inform national policies (see Box 5).

13 Primavera, J.H. et al. 1997. "Mangroves as nurseries: shrimp populations in mangrove and non-mangrove habitats." *Bulletin of Marine Science.*

BOX

5 Addressing gaps examples: Mapping seagrass to support climate action

Although seagrass meadows are found along the coasts of all continents except Antarctica (Serrano et al. 2021), robust global estimates of seagrass carbon storage are limited by gaps in regional data.

Estimates of carbon storage for seagrass meadows are scarce in portions of North and South America (Serrano et al. 2021), precluding seagrass incorporation into national carbon accounting and implementation of Blue Carbon strategies within NDCs. Despite a limited extent of just 661 km2 within the Colombian Caribbean, a 2021 study measured an annual carbon sequestration equivalent to roughly 0.4 percent of CO_2 emissions from fossil fuels in Colombia (Serrano et al. 2021). The addition of data from a data-scarce region bolstered a growing global dataset on seagrass carbon storage.

On another continent, an initiative currently underway through Pew Charitable Trusts focuses on mapping the extent of seagrass beds in Seychelles—generating the first countrywide estimates of the Blue Carbon ecosystem's carbon stocks. The data gathered through the study will provide a scientific baseline that policymakers will use to support the country's climate action plan, and to include seagrass protection in Seychelles' Nationally Determined Contributions (NDCs) to the Paris Climate Agreement.

There are also considerable gaps concerning practical knowledge and expertise (Macreadie et al. 2022). Mangrove restoration specifically is often done without proper planting plans and designs, causing unnecessary planting failures. A warming ocean, extreme weather events, and sea-level rise have an ever-growing impact on the health of Blue Carbon habitats. Vastly lacking are practical datasets on how to respond to these factors, and how to make Blue Carbon habitats—and in turn coastal communities, coastal infrastructure, and the broader Blue Economy—more resilient.

Furthermore, there are knowledge gaps at the level of governments and policymakers. This is often the result of a conspicuous absence of institutional structures, knowledge reservoirs, and governance continuity for the enhancement of Blue Carbon science, improved policy design, and the scaling-up of Blue Carbon interventions. Several examples—including from the forestry (REDD+) sector, such as the Forest Carbon Partnership Facility (FCPF) and the Lowering Emissions by Accelerating Forest Finance (LEAF)—provide interesting templates for deep and lasting international institutional cooperation. Some of these initiatives (including the FCPF with its country programs in Indonesia, Madagascar and elsewhere) even give attention to Blue Carbon—albeit restricted to mangroves and therefore marginal, since the portion of mangrove forests in a country's overall forest inventory is usually minimal. Existing international initiatives may deepen their focus on Blue Carbon, and some of them may be replicated specifically for Blue Carbon.

There are also various global initiatives dedicated to Blue Carbon knowledge sharing that link governments and non-state actors, including:

The Blue Carbon Initiative (launched in 2011, ongoing). This is a partnership between the Intergovernmental Oceanographic Commission of UNESCO (United Nations Educational, Scientific, and Cultural Organization), the IUCN, and the Food and Agriculture Organization (FAO) of the United Nations. It works to raise awareness about the role of coastal and marine ecosystems in mitigating climate change and to develop policies and strategies to promote the conservation and restoration of these ecosystems.

Blue Forests Project (2014–2021). This project was a partnership between several non-governmental organizations (NGOs) and the governments of Indonesia, Ecuador, and Mozambique. The project aimed to demonstrate the value of mangrove and other coastal ecosystems for carbon sequestration, and to promote their conservation and restoration as a climate change mitigation strategy. It has generated important platforms for Blue Carbon engagement between governments and non-state actors in the participating countries, and given rise to a robust set of knowledge resources.

Global Mangrove Alliance (launched in 2018, ongoing). This is yet another successful partnership between governments and non-state actors. The GMA brings together governments, NGOs, and private sector actors to promote the conservation and restoration of mangrove ecosystems, given their importance for Blue Carbon storage and other ecosystem services. The Alliance has already achieved significant progress in protecting and restoring mangroves in several countries, including Indonesia, Madagascar, and the Dominican Republic.

The Changing Wealth of Nations (CWON) (launched in 1995, ongoing). CWON is a database on the world's wealth, which recently presented its first valuation of "blue natural capital," with a focus on mangroves and fisheries (World Bank 2021d). The initiative is a milestone for the universal recognition of the economic value of Blue Carbon habitats. It is only a beginning, however, and other BCEs outside mangroves should be added in the near future. The CWON 2.0 (forthcoming), will present the technical results of the Estimated Global Carbon Storage in Mangrove Ecosystems (see Table 3).

Table 3 Total carbon stock and change in stock (value, percent) in MMT for the top 20 countries, 1996–2020

Country	1996	2010	2015	2020	1996-2020	% Change
Indonesia	2,036.06	1,910.22	1,894.96	1,892.07	-143.99	7%
Brazil	491.03	482.69	480.26	487.30	-3.73	1%
Nigeria	446.27	439.77	438.37	435.49	-10.78	2%
Australia	431.47	410.86	406.57	405.95	-25.52	6%
Mexico	352.62	333.90	331.93	334.06	-18.56	5%
Malaysia	324.28	321.54	319.77	318.65	-5.63	2%
Papa New Guinea	277.86	277.47	276.35	274.11	-3.75	1%
Myanmar	223.27	207.41	203.41	206.44	-16.83	8%
Cuba	214.25	199.03	193.94	194.42	-19.83	9%
Colombia	162.05	156.83	156.23	157.21	-4.84	3%
Philippines	161.38	153.24	153.35	155.53	-5.85	4%
Venezuela	148.03	147.06	147.31	148.36	0.33	0%
United States	139.93	135.56	133.07	134.75	-5.18	4%
Bangladesh	120.54	121.48	120.94	121.45	0.91	1%
India	117.37	113.79	114.90	114.61	-2.76	2%
Gabon	107.81	107.54	107.32	106.87	-0.94	1%
Cameroon	106.98	107.51	107.71	107.22	0.24	0%
Thailand	105.16	99.09	99.17	101.53	-3.63	3%
Madagascar	103.16	100.43	100.32	100.66	-2.50	2%
Guinea Bissau	102.01	100.66	100.82	99.72	-2.29	2%
Grand Total	**6,171.53**	**5,926.09**	**5,886.69**	**5,896.41**		

Source: World Bank, and Silvestrum Climate Associates 2023. CWON 2.0 (forthcoming, 2024)

These instances of institutionalization help ensure that knowledge is built, archived, updated, and shared as needed among participating countries. Ultimately, this will provide a multilateral, results-based finance framework dedicated to Blue Carbon and/or acting as a conduit for national results-based frameworks. Multilateral initiatives could promote and support science projects, including those concerning the development of user-friendly and publicly available online tools on Blue Carbon data, with a wide variety of formats customized for specific end-user communities. Such initiatives could also enable identification of suitable partners—not just philanthropic donors but also Blue Carbon delivery institutions—with the aim of creating regional Blue Carbon clusters or "hubs" (regional Blue Carbon hubs or RBCHs). Key priorities to address knowledge gaps are presented in Box 6.

BOX 6

Key priorities to address knowledge gaps

- **Design Blue Carbon-tailored research programs** that deepen the understanding of BCEs, with a specific focus on actionability (see above).
- **Improve mapping and monitoring** of carbon stock changes, as well as of human-induced degradation trends.
- **Promote the assessment of the economic value of BCEs outside mangroves by the Changing Wealth of Nations (CWON)—or similar—initiatives.**
- **Enhance the space for Blue Carbon in existing and planned initiatives on REDD+.** That includes developing comprehensive carbon-stock data and data on stock changes; assessing drivers of degradation from land and sea; and designing tailored solutions to reverse the degradation trends.
- **Create and boost national and international partnerships** between government, non-governmental organizations, and private institutions, to promote knowledge-sharing of BCEs.
- **Consider designing a multilateral initiative on Blue Carbon,** building on the experience from REDD+ and including the experience from the FCPF to provide World Bank client countries with a Blue Carbon knowledge and technical cooperation framework.

CHAPTER

2 Building a Policy and Institutional Environment for Blue Carbon

(Pillar 2)

Governments are not entirely left to their own devices when it comes to improving knowledge, refining datasets, designing interventions, and mobilizing finance for meaningful Blue Carbon action. Multilateral frameworks have facilitated international cooperation and enabled the establishment of platforms of collective action and of innovative finance.

The two key conventions, the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD), have been in existence since 1992, while others, such as the 1971 Ramsar Convention on Wetlands ("Ramsar Convention"), were adopted even earlier. However, the specific focus on conservation and restoration of coastal wetlands as a means to combat the crisis of climate change and biodiversity loss has been a more recent development. The release of dedicated guidance from the Intergovernmental Panel on Climate Change (IPCC) in 2013, the Wetlands Supplement (IPCC 2014), the adoption of the Paris Agreement in 2015, and the ubiquitous use of the mechanism that sits at its heart (Nationally Determined Contributions) added particular momentum to Blue Carbon action.

2.1 United Nations Framework Convention on Climate

The attention given to coastal wetlands within the UNFCCC was initially mixed. From 1992 onward, it adopted a decidedly holistic view on sources of GHG emissions (sources) and removals (sinks), noting the role of "biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems" (Article 4.1.d). The Paris Agreement has similarly explicitly encouraged countries to conserve and enhance coastal ecosystems (Article 5.1), including the coastal and marine ecosystem referenced in Article 4.1.d of the UNFCCC. Nevertheless, technical rules to track GHG stock changes in wetlands were not available before the release of the 2013 Wetlands Supplement.

The hiatus between 1992 and 2013 (when accounting guidance for coastal wetlands was finally released) can be partially explained by the Kyoto Protocol of 1997. That multilateral agreement, adopted in 1994 and enforced in 2005, had set highly restrictive accounting and carbon crediting rules for land use. While reporting obligations under the UNFCCC were not directly affected by these restrictions, in practice international reporting of GHG emissions and removals from land—specifically from wetlands—remained weak.

Since the release of the Wetlands Supplement in 2013, the tide has been turning. The Wetlands Supplement is an addendum to the "Agriculture, Forestry and Land Use" (AFOLU) volume of the 2006 IPCC "Guidelines for Greenhouse Gas Inventories." The latter provides a comprehensive set of methods for inventorying greenhouse gas emissions GHGs and removals caused by human activities in all sectors—from industry and waste management to agriculture and forestry.

The guidance provides countries with default values (known as Tier 1 values) with which to calculate their GHG inventory data. In principle, countries where wetlands are a major source of national emissions must go beyond Tier 1 and conduct more sophisticated inventories, using more precise, location-specific datasets. (These are Tier 2 and Tier 3 values, with the 2013 Wetlands Supplement also providing input data for these values.) If a country lacks the capacity to complete its inventory using Tier 2 and Tier 3 values, however, the application of Tier 1 provides a good starting point. Countries still need to generate robust activity data—that is to say, data on the magnitude of a human activity resulting in emissions or removals taking place during a given period. However—at least for mangroves—these datasets mostly exist. Moreover, their application to the tier values from the 2013 Supplement (since updated with the so called "2019 Refinement") is straightforward.

2.2 Commitments under the Paris Agreement

About 50 countries have committed to protect and restore BCEs in their NDCs, and another 20 or so have put forward action goals on coastal zone management and marine protected areas.[14] Signatory countries of the Paris Agreement agreed to periodically communicate their NDCs, outlining each country's efforts to reduce their national GHGs. NDCs are both political and implementation-focused documents, and they set the tone for international cooperation. The fact that Blue Carbon is prominently addressed by a great many small island developing states (SIDS), as well as some of the countries with the highest Blue Carbon stocks in the world, is significant.

Across NDCs dedicated to coastal and marine solutions, linkages are made to benefits beyond climate mitigation and adaptation ("co-benefits"), both economic and social. This includes SDG 1 (no poverty); SDG 2 (no hunger); SDG 4 (quality education); SDG 5 (gender equality); SDG 13 (climate action); SDG 14 (life below water); and SDG 15 (life on land). Certain social groups (for example, African Americans, youth, women, and indigenous communities) are identified as vulnerable with respect to coastal and marine exposure, and NDCs highlight the need to engage these groups in active climate action.

2.2.1 Nationally determined commitments and inventories

While the value of BCEs for these countries lies primarily in their co-benefits (specifically for adaptation and disaster risk reduction—see Box 7), a growing number of countries specifically recognizes the role of BCEs as a carbon sink. That recognition carries more complexities than might initially appear, at least if a country seeks to quantify the respective mitigation output.

The ability for a country to make such quantification and to include a given sector (here, Blue Carbon) in its NDC climate mitigation commitment, depends on whether the sector is covered in the country's GHG inventory. As part of their NDC, very few countries have formally committed to the use of the 2013 Wetlands Supplement. However, since 2016 (when Australia was the only country making such a commitment) the pace has been picking up, with Australia, Canada, Fiji, Jamaica, Norway, Panama, Lebanon, Korea, Singapore, and UK formally committing to its use.

14 Lopez 2022 and observations of the authors.

BOX 7

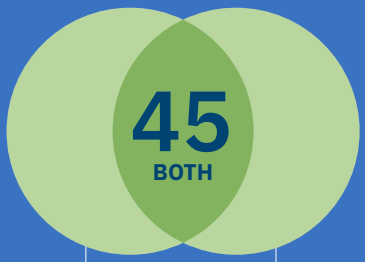
Blue Carbon ecosystems and adaptation measures: Global NDC practice

There is growing attention worldwide to ocean-related measures in climate strategies. This has led the international community and national governments to advance their climate mitigation and adaptation assessments and to include coastal and marine ecosystems as mitigation or adaptation measures. Adopting and scaling-up coastal and marine conservation and restoration measures in new or updated Nationally Determined Contributions (NDCs) can, for some countries, act as a multi-purpose solution for climate mitigation and adaptation.

Under Article 7.11 of the Paris Agreement, it is stated that adaptation communication can be submitted as a component of, or in conjunction with, other communications or documents, including an NDC. Adaptation measures are crucial to protect goods, people, and ecosystems from increasing climate risks and vulnerability[15].

When Lecerf et al. examined the submissions until 2021, 71 countries included coastal and marine Nature-based Solutions for adaptation in their new or updated NDCs. Three types of solutions for adaptation have been incorporated in NDCs, including: a) protecting and restoring coastal and marine ecosystems; b) coastal zone management and protected areas; and c) climate-ready fisheries and fishing communities.

71 Countries included coastal and marine NbS in their new or updated NDCs



1 countries included coastal and marine NoS for only **MITIGATION**

25 countries included coastal and marine NUS for only **ADAPTATION**

15 Lecerf, M. et al. 2021. "Coastal and marine ecosystems as Nature-based Solutions in new or updated Nationally Determined Contributions." Ocean & Climate Platform, Conservation International, IUCN, GIZ, Rare, The Nature Conservancy, Wetlands International and WWF.

Despite the policy priority on adaptation, risk reduction, and perhaps other co-benefits, the capacity to use the 2013 Wetlands Supplement for NDC accounting is rightly se en as a key touchstone for global cooperation on Blue Carbon as such (Thomas et al. 2020). While commitments do not necessarily need to cover climate-change mitigation and adaptation, the dual focus adds precision and provides a measure for comparing climate targets.

A Blue Carbon mitigation commitment built on comprehensive GHG inventory reporting also allows countries to track progress against their commitments, through biennial reporting (as required under the Paris Agreement). If GHG emissions and removals from coastal wetlands are not covered in the GHG inventories, there is no way to rigorously monitor and report whether or to what extent commitments are achieved.

While some countries include targets to conserve and enhance natural carbon sinks in their NDCs, support in making targets fully operational is still needed. Notably, NDCs sometimes include ambiguous or conditional language. They are also not always realistic when it comes to land-use and the

complexities of land tenure. As the 2022 Land Gap Report points out (Dooley et al. 2022), the total area of land needed to meet climate mitigation commitments through natural carbon sinks is almost 1.2 billion hectares, which is equivalent to the total area of global cropland. Furthermore, countries' climate pledges rely on unrealistic amounts of land-based carbon removal. More than half of the total land area pledged for carbon removal—633 million hectares—involves reforestation, putting potential pressure on ecosystems, food security, and indigenous peoples' rights. Support to operationalize NDCs can—and should—focus on:

- Well-designed targets, with clear outlines of relevant habitats and ecosystems;
- Mitigation values (carbon sink credentials and quantities; GHG mitigation benefits);
- Information on assumptions and methodological approaches regarding how climate action is tracked, including GHG mitigation benefits;
- Outlines of adaptation and resilience values for vulnerable communities;
- Mitigation targets, adaptation actions and milestones;
- Connections and complementarities between mitigation and adaptation measures;
- Links to the GBF and the SDGs; and
- Programs, plans, and other implementation details (von Unger, Herr & Castillo, 2020).

Restoring degraded land and ecosystems accounts for 551 million hectares pledged (all natural landscapes). It is not surprising that many countries struggle to adopt NDC implementation plans that spell out concrete measures to meet the NDC targets. However, there are encouraging examples, such as the implementation plan from Costa Rica. The country has been applauded for its wider NDC implementation strategy, manifested in its Decarbonization Plan and the addition of a Blue Carbon Strategy to its toolbox of implementation. The country recognizes the extraordinary opportunities presented by Blue Carbon, which provides optimal mitigation potential in terms of (per hectare) density and highly effective adaptation and resilience benefits (see Box 8).

BOX 8

NDC implementation: Costa Rica's 2023 Blue Carbon Strategy

On World Wetland Day (2 February 2023), the Government of Costa Rica released its first Blue Carbon Strategy[16]. The fresh focus on Blue Carbon is in line with Costa Rica's NDC commitment to protect 100 percent of the country's coastal wetlands, restore priority coastal wetland areas, develop wetland management and monitoring plans, and expand innovative conservation finance mechanisms. The strategy not only promotes traditional wetland protection measures; it also calls for Costa Rica to establish official guidance and criteria for the registration of Blue Carbon projects by 2025—and at the same time to establish financial mechanisms for effective Blue Carbon ecosystems management. The strategy also plans to call for Costa Rica's Central Bank to develop and standardize, by 2030, a methodology for the economic evaluation of the benefits provided by Blue Carbon ecosystems—including but not limited to carbon sequestration.

16 https://drive.google.com/file/d/111dSMS1TBtEL_TN-UErUc3899-GXk-Uw/view.

2.2.2 Blue Carbon and REDD+

Blue Carbon also indirectly benefits from the Paris Agreement's close attention to the global policy framework for reducing emissions from deforestation and forest degradation (REDD+). In one of its main articles (Article 5.2), the treaty specifically encourages Parties to take actions on "**results-based payments**" in relation to REDD+, as established under the UNFCCC (see Box 9).

BOX

9 Reducing emissions from deforestation and forest degradation (REDD+)

At COP 19 in Warsaw (2013), the Conference of the Parties (COP) endorsed the Warsaw Framework for REDD+. The framework is based on Article 5 of the Paris Agreement, encouraging governments at a national level to voluntarily reduce human pressure on forests that result in greenhouse gas (GHG) emissions. The framework acknowledges that each country's effort will vary according to their capacities and capabilities.

Plenty of work has gone into developing different features and aspects of REDD+ to help make the instrument operational for countries. There is considerable guidance—based on increasing practice—on the calculation of forest (emission) reference levels (**FRL** and **FREL**). These are benchmarks or baseline values that are established to measure the GHG emissions and removals from forest-related activities such as deforestation, forest degradation, and afforestation. A distinct body of work Is dedicated to **REDD+ safeguards,** including with respect to governance roles and participation rights of local communities.

There are rules both for national REDD+ implementation as well as for **sub-national ("jurisdictional") approaches.** Strong bilateral and multilateral activities have supported the REDD+ development in recent years, among them the United Nations Collaborative Initiative on Reducing Emissions from Deforestation and Forest Degradation (UN REDD) and the World-Bank-managed Forest Carbon Partnership Facility (FCPF). Some 50 (mostly tropical) countries have started building country-wide REDD+ implementation frameworks, with financial support from developed countries.

REDD+ and Blue Carbon share a wide range of characteristics. In most countries, mangroves are considered forestland. Governments increasingly design REDD+ projects and toolkits for coastal environments, in general, and mangrove forests, in particular (Fortuna 2020; Bhomia et al. 2021; FAO 2020).

REDD+ has also produced a blueprint for ecosystem interventions that Blue Carbon interventions benefit from. The concept of "results-based" (or "performance-based") support is particularly helpful for both the promotion of transparent impact evaluation (based on measuring-reporting-verification or MRV guidelines) and the installation of community-focused benefit systems (carbon benefits as well as non-carbon benefits). REDD+ policy development has also advanced land-tenure discussions and participatory engagement actions (including recourse mechanisms), benefiting indigenous populations (Halverson 2019).

The global REDD+ infrastructure provides rich models and templates for intervention that are helpful for the planning and design of Blue Carbon interventions. This includes stepwise guidance on preparation of a financing plan, with a focus on the organization of data on costs, revenues, and sources of financing; measures to address any funding gaps; process for conducting financial and economic analysis and sensitivity analysis of variables influencing program finance; and arrangements for flow of funds to ensure that the financing plan is robust in supporting emission reduction program implementation.[17]

This said, REDD+ engagement also holds a certain level of ambiguity for Blue Carbon environments—in terms of both overlapping scope and conflicting administrative responsibilities. This can impede action on the ground. Perhaps the ambiguity is less of an issue for seagrass beds and salt marshes, since they do not qualify as forests in national regulatory systems and clearly fall outside the scope of REDD+. For mangroves, however, there is potentially contentious overlap.

First, while many REDD+ countries follow a broad REDD+ forest scope that includes mangroves in their REDD+ scope, they restrict their REDD+ accounting framework to above-ground biomass, leaving the enormous below-ground carbon sink in limbo. For other countries, the REDD+ treatment of mangroves remains altogether unclear. This not only has repercussions for the correct calculation of emission reductions but also jeopardizes analytical work, stakeholder involvement, and policy planning (see Box 10).

17 https://www.forestcarbonpartnership.org/system/files/documents/fcpf_process_guidelines_2021_v5.2.pdf

BOX

10 Improving Blue Carbon accounting through REDD+, Indonesia

Indonesia has built a robust carbon dataset that includes removals of mangrove forests. When Indonesia submitted its first forest reference emissions levels (FREL) to the United Nations Framework Convention on Climate Change in 2016,[18] the accounting lacked robustness, with various gaps and omissions. It did not account for emissions from peatland fires (which accounted for almost 30 percent of national emissions in 2014) or for non-CO_2 gases from land, in the form of methane. It also included emissions from soil carbon only for deforested or degraded terrestrial peatlands, not mangroves (for which too few data points were available). However, in its new submission from 2022[19], Indonesia comprehensively accounts for emissions and removals of mangrove forests, including with respect to soil carbon.

18 https://ditjenppi.menlhk.go.id/reddplus/images/resources/frell/FREL-Submission-by-Indonesia-2016.pdf.
19 https://redd.unfccc.int/files/2nd_frl_indonesia_final_submit.pdf.

Second, mangroves are often the subject of inter-departmental administrative attention—from forestry departments to water and fisheries departments. The latter rarely have institutional links to REDD+ frameworks, which in many countries complicates coherent REDD+ governance for mangrove ecosystems (see Box 11).

BOX 11

Jurisdictional reach: Delta Blue (Mangrove) Project, Pakistan[20]

The Delta Blue Project is formally a restoration project but follows a jurisdictional script in all but its name. Borne out of a public-private partnership with the provincial government of Sindh, the project spreads over 350,000 hectares. A replication plan is in the making to include the remaining restoration sites in Sindh (Delta Blue II). The government—in this case—provides the land, oversees restoration activities, and interacts with communities on the ground. The provincial government also acts as a focal point for aligning the project with central government policies and NDC integration.

20 https://deltabluecarbon.com.

2.3 Convention on Biological Diversity's COP15 and UNFCCC's COP27

Parties at COP15 (CBD, Montreal) adopted the long-awaited Kunming-Montreal Global Biodiversity Framework (GBF). It updates the Aichi targets for 2020 and provides a roadmap towards 2030 and 2050. The GBF holds momentum for coastal and marine ecosystems—notably BCEs—by vastly increasing the conservation and restoration targets. Described as "more inclusive, more comprehensive, more SMART (specific, measurable, achievable, relevant, and time-bound)," the GBF raises the ambition level on multiple fronts by:

- **Proposing spatial planning** to reduce the losses to areas of high biodiversity importance, bringing losses close to zero by 2030;
- **Conserving 30 percent of terrestrial, inland water, coastal, and marine areas by 2030 through protected areas and other effective area-based conservation measures** (compared to 17 percent for terrestrial and inland water, and 10 percent for coastal and marine areas by 2020, under Aichi);
- **Ensuring that at least 30 percent of degraded terrestrial, inland water, coastal, and marine ecosystems are under effective restoration** by 2030 (compared to 15 percent by 2020, under Aichi);
- **Ensuring the full integration of biodiversity into policies and regulations—including environmental impact assessments** (EIAs)—across all levels of government and sectors, and progressively aligning all public and private activities, fiscal and financial flows with the GBF;
- **Eliminating or reforming incentives that are "harmful to biodiversity"** (such as subsidies) by 2050, progressively reducing them by at least $500 billion per year by 2030, and by scaling up positive incentives for biodiversity conservation and sustainable use; and
- **Increasing the level of financial resources from all sources "substantially and progressively," to at least US$200 billion per year by 2030.** This fresh and unprecedented goal would be achieved by, for example, increasing transfer from developed to developing countries to at least US$20 billion per year by 2025, and at least US$30 billion per year by 2030.

In support of the GBF, COP15 requested the Global Environment Facility (GEF) to set up a Special Trust Fund to assist developing countries to achieve their conservation targets. Then, with finance in mind, 23 countries and organizations—led by Colombia and Germany—launched the **Accelerator Partnership.** This is intended to help countries fast-track and upscale the implementation of their **National Biodiversity Strategies and Action Plans (NBSAPs)**. The German Federal Government will support and kick-start the operationalization of the NBSAP Accelerator Partnership, as well as concrete implementation activities in selected countries.

During UNFCCC's COP 27 (UNFCCC, Sharm El Sheikh), multiple initiatives were also launched regarding climate change, land, and ecosystem degradation, and including BCEs in scope. One of them is the Enhancing Nature-based Solutions (NbS) for Climate Transformation (ENACT) Initiative, which aims to drive collective action across climate, biodiversity, and desertification, and to help close

the finance gap for NbS. The initiative will serve as a hub for government and non-state actors in fostering collaboration, accelerating action, facilitating policy dialogue and bringing global coherence to activities. Focus areas include food security and productivity, adaptation and disaster risk reduction, oceans, coastal systems, Blue Carbon and the sustainable blue economy, and green-grey infrastructure. Another initiative is the "**Mangrove Breakthrough**", launched by the Global Mangrove Alliance (GMA) in collaboration with the UN Climate Change High-level Champion. This initiative represents a science-based, measurable, and achievable goal for non-state actors and governments to commit on collective action to halt mangrove losses, restore half of recent mangrove losses, double the protection of mangroves globally, and ensure long-term finance, with an investment level of US$4 billion by 2030.

2.4 Stacking the Platforms: Synergies of Climate Action, GBF, and the Sendai Framework

Other recent international developments have tapped into the momentum for Blue Carbon and Nature-based Solutions, more generally. They include the adoption of the IUCN Global Standard for NbS and the resolution from the fifth session of the United Nations Environment Assembly ("UNEA-5"), which recognized the essential role for NbS in achieving SDGs. Under the IUCN Standard, Nature-based Solutions are defined as "actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits" (IUCN, 2016). This is a concept that strongly resonates with Blue Carbon conservation and restoration. It enforces NbS as a holistic tool, capable of providing climate mitigation benefits and more. The UNEA-5 Resolution, in turn, emphasizes the potential of NbS in delivering co-benefits (see Box 12) while addressing social issues (for example, land tenure rights clarification).

BOX

12 Nature-based solutions

Nature-based solutions are actions capable of "addressing major social, economic and environmental challenges, such as biodiversity loss, climate change, land degradation, desertification, food security, disaster risks, urban development, water availability, poverty eradication, inequality, and unemployment, as well as social development, sustainable economic development, human health and a broad range of ecosystem services" (UNEA, 2022).

Many stakeholders have firmly embraced the new turn towards NbS. They include financial institutions (representing US$ 24.8 trillion in assets under management) that have spoken on the need to prioritize support for nature conservation and restoration and to synchronize the different policy platforms, specifically on climate and biodiversity—that is to say, NBSAPs and NDCs (UNEP FI et al. 2022). The private sector's commitment to "contribute to the protection and restoration of biodiversity and ecosystems through [their] financing activities and investments" is linked to a clear GBF mandate for the alignment of financial flows, the disclosure of nature- and climate- related impacts and dependencies, and the development of a pipeline of nature-positive projects and investments. Moreover, BCEs provide a valuable opportunity to link the UNFCCC and CBD by contributing to the achievement of the GBF's terrestrial and marine conservation targets, through various sources of funding—including traditional biodiversity funding and climate finance, carbon credits stacked with biodiversity benefits, and results-based funding from REDD+.

Another important synchronization through Blue Carbon can happen between climate action (mitigation and adaptation) on the one hand, and the Sendai Framework for Disaster Risk Reduction 2015–2030. The Sendai Framework is the first major agreement of the post-2015 international development agenda. It provides its member states with concrete actions to protect development gains from the risk of disaster. The Sendai Framework recognizes and promotes the role of ecosystems and environment as a cross-cutting issue. The framework outlines seven targets and four priorities for action to prevent new, and reduce existing, disaster risks:

- Understanding disaster risk;
- Strengthening disaster risk governance to manage disaster risk;
- Investing in disaster reduction for resilience; and
- Enhancing disaster preparedness to ensure an effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction.

Blue Carbon ecosystems—and the sustainable management of their surrounding land and water resources—are pertinent to all four priorities of the Sendai Framework, and are therefore critical to reducing climate risks in coastal areas.

2.4.1 National Delivery Frameworks

While international momentum has been building, practice points to the importance of building and using suitable policy and institutional frameworks at the national level to develop country-specific NbS roadmaps—especially, to realize the opportunities for Blue Carbon. Not all of these frameworks are new. Countries will often have existing structures, policies, and norms to manage and protect BCEs but they are sometimes too broadly or weakly formulated to have a specific impact, or they lack well-resourced and effectively-mandated enforcement agencies, and adequate enforcement powers.

Recent decades have seen dramatic improvements when it comes to adopting and installing robust legal protection regimes. Many countries have introduced protective bans, such as bans on cutting mangroves (Slobodian and Badoz, eds. 2019) and, less commonly, sanctions on removing or damaging seagrasses (Griffiths et al. 2020) as well as legal frameworks for community-based mangrove management. There is also now specific protection of BCEs through marine protected areas. However, despite these improvements over the past two decades, overall government efforts still do not match the threat, especially in countries with the highest rates of degradation, including in Southeast Asia. It is hoped that the new protection targets agreed under the GBF will specifically benefit coastal systems, and that governments employ community-based management tools for the operation of protected areas.

Novel challenges (linking law, governance, and finance for NbS interventions) concern the recognition of carbon rights in the context of land tenure and the inclusion of local communities, when setting out monetary and non-monetary arrangements for forest carbon and Blue Carbon investments. The World Bank's BioCarbon Fund and the Forest Carbon Partnership Facility (FCPF) provide invaluable insights into the challenges as well as ready-to-use solution sets for countries to define carbon rights, mandate carbon transactions, and set out principles for benefit-sharing with communities.

2.4.2 Land tenure and carbon rights

Certainty regarding land tenure is essential for investments in conservation and restoration of natural habitats, particularly if private sector finance is involved, with its high expectations for predictability and its low appetite for risk. Land tenure over Blue Carbon habitats is often problematic for various reasons, including the natural variability of the inter-tidal zone, multi-layered legal claims, and interdependencies, as well as the modern era's disrespect for **customary** tenure, on the one hand, and **collective** tenure, on the other.

While governments, as a policy priority, should formalize land tenure of Indigenous Peoples and Local Communities (IPLC) where mangroves, seagrasses and salt marshes are located, Blue

Carbon engagement can both pioneer and fast-track the effort. The recognition of carbon rights in coastal wetlands can help. Interventions may be modeled on the FCPF's work in developing countries across the globe. The facility, through the FCPF Methodological Framework, connects the ability to hold (and transfer) title to emission reductions with land and resource tenure rights. Indicator 28.3 of said framework refers to the "implications" of the land and resource regime assessment for the program. Indicator 36.2 aims at the alignment between the two: "The emissions reductions program entity demonstrates its ability to transfer to the carbon fund title to emissions reductions while respecting the land and resource tenure rights of the potential right holders, including indigenous peoples."

Title to emissions reductions and removals, in this context, have a triple function. They support:

A defensive or protective claim

Land and resource tenure holders must not be restricted in their rights and not be integrated in the emissions reduction program outside an existing framework of mandatory law or their free (prior, informed) consent;

A reward or compensation claim

Where emission reductions and removals are the result of an effort by stakeholders (including, but not necessarily limited to, land and resource tenure holders), such stakeholders acquire a right to control and share the results and the proceeds; and

An exclusivity claim

Title to emission reductions and removals may be (and often is) shared among various stakeholders, including land and resource tenure holders. However, the title itself is unique and not replicable. It gives a single, exclusive right to the emission reductions or removals achieved through the specific program and the specific program activities.

2.4.3 Benefit sharing

Blue Carbon ecosystems are increasingly understood in their role as "social-ecological systems," providing a range of services to local communities and, depending on the stewardship of their natural tenure holders (fisher-people), acting as a buffer to a multitude of threats. (Dahdoub-Guebas et al. 2021; Partelow et al. 2018). Integrating communities—specifically fishing communities, and indigenous peoples—into the governance framework for Blue Carbon interventions is essential (see Box 13). Equally important is to have these communities partake in the distribution of investment benefits and proceeds.

BOX

13 Payment for ecosystem services schemes on mangroves

Ecuador

The Socio Manglar Program in Ecuador is a successful payment for ecosystem services (PES) initiative launched in 2008. It aims to conserve and restore mangroves—vital ecosystems that offer services such as carbon sequestration, coastal protection, and biodiversity habitat. The program, supported by the Government, UNDP, NGOs, and community organizations, provides economic incentives to local communities. These incentives come in the form of direct payments and support for sustainable livelihood activities like ecotourism and artisanal fisheries. To participate, communities establish and manage communal mangrove reserves, legally recognized by the government and monitored for ecological and social compliance. The program has achieved significant results, including the establishment and management of over 50 mangrove reserves, covering more than 20,000 hectares. It has also generated co-benefits such as sustainable livelihoods and community empowerment. Recognizing the positive outcomes, the Government took a significant step in 2021 by incorporating an additional 2,900 hectares of mangrove forest into the conservation program. The Socio Manglar Program exemplifies how PES schemes can incentivize the conservation of coastal ecosystems, foster sustainable development, and empower local communities.

Benefit sharing arrangements and plans refer to a structure that allows distribution of monetary and non-monetary benefits generated from carbon projects among local communities. To ensure equitability, it is imperative that governments and investors alike understand the specific role of the IPLC. This understanding should encompass the demography, economic activities, health, employment, education, and other relevant factors relating to the communities residing in and around the project area.

When formulating benefit-sharing agreements, investors and developers must adhere to core principles, and governments should provide relevant guidance. These principles include:

- Negotiating benefit-sharing arrangements prior to monetization (such as the sale of credits);
- Transparently disclosing the portion of revenues that directly benefits the communities; and
- Clearly indicating how the funds are allocated among the communities (Meridian et al. 2022).

Furthermore, project costs, finance flows, and revenue sharing should be described in a transparent manner. The transparency of this information empowers individuals to make well-informed assessments about the project's structure and benefits distribution.

To ensure fair distribution of the proceeds generated by a project, various methods can be employed, in terms of both content (setting specific quotas) and process (such as establishing a trust, partnering with local NGOs, or facilitating the formation of cooperative organizations). The community-oriented Plan Vivo Standard requires that "[at] least 60% of income from the sale of Plan Vivo Certificates, after payment of any charges, taxes or similar fees levied by the host country, must directly benefit the Project Participant(s) and other Local Stakeholders" (Plan Vivo 2022). While details may be missing regarding what is considered income and what direct benefits there are to communities, the standard's programmatic approach represents a touchstone for Blue Carbon interventions (see Box 14).

CASE STUDY BOX

14 Mikoko Pamoja, Kenya

Mikoko Pamoja is a project that engages local communities in the conservation and restoration of mangrove areas through the sale of carbon credits. The project was accredited by Plan Vivo Standard to operate for a period of twenty years. Under the coordinating body of the project, Association of Coastal Ecosystem Services (ACES), the credits are sold, and the community decides where the revenues will be allocated. To date, the money has supported local development projects in water and sanitation, education, health, and environment conservation. From the avoidance of deforestation of a 107-ha Standards to operate for a period of mangrove forest and 10 ha of plantation, prevention of forest degradation and new planting of trees, the project's carbon benefits are estimated to be 2,400 CO_2 yr -1. The project was awarded with the UNDP Equator Prize 2017 for being an outstanding example of a nature-based local solution to sustainable development.

CHAPTER

3 Mobilizing Finance for Blue Carbon

(Pillar 3)

The gap between the financing needed to reverse nature's decline, and current spending, is a major challenge. It is estimated that at least US$ 700 billion annually in financing is missing (World Bank 2022d). CBD-focused international financial flows remain unimpressive[20]. As the OECD reported in 2020 (OECD 2020), the majority of biodiversity-related development finance targets terrestrial and freshwater biodiversity; only a small fraction is allocated to the conservation and sustainable use of marine (ocean) biodiversity. An estimated US$ 360 million of bilateral official development assistance (ODA) targets marine biodiversity each year as a principal or significant objective—equivalent to 4 percent of total allocable bilateral biodiversity-related ODA. Multilateral ODA targeting marine biodiversity as a principal or significant objective, is estimated at US$ 63 million per year, which is approximately 9 percent of multilateral biodiversity-related ODA reported.

20 https://doi.org/10.1038/s41467-021-23168-y.

The picture is not much different for climate finance leveraged in the context of the UNFCCC. While annual financial flows for forest, agricultural, land use, and fisheries have exceeded US$16 billion, fisheries (the category traced by the Climate Policy Institute that comes closest to BCE) have received only 1 percent of that amount, or US$ 160 million (CPI 2022). In contrast, unsustainable fishing receives subsidies that lead to overcapacity and overfishing. The International Monetary Fund estimates that US$ 22 billion is allotted to fishing subsidies each year (Sumaila et al. 2021).

3.1 Multilateral Funding

At the level of financial support, Blue Carbon is on the way to receiving increasing attention by multilateral funds and multilateral banks. Multilateral banks have a role to play in helping bring Blue Carbon into development policy and bridging financial gaps. Mainstreaming Blue Carbon into the development process requires scale and speed.

The **World Bank Group** is the largest multilateral financier of climate action in developing countries. Our climate financing and technical support reached a record of nearly US$ 32 billion in fiscal 2022 alone[21]. The institution has become a key investor in coastal protection, restoration, resilience, and the Blue Economy. The World Bank Group recently approved for funding the Mangroves for Coastal Resilience project, which invests US$ 420 million as a concessional loan to enhance the management of mangroves and the livelihoods of local communities in Indonesia. The World Bank Group also recently approved a US$350 million loan to help Morocco launch its Blue Economy Program for Results, aiming to improve job creation and economic growth, as well as the resilience of natural resources and food security. Another example is India's National Cyclone Risk Mitigation Program–II, which received a US$ 308 million loan in 2015. It seeks to minimize vulnerability in the cyclone hazard-prone states and aims to make people and infrastructure more disaster-resilient. Through the PROBLUE Trust Fund, the World Bank has been strengthening the protection and restoration of marine ecosystems by supporting policy development and strategic investments. With a portfolio of technical assistance that amounts to US$ 134 million in 81 countries, **PROBLUE** has played a catalytic role in accelerating the adoption of ecosystem-based approaches in ocean-related sectors, including Blue Carbon interventions. PROBLUE has been instrumental in supporting the expansion of the World Bank Group's blue portfolio, which exceeds US$ 7 billion through core IBRD and IDA financing. For a non-exhaustive funding overview, see Appendix 2.

At the level of financial support, BCEs are attracting increasing attention from multilateral funds and multilateral banks. Since 2010, the **Adaptation Fund (AF)** has invested around US$ 120.4 million in coastal-related adaptation measures, with US$82.3

21 World Bank Press Release. https://www.worldbank.org/en/news/press-release/2022/09/07/world-bank-group-delivers-record-31-7-billion-in-climate-finance-in-fiscal-year-2022.

million currently invested in projects approved or under implementation. The AF has invested most in flood defense and resilience. For example, US$ 14 million is being invested in climate change adaptation in vulnerable coastal towns and ecosystems of the Uruguay River, and another US$ 14 million in reducing climate vulnerability and flood risk in coastal urban and semi-urban areas in cities in Latin America (Chile, Ecuador).

The Global Environment Facility (GEF) currently has about US$ 208 million invested in about 40 blue or coastal projects (not all of them targeting Blue Carbon, however). The global Blue Nature Alliance has received US$ 22.6 million in grant funding for their efforts at improving the conservation of 1.25 billion hectares of ocean ecosystems. The PROCARIBE+ Project received grant funding of US$ 15.4 million. This project aims at protecting and restoring the ocean's natural capital and building resilience in the Caribbean. Another US$ 15 million grant has been approved for the Pacific I2I Regional Project: Ocean Health for Ocean Wealth—The Voyage to a Blue Economy for the Blue Pacific Continent. Approximately US$ 24 million is currently being invested in nine mangrove projects (protection, conversion, and management). Between 2016 and 2021, the GEF (in partnership with UNEP), also funded the Blue Forests Project (at US$ 4.5 million), an initiative to improve the management of coastal carbon and ecosystem services to build climate-resilient and sustainable communities.

The **Green Climate Fund (GCF)** has spent US $374 million in grants for projects that include coastal resilience, coastal protection/coastal communities, or flood protection. US$ 57.7 million has been raised to make Samo's capital climate-resilient, and to strengthen adaptive capacity and reduce exposure to climate risks. US$ 30.4 million also partially funds, for example, the Blue Action Fund, which aims to improve the protection of the world's oceans and coasts. In addition, there is US$ 125 million equity for the Global Fund for Coral Reefs, which serves as a blended-funding vehicle using grants, debt, and other financial instruments to facilitate private, return-oriented investments in coral reef conservation and resilience.

3.2 Results-Based Carbon Finance

Results-based carbon finance (RBCF) refers to a financing mechanism that rewards the achievement of predetermined results, rather than the delivery of inputs or outputs. In the context of REDD+ (see above, section 2.2.2), RBCF is used to incentivize developing countries to reduce their GHG emissions from deforestation and forest degradation, and to conserve and enhance forest carbon stocks. Under REDD+, developing countries can receive payments for the verified reduction of GFG emissions that result from deforestation and forest degradation. These payments are made based on the results achieved, rather than the inputs provided or the activities carried out. This means that the countries are rewarded for reducing their emissions, rather than simply for carrying out activities that may or may not lead to emission reductions.

The RBCF approach in REDD+ is typically structured as a performance-based payment system, where payments are linked to the achievement of specific targets or milestones. For example, a country may receive payments for reducing its deforestation rate below a certain threshold, or for increasing the area of forest under protection.

Importantly, REDD+-based RBCF does not involve emissions-trading in the sense that host countries would have to debit the units funded from their NDC accounting frameworks. That means that host country governments can use the units paid for under an RBCF scheme for their own NDC targets (on the debiting or "Corresponding Adjustments"[22]). The allocation is important for both the host country's capability of meeting its NDC targets and the wider discussion of double counting of emissions reductions or carbon credits. It is noted in this context that most experts agree that RBCF does not give rise to double counting, as long as the purchaser makes no offset claim and the use towards the host country's NDC is transparently communicated.

The amount of funding provided for REDD+ through RBCF varies depending on the source of the funding and the time period being considered. However, according to the latest available data from the REDD+ Resource Database, by the end of 2021, a total of US$ 2.2 billion had been committed or disbursed for REDD+ through RBCF. This funding has been provided by a range of sources, including governments, multilateral institutions, and private sector actors. Some of the largest sources of RBCF funding for REDD+ include the World Bank's Forest Carbon Partnership Facility (FCPF), the Green Climate Fund (GCF), and the Norwegian International Climate and Forest Initiative (NICFI).

22 This mechanism subtracts the GHG emissions reductions from the host country's account and adds them to the importing country's account.

Several RBCF funding schemes included mangrove interventions, although data is not available on the RBCF share that went specifically into mangroves. Overall REDD+ RBCF pricing has been mostly stable over the past year, if at a relatively low level of between US$ 5 and US$ 10 per tCO_2 (FCPF and LEAF, respectively). In the future, REDD+ and Blue Carbon may be unified under the World Bank's Scaling Climate Action by Lowering Emissions (SCALE) Partnership Crediting Framework (see Box 15).

BOX

15 Scaling climate action by lowering emissions partnership crediting framework

As part of COP27, hosted in Sharm El-Sheikh, the World Bank presented the Scaling Climate Action by Lowering Emissions (SCALE). SCALE is a multi-partnered trust fund that seeks to catalyze transformative climate action by deploying Results-Based Climate Finance (RBCF) in developing countries, where countries receive grant payments for achieving pre-agreed, verifiable results, to accelerate the fulfillment of their National Determined Contributions (NDCs). (The World Bank 2021f)

SCALE supports countries to build a track record of generating verified emissions reductions that they can apply towards their NDC commitments, and yielding excess credits that can be made available for carbon markets. To support the achievement of its outcomes, SCALE also deploys targeted funding for technical assistance activities such as knowledge generation, capacity building, development of tools and modeling, and program preparation.

Social inclusion is a central element of all SCALE programs. Enhancing Access to Benefits while Lowering Emissions (EnABLE) is an associated trust fund that will enhance the inclusion

of marginalized communities and indigenous peoples through the design of benefit-sharing arrangements.

SCALE supports just and inclusive transition towards reduced greenhouse gas emissions in three major pillars:

- **Natural climate solutions.** SCALE supports the implementation of mitigation actions conducive to reducing emissions and enhancing removals under REDD+, Blue Carbon, Climate Smart Agriculture (CSA), and landscape-scale agriculture, forest, and other land-use (AFOLU) programs; and delivering outcomes such as enhanced agricultural productivity, ecosystem conservation, and resilient marine economies.
- **Sustainable infrastructure solutions.** SCALE incentivizes the building and operation of sustainable infrastructure—including energy, industry, buildings, transport, urban water and waste management— delivering direct emissions reductions while improving public services, productivity, and resilience.
- **Fiscal and financial solutions.** SCALE supports green fiscal policy reform, including harmful subsidy removal, energy pricing reform, carbon pricing, and green financial sector interventions such as climate- smart public co-financing, incentivization of portfolio shifts with commercial banks, and climate-risk- reflecting financial regulation and monetary policy.

3.3 Carbon Markets

Setting incentives for communities, fishers, farmers, and other landowners and land-users (including governments) to conserve pristine coastal wetlands and restore those that are drained or degraded, is a key challenge in achieving the goals of the Paris Agreement. Emissions trading (carbon markets) can play an important part in this incentivizing. While carbon markets have long been used for terrestrial forest interventions, they have recently been tapped for Blue Carbon interventions.

Some of the GHG accounting procedures for Blue Carbon interventions are quite similar to those for the more established category of forestry projects—for example, assessing baseline scenarios, carbon stocks in biomass, leakage emissions from activity shifting, as well as permanence. But specific components are distinctly different when assessing other dynamics, such as the effects of sea-level rise (as the tidal zone may shift landward), ecological leakage (changes to adjacent areas due to hydrological connectivity), carbon stocks in tidal wetland soils, and methane emissions. (For conceptual details, see Appendix 3.)

3.3.1 Clean Development Mechanism

Most of the existing carbon markets are government-backed. They are confined to domestic marketplaces (emissions trading in China, Australia, North America, the EU, and so on), and they work based on a mandatory emissions reduction target to be met (hence "compliance markets"). They are also primarily focused on industrial emissions, rather than natural solutions.

This said, the Clean Development Mechanism (CDM), the project-based mechanism for the creation of officially recognized carbon credits in the era of the Kyoto Protocol (2008-2020), had a window for land-based interventions, including on mangrove restoration. However, the credits generated were defined as temporary (in need of continuous replacement), which put them at the periphery of investor interest. It is also one of the reasons why the largest emissions trading scheme at the time—the European Emissions Trading Scheme (EU ETS), which drove most of the demand for CDM credits for many years—never opened up to land-based projects. To reduce the non-permanence risk, buffer approaches, such as those piloted under FCPF and ISFL, could be developed where a certain amount of verified ERs is set aside in a buffer mechanism to insure against any potential future reversal event under the BCEs project and renders Blue Carbon ERs a more permanent—thereby more attractive— carbon asset.

Nevertheless, for all its limitations, the CDM triggered the development of more than 10 ecosystem-based accounting methodologies. These include one on Afforestation and Reforestation of Degraded Mangroves (UNFCCC 2013), and some

50 projects worldwide—among them Protection of Cameroon Estuary Mangroves through Improved Smoke Houses (UNFCCC 2010a) and Small-Scale and Low-Income Community-Based Mangrove Afforestation Project on Tidal Flats (UNFCCC 2010b) in Riau Island Province, Indonesia.

3.3.2 Voluntary carbon markets

A small but growing market is built by and for non-state actors (see Table 4). These privately organized, non-regulated (non-compliance) initiatives, or "voluntary carbon markets," fill two significant gaps. First, they have an important transnational segment. Two of the big four standards—the Verified Carbon Standard (VCS) and the Gold Standard—are available across countries, and carbon credits can be traded across borders. The other two—the American Carbon Registry (ACR) and the Climate Action Reserve (CAR)—are available in the Americas.

Table 4 Comparison of the size of compliance and voluntary carbon markets.

	Compliance Carbon Market	Voluntary Carbon Market
Total market value	Total Market Value $272 billion USD (2020)[23]	Total Market Value $1 billion (2021)[24]

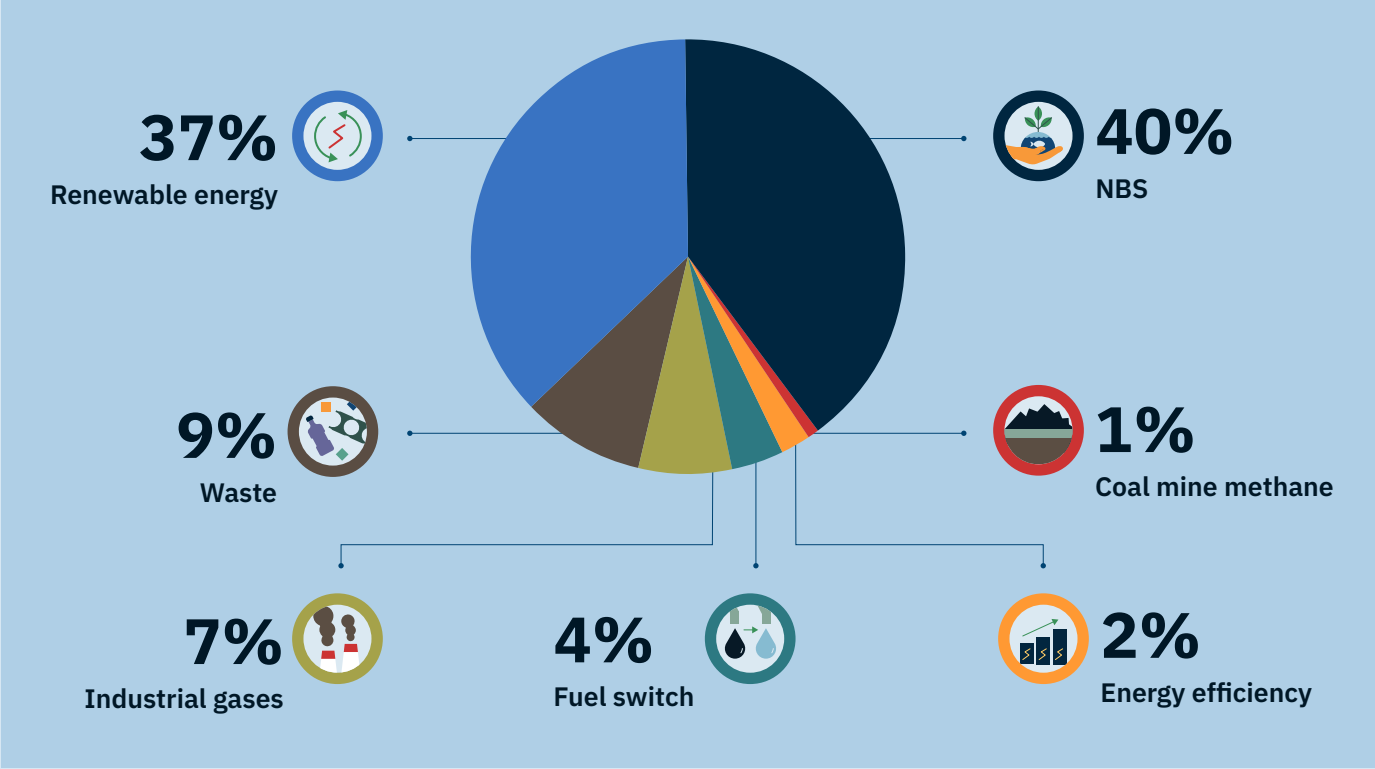
Source: World Bank's GFDRR 2023 (forthcoming)

Second, voluntary carbon markets have moved into the sectors left out by most compliance markets: agriculture, forestry, and other land use (AFOLU). The World Bank and BeZero Carbon identified that of all voluntary carbon market credits issued, 48.85 percent are categorized as nature-based solutions (Figure 9). These nature-based projects (nature-based solutions/natural climate solutions) account for much of the (strong) growth of the voluntary carbon markets, accounting for a trade volume of 37 million tCO_2e in 2019, 58 million in 2020 and, in a huge leap, 227 million tCO_2e in 2021 (Forest Trends 2022, Forest Trends 2021).

23 REFINITIV, Carbon Market Year in Review 2020, 2021, https://www.refinitiv.com/content/dam/marketing/en_us/documents/gated/reports/carbon-market-year-in-review-2020.pdf.

24 EM Insights Team, Voluntary Carbon Markets Top $1 Billion in 2021 with Newly Reported Trades: A Special Ecosystem Marketplace COP26 Bulletin, n.d., https://www.ecosystemmarketplace.com/articles/voluntary-carbon-markets-top-1-billion-in-2021-with-newly-reported-trades-special-ecosystem-marketplace-cop26-bulletin/.

Figure 9 Voluntary Carbon Market credits issued by activity type (2022).



Source: World Bank GFDRR, 2023 (forthcoming).

Voluntary carbon standards operate as "baseline-and-credit" instruments. They define methodologies to calculate in detail "baseline" (or business-as-usual) GHG emissions (from land conversion, drainage of peatlands, degradation, and other) and issue credits when and after the project verifies that GHG benefits have been achieved compared to the baseline. Each credit stands for one ton of CO_2e avoided, reduced, or removed (sequestered).

The credits are issued into a registry account, where they can be freely traded. While the registries follow all credit movements from issuance to retirement (each credit has a unique serial number linking it to a specific project and a specific "vintage" or generation year), there is no single marketplace for traders. Most of the trades happen over-the-counter—that is, away from centralized platforms or brokers.

The end-buyers are companies (and also individual consumers) committed to either offsetting part or all of their GHG emission (carbon neutrality), or contributing to climate change mitigation without claiming carbon neutrality as a result. Offsetting, in this constellation, is a voluntary action by the end users. They are not under obligation from their government, and also the offsetting action does not show in a compliance registry—in particular, not in the accounting/registry system under development at the level of the United Nations Framework Convention on Climate Change (UNFCCC).

3.3.4 Voluntary carbon market approaches to Blue Carbon

Carbon project interventions in Blue Carbon ecosystems (BCEs) account for both GHG removals (for instance, through restoration practices) and reduced GHG emissions (for example, through conservation of coastal ecosystems). The Verified Carbon Standard (VCS, managed by Verra), is by far the largest standard in the AFOLU sector, with the most projects registered, the most carbon credits issued, and the most comprehensive coverage of conservation, restoration, and management practices across landscape and land-use types, including Blue Carbon ecosystems. It is not the only standard available for BCE, however (see Table 5).

The VCS has two global methodologies: VM0033 (Methodology for tidal wetland and seagrass restoration) and VM0007 (REDD+ Methodology Framework), which connect with tidal wetlands modules. The latter covers all functionality of VM0033, which focuses on restoration activities, as well as activities for conservation. Under VM0033, additionality is addressed using a standardized method, involving a so-called "positive list." The methodology implies that projects that implement activities to the positive list are automatically deemed as additional, meaning that projects automatically qualify for crediting. Classes of project activities that have low levels of adoption in the marketplace, that are not the least-cost option or that have no revenue streams besides carbon finance, can be predetermined as additionalities. Following an attempt from Verra to harmonize baseline accounting procedures across all their REDD+ methodologies, the baseline accounting procedure of the VM0007 will be subject to changes after expert revisions.

Verra has chosen to make VM0033 the all-encompassing Blue Carbon methodology, in a further attempt to capitalize on the increasing interest in Blue Carbon methodologies and lessons learned from years of both restoration and conservation practices. The updated VM0033 will adopt the new REDD baseline principles and procedures in the all-new VCS ARR methodology (currently under validation). The new methodology (VM0033 v3) is expected to be available at the end of 2023, with tidal wetlands procedures removed from VM0007.

In addition, certain countries or jurisdictions, from the US (Louisiana), to Japan and Australia, have their local GHG accounting methodologies for BCEs. Australia has included BCEs in its national GHG accounts. The Australian Government's Emissions Reduction Fund has developed comprehensive guidelines for that purpose (Kelleway et al. 2017). In Japan, guidance documents describing measurement methods for seagrass meadows, tidal flats, embayments, and port facilities have been prepared (Tokoro et al. 2015).

As shown in Appendix 3, most currently registered mangrove restoration projects have previously applied the CDM methodology AR-AM0014 (Afforestation and Reforestation of Degraded Mangrove Habitats). In 2022, Verra set a December 2022 deadline for new projects using the CDM afforestation/reforestation methodologies (including AR-AM0014). Since then, all projects must apply VM0033.

A small standard—Plan Vivo, which targets community-led projects that involve rural smallholders and communities dependent on natural resources for their livelihoods—has recently become a favorite of many (potential) Blue Carbon developers. It currently has three

"approved approaches" for issuing certificates. The current process—whereby Plan Vivo assesses any methodological approach to measuring carbon and other climate benefits suggested by the project developer—will soon be replaced by a more regulated approach, with predefined "Methodology Requirements".

Table 5 Carbon standards and methodologies for Blue Carbon credits in the voluntary market.

Carbon Standard body	Methodology / Version
Verra	AM0014 (available until 2022) VM0033 Methodology for Tidal Wetland and Seagrass Restoration, Version 2.0 VM007 REDD+ Methodology Framework (REDD+MF), Version 1.6
Plan Vivo	Project-specific
American Carbon Registry (ACR)	The Restoration of California Deltaic and Coastal Wetlands, Version 1.1 Restoration of Pocosin Wetlands, Version 1.0
Climate Action Reserve (CAR)	Mexico Forest Protocol, Version 1.5

Source: Silvestrum Climate Associates (2023)

3.3.5 Blue Carbon pricing

There have been too few credit issuances and purchases to establish clear trends as to how these credits are used and by whom. There are several indicators, however, that Blue Carbon credits are not commodity- and trade-driven in the same way as other project categories. While average voluntary carbon market credits have been sold below US$5 for years, credits from across NbS sectors— including agriculture and forestry—now consistently trade above US$5, and Blue Carbon credits are at the top end (trading in 2022 at an average of US$28) due to their extraordinary capacity to deliver on carbon and on a multitude of co-benefits, such as food security and climate adaptation. This said, there is no clear pricing methodology for Blue Carbon in place, other than that that the credit price is negotiated for each project anew. However, there may be a trend toward higher prices for credits stacked with co-benefits (see Box 16) and for models under which credit returns are transparently shared between communities and habitat protection.

BOX

16 Stacking co-benefits

Verra houses not only the VCS but also, among others, the Climate, Community and Biodiversity (CCB) Standard and the Sustainable Development Verified Impact Standard (SD VISta). **Blue Carbon projects that register under the VCS can choose to go through a secondary screening by the CCB Standard, which examines a project for its specific social (community) and ecosystem (namely biodiversity) benefits**, or SD VISta, which enables projects to measure their social and environmental impacts and link them to the United Nations Sustainable Development Goals (SDGs). CCB applies to land-use projects only; SD VISta is not restricted to any sector. Its current project list is strongest on cookstove, water-access, and rice-farming projects.

If successfully verified under both VCS and CCB, any credit issued by Verra/VCS receives a CCB label. SD VISta also provides for a label mechanism but allows SD VISta Claims Statement and SD VISta credits.

The Gold Standard (the other big international voluntary carbon standard) does not yet have Blue-Carbon-specific methodologies in place. It is working on a mangrove restoration (not conservation) methodology, however. Once approved, the standard may offer a solid alternative certification procedure. The Gold Standard offers projects certification for multiple ecosystem services (including water benefits, gender benefits, as well as impacts to reduce short-lived climate pollutants) within the Gold Standard for the Global Goals (GS4GG).

While these co-benefit standards are generic and apply to all project categories (CCB applies to AFOLU only), Blue-Carbon-specific methodologies that focus on co-benefits are being tested within these standards and beyond.

Verra has released a draft methodology for measuring coastal-resilience benefits from restoration and protection of tidal wetlands. It seeks to lay out verifiable metrics for gauging protection levels from enhanced Blue Carbon ecosystems and naturally raised shorelines for communities. The insurer Axa, one of the funders of the initiative, explains that resilience credits—envisaged to be purchased in tandem with Blue Carbon (climate mitigation) credits or as a stand-alone—would then be issued on the back of the quantification of risk-reduction benefits derived from preserving these natural flood barriers, and from conserving and restoring coastal ecosystems.

An interesting VCS model is the Vida Manglar project in Cispatá, Colombia (Conservation International 2022). The mangrove conservation project, which uses VM007 for its carbon credit accounting and is also registered under Verra's Climate, Community & Biodiversity Standard, has been developed by a coalition of local stakeholders and communities. This has been facilitated by Conservation International, with philanthropy funding from Apple. The project's first credits were marketed close to or after credit issuance to corporate buyers. While the price per tCO_2 has not been disclosed, it is expected to be above US$20 and perhaps as high as US$30. A full 92 percent of the proceeds flow back to the communities to fund Vida Manglar's conservation management plan. Revenues from future issuances are expected to keep the distribution benchmark of above 90 percent (communities) and below 10 percent (transaction costs). The project serves as a good model for funding approaches that mix classic philanthropy funds with Blue Carbon credit proceeds.

Low price-predictability and the orientation at standard market prices in practice (even accounting for higher prices in 'niche' segments), on the other hand, risk missing the target. Therefore, leading not-for-profit organizations—such as WWF (WWF 2021b)—have suggested turning the traditional approach to

carbon pricing (reflecting the price of the offset) into reverse. This would mean that **corporate investors calculate in detail their own (transitory and residual) emissions and make a financial commitment for nature based on the cost of the emissions.** The calculation may use generic figures on the social and environmental cost of emissions or, alternatively, calculate implicit carbon prices at the corporate level, or against the collective effort to reach the 1.5-degree Celsius goal.

For Blue Carbon interventions, such an approach ensures that investors are not simply going for the low-hanging fruits (interventions payable with offset prices of US$10 or US$20 a credit) but tackle the full scale of investment needs. These include research, capacity-building, community development, and high-integrity restoration. However, this boutique-style approach may struggle when applied to larger, potentially jurisdictional interventions, in which price elasticity will be less pronounced and government-backed re-investment models less discretionary.

3.3.6 Future opportunities: Emissions trading under the Paris Agreement

The Paris Agreement's crediting mechanisms under Article 6 (recently finalized, in principle) may also be used in the future for Blue Carbon actions (see Box 17).

BOX 17

Crediting approaches under Article 6 of the Paris Agreement

The instrument on cooperative approaches (Art. 6.2 of the Paris Agreement) covers internationally transferred mitigation outcomes and enables parties to the Paris Agreement to engage in emissions trading in a decentralized, bilateral, or multilateral manner.

The mechanism established under Article 6.4 of the Paris Agreement resembles the Clean Development Mechanism (CDM) of the Kyoto Protocol, in being the more centralized instrument governed by a Supervisory Board responsible for the accreditation of validation and verification entities (Designated Operational Entities or DOEs); the approval of methodologies; the registration of activities; and the operation of a centralized registry.

Article 6.2 activities are bilaterally (and sometimes unilaterally, by the host country) defined and developed. Article 6.4 activities are developed under rules and methodologies that are a priori the same for all countries. These rules include provisions on set-asides (quotas of each issuance) that are cancelled or transferred to benefit overall mitigation efforts and adaptation purposes.

Both instruments allow for the trade in "emission reductions" as well as "emission removals", provided these are "real" (not hypothetical), "verified" (independently confirmed) and additional (generated because of the incentive offered by emissions trading). Tradable credits are those generated in 2021 or later. The Article 6.4 decision also provides for the use of some pre-2021 units issued under the CDM between 2013 and 2020, for use towards the first NDC period.

Article 6 instruments imply a form of "approval" and/or "authorization" of crediting activities by the host country. For Article 6.2 authorizations, this means that the host country will need to make a "Corresponding Adjustment"—that is, neutralize the amount of traded emission reductions or removals from its balance sheet when accounting for its NDC. **This means that an emission reduction traded under Article 6.2 must not be considered towards the host country's own emission reduction (NDC) target.**

Article 6.4 approvals do not require a Corresponding Adjustment per se. However, in practice, if a host country seeks to trade Article 6.4 emission reductions/removals to another country, the authorization procedure of Article 6.2 applies as well (that is, the host country must approve under Article 6.4 and authorize under Article 6.2).

A third instrument under Article 6 is provided by the framework for non-market approaches to sustainable development (Article 6.8 and 6.9). It targets "integrated, holistic and balanced non-market approaches" to enable voluntary cooperation among Parties in implementing their NDCs, to allow for higher ambition in their mitigation and adaptation actions. The framework—currently under development (a work program has been adopted)—will likely widen its scope to include, not only GHG reductions and removals, but ecosystem services across the spectrum of both mitigation and adaptation, including flood protection. The Glasgow Climate Pact specifically referred to "Blue Carbon" as a programmatic item for the framework, however.

In a radical departure from the Kyoto Protocol and CDM precedents, the new mechanisms do not come with a priori sectoral exclusions. Land-use interventions (including Blue Carbon projects and programs) qualify for credit generation and emissions trading under these instruments, just like any project or program from another sector.

Furthermore, the Paris rules also allow for the creation of hybrid markets. Governments can issue letters of authorization to interventions specifying how credits can be used: for use towards an NDC (by another government); for "other international purposes" (a code term associated with crediting under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), an instrument set up by a specialized United Nations agency called the International Civil Aviation Organization or ICAO); and for other purposes, including for voluntary carbon markets. The authorization entails an obligation for the host country to undertake a "corresponding adjustment" in its books, even if the crediting permitted is for voluntary carbon markets only. The government authorization, together with the promise of a corresponding adjustment, may consolidate the standing of voluntary carbon markets, which are currently going through a rough spell. Commentators and sustainability standards—notably the Science-Based Target Initiative (SBTI)—are questioning the motivation behind corporate carbon credit investment ("greenwashing") and discouraging the concept of "offsetting" for climate neutrality purposes.

At COP27, there was a noticeable, multi-level convergence of official (traditionally referred to as "compliance") voluntary carbon markets, and results-based finance.

Africa Carbon Markets Initiative

Multiple African nations, including Kenya, Malawi, Gabon, Nigeria, and Togo; global and regional initiatives; and private sector representatives announced the Africa Carbon Markets Initiative (ACMI), which aims to dramatically expand Africa's role in voluntary carbon markets. ACMI seeks to generate 300 million credits annually by 2030 and 1.5 billion credits by 2050. This level of production would by 2030 unlock US$6 billion in income and support 30 million jobs, and by 2050 unlock over US$120 billion in income and support over 110 million jobs.

High-Quality Blue Carbon Principles and Guidance

Conservation International, the World Economic Forum's Friends of Ocean Action, The Nature Conservancy, Ocean Risk and Resilience Action Alliance, and Salesforce, with the support of the Meridian Institute, announced the High-Quality Blue Carbon Principles and Guidance, a framework that provides a consistent approach to ensuring that Blue Carbon credits optimize outcomes for people, biodiversity, and the climate. The guidance is set out in five key principles, "each of equal importance" (Meridian 2022a; Meridian 2022b):

- Safeguard nature;
- Empower people;
- Employ the best information and carbon accounting principles;
- Operate contextually and locally; and
- Mobilize high-integrity capital.

LEAF Inks Agreements

A total of six new agreements with forest nations and states were announced by the Lowering Emissions by Accelerating Forest (LEAF) finance Coalition, whose goal is to halt deforestation by financing large-scale tropical forest protection on an RBCF basis. Amapá, Amazonas, Mato Grosso, and Pará have become the first Brazilian states to sign Letters of Intent (LOI) with Emergent, the coordinator of The LEAF Coalition. These LOIs demonstrate the commitment of all parties to progress negotiations towards binding agreements to supply emissions reductions to LEAF Coalition participants and signal significant progress for LEAF in Brazil. LEAF also announced that Costa Rica and Nepal have signed memoranda of agreement (MOAs) with Emergent. These agreements, for countries who have already signed LOIs, outline the next steps and put in place a clear roadmap and timetable for the signing of binding Emissions Reduction Purchase Agreements (ERPAs) by the end of April 2023. Costa Rica and Nepal join Ecuador, which at COP27 was announced as the first country to sign an MOA.

VCMI and We Mean Business Join Forces

Through a new partnership, the Voluntary Carbon Market Integrity (VCMI) Initiative and the We Mean Business (WMB) Coalition will deepen engagement and feedback from companies in the VCMI process. WMB will support companies to follow VCMI's claims code. This is a set of principles and rules designed by VCMI to specify to what extent carbon market investors can claim the GHG benefits the purchased credits represent within their value chain and towards a net-zero trajectory. These principles and rules help ensure that voluntary carbon crediting will strengthen, rather than undermine, global action towards achieving the goals of the Paris Agreement.

3.4 Emerging Financing Approaches

Emerging funding alternatives are gaining importance as an alternative to political obstacles and limited government resources. Governments, in theory, dispose of their wide set of classic fiscal policies and instruments to create disincentives for non-sustainable habitat management (think of the phase-out of harmful subsidies to industrial fishing and non-sustainable, area-extensive farming). At the same time, they effectively drive sustainable action through tax incentives and positive subsidies for conservation and habitat restoration. However, in practice, phasing out long-granted subsidies is politically difficult, and government funding is limited. Policy makers therefore keep a lookout for opportunities for private sector investments, while considering a range of novel funding approaches.

3.4.1 Financing facilities and impact funds

Recent years have seen increasing recognition of the economic value of coastal ecosystems and the need for investment in their protection and restoration. This has led to the emergence of a number of innovative financing mechanisms that seek to leverage private sector finance for coastal conservation and restoration. Active facilities and impact funds include:

BNCFF
Blue Natural Capital Financing Facility

Blue Carbon Accelerator Fund (BCAF) and Blue Natural Capital Financing Facility (BNCFF)

The IUCN, through its Global Marine and Polar Program, operates both funds to advance financially viable coastal climate-resilience projects with clear ecosystem-services benefits. The aim is to integrate Nature-based Solutions (restoration of coastal wetlands, including mangroves) with modern data systems and marine technology, as well as small renewable energy and clean water solutions, to strengthen the investment case for integral coastal-resilience management. The facility is intended to operate for projects in developing countries, especially small island developing states. BCAF is funded by the Government of Australia, and BNCFF is funded by the Government of Luxembourg.

Global Innovation Lab for Climate Finance

is a platform that incubates and develops innovative financial instruments to support climate change mitigation and adaptation efforts, including Blue Carbon initiatives.

Natural Capital Financing Facility

is a joint initiative of the European Investment Bank and the European Commission, which provides financing for projects that promote the conservation and sustainable use of natural capital, including coastal and marine ecosystems

Althelia Biodiversity Fund

is a private equity fund that invests in sustainable land use and conservation projects around the world, with a particular focus on the conservation of marine and coastal ecosystems.

Ocean Innovation Challenge

is a global funding program that supports innovative projects aimed at addressing ocean-related challenges, including the conservation and restoration of coastal and marine ecosystems that support Blue Carbon. These are just a few more examples of programs, funds, and facilities that provide funding for Blue Carbon conservation or restoration action

Ocean Fund and ReOcean Fund (Prince Albert II of Monaco Foundation)

are funding mechanisms established by the Prince Albert II of Monaco Foundation to support ocean conservation projects, including the restoration of BCEs.

Aqua-Spark

is a venture capital fund that invests in sustainable aquaculture projects that promote healthy oceans, enhance food security, and create economic opportunities for coastal communities.

Green Ocean Fund

is a funding mechanism established by the South Korean government, which provides financing for marine conservation and restoration projects, including BCEs

Ocean 14 Capital Impact Fund

is a partnership between the founders of Vedra Partners Ltd., Pontos Aqua Ltd., and Blue Marine Foundation. Blue Marine Foundation is an investment advisory to Ocean 14 Capital Fund 1, a Private Equity fund focused on the United Nations' Sustainable Development Goal 14, Life Below Water.

Blue Forest Conservation

is a private equity fund that invests in the conservation and restoration of coastal and marine ecosystems, including mangroves, seagrasses, and coral reefs.

Encourage Capital Blue

is a private equity fund that invests in sustainable fisheries, aquaculture, and marine conservation projects that deliver environmental and social benefits.

Meloy Fund

is a private equity fund that invests in sustainable small-scale fisheries and coastal enterprises in Indonesia and the Philippines, with a focus on improving livelihoods and conserving marine ecosystems.

NatureVest Ocean

is a conservation finance initiative of The Nature Conservancy, which focuses on investing in sustainable fisheries, coastal resilience, and marine conservation projects.

3.4.2 Emerging government-led financing approaches

There are multiple income streams to support long-term sustainability for Blue Carbon conservation and restoration actions. They include habitat and fisheries-sensitive public procurement standards; public-private partnerships; payment for ecosystem services (PES) schemes; as well as new financing tools (including Blue Bonds, debt swap agreements, impact insurance, as well as project finance for permanence (PFP)).

The overall numbers are still modest. According to Convergence, which tracks blended finance transactions against their alignment with the Sustainable Development Goals (SDG), in the period 2018 to 2020 only 2 percent of transactions supported SDG 14 (Life below Water), mobilizing US$130 million (out of US$31 billion in SDG funding overall) (Convergence 2021). Yet, the number of transactions based on innovative and “blended” funding tools (linking public and private finance) is growing. The list includes:

Public procurement

Governments can use public procurement policies to encourage the use of sustainable practices in construction and infrastructure projects that impact coastal habitats. This can include requirements for the use of sustainable materials and the incorporation of habitat restoration measures in project design. Priority can also be given to suppliers that demonstrate strong supply chain rules in their own procurement.

Public-private partnerships (PPPs)

Governments can collaborate with private sector companies and organizations to finance and implement coastal habitat conservation and restoration projects. PPPs can leverage private sector investment and expertise to achieve conservation and restoration goals. Overall, fiscal policies and instruments can provide important incentives and support for the conservation and restoration of coastal habitats, helping to protect and restore these critical ecosystems.

Payment for ecosystem services (PES) schemes

PES schemes are mechanisms that aim to create financial incentives for landowners and other stakeholders (in the case of Blue Carbon habitats, primarily fishing communities) to protect or enhance the provision of ecosystem services. In a PES scheme, a buyer or group of buyers (such as a government, NGO, or private company) pays a provider (such as a landowner or community) for the delivery of a specified ecosystem service. The payment is typically based on the achievement of pre-defined ecological and social outcomes, such as the maintenance or restoration of a particular habitat, or the provision of clean water to downstream users. PES schemes can take various forms, such as direct payments, subsidies, tax incentives, or tradeable credits. They are often used to address market failures that result in the under-provision of ecosystem services, such as the inability of landowners to capture the full value of their ecosystem services, or the negative externalities generated by activities that harm ecosystems. PES schemes have been implemented in various contexts (including agriculture, forestry, water management, and mangrove conservation) and they are at the basis of REDD+ results-based finance frameworks and carbon crediting (see Box 18). They are often used in developing countries, where ecosystems are particularly valuable but also vulnerable to degradation, and where rural communities depend heavily on ecosystem services for their livelihoods.

BOX

18 Examples of payments for ecosystem services schemes on mangroves

Ecuador

The Socio Manglar program in Ecuador is a payment for ecosystem services (PES) program that targets mangrove conservation and restoration in the country. The program was launched in 2008 by the Ministry of Environment and the Ministry of Finance, with the support of the United Nations Development Program (UNDP) and various non-governmental (NGO) and community organizations. The program provides economic incentives to local communities to conserve and restore mangroves, which are important ecosystems that provide a range of services, including carbon sequestration, coastal protection, and habitat for biodiversity. The incentives take the form of direct payments to communities, as well as support for sustainable livelihood activities such as ecotourism and artisanal fisheries. To participate in the program, communities must establish and manage communal mangrove reserves, which are legally recognized by the government. These reserves are monitored and evaluated to ensure that they meet the program's ecological and social standards. The Socio Manglar program has been successful in promoting mangrove conservation and restoration in Ecuador. As of 2021, the program had supported the establishment and management of over 50 communal mangrove reserves, covering more than 20,000 hectares of mangroves. The program has also generated important co-benefits, including the promotion of sustainable livelihoods and the empowerment of local communities in natural-resource management. Overall, the Socio Manglar program is a good example of how PES schemes can provide economic incentives for the conservation and restoration of important coastal ecosystems, while also promoting sustainable development and community empowerment.

Indonesia

The program in Sulawesi, Indonesia, pays local fishers to restore and maintain mangrove forests, in exchange for access to fishponds that are integrated into the mangrove ecosystem.

Mexico

Mexico's Payments for Hydrological Services Program is a program that provides payments to landowners who maintain and restore forests—including mangroves—that help protect water quality and quantity in critical watersheds. The program is administered by the National Forestry Commission and is supported by various government agencies and NGOs.

Vietnam

Blue Carbon Initiative in Vietnam pays local communities to restore and protect mangroves in exchange for carbon credits that are sold on the voluntary carbon market. The program is supported by the International Union for Conservation of Nature (IUCN), the Vietnamese government, and various NGOs.

Blue Bonds

Blue Bonds offer tremendous business opportunities and address pressing challenges such as climate change, biodiversity loss, and pollution, all of which affect BCEs. Blue Bonds are a variant of Socially Responsible and Impact (SRI) Bonds, which enable investors to deliver positive societal impact, while generating long-term, competitive financial returns. Proceeds raised finance climate-friendly projects for preserving the Blue Economy and increasing clean water resources. These projects can include initiatives to protect marine ecosystems, mitigate climate-change impacts on oceans, and promote sustainable fisheries. Blue Bonds work in the same way as traditional bonds, with investors purchasing bonds from the issuer, who then uses the proceeds to fund projects. The issuer typically agrees to repay the bondholders at a predetermined interest rate over a specified time period. Blue Bonds can be issued by a variety of entities, including governments, development banks, and private sector organizations. For example, the Republic of Seychelles issued the world's first Blue Bond in 2018, while the World Bank and the European Investment Bank have also issued Blue Bonds to finance ocean conservation projects. In 2022, the International Finance Corporation (IFC), from the World Bank Group, released the Guidelines for Blue Finance: Guidance for Financing the Blue Economy, Building on the Green Bond Principles and the Green Loan Principles.[25] This identifies eligible blue project categories to guide IFC's investments to support the Blue Economy, in line with the Green Bond Principles and Green Loan Principles. The market has been seeking guidance on project eligibility criteria, translating general Blue Economy Financing Principles, such as the Sustainable Blue Economy Principles and the Sustainable Ocean Principles, into guidelines for Blue Bond issuances and blue lending.

Project finance for permanence (PFP)

PFP combines results-based finance approaches (known from REDD+) as well as carbon project finance models with classic philanthropic funding. PFP approaches are also currently pioneered by the Government of Belize, in partnership with the World Wildlife Fund (WWF). A PFP program begins with the design of conservation goals and a financial plan to ensure that these goals are adequately funded. (The PFP in Belize is currently in the design phase, with an initial focus on the sustainable financing of MPAs, then expanding into coastal ecosystems like mangroves and seagrasses, fisheries, and upstream ridge-to-reef areas.) Following this, the program will need to find donors willing to commit the initial funds required to achieve the conservation goals, and to deliver the money once all the key financial and legal preconditions required from the government are met. Finally, the government will progressively increase its level of spending until it fully assumes the costs of conservation.

25 IFC. 2022. Guidelines on Blue Finance. https://www.ifc.org/wps/wcm/connect/industry_ext_content/ifc_external_corporate_site/financial+institutions/resources/guidelines-for-blue-finance.

BOX

19 Emerging blue financing tools: Bonds and debt-for-nature swaps

Various novel funding instruments have been proposed in recent years, and some of them have been tested (Finance Earth 2022).

Seychelles

The Global Environment Facility (GEF) provided support to the Seychelles in the past to design and issue the world's first Blue Bond. Conceptually based on the model of a Green Bond, a Blue Bond earmarks the use of the proceeds to finance coastal, marine, and ocean-based projects (Roth et al. 2019). The Seychelles Blue Bond was a US$15 million sovereign bond sold in a private placement to three US-based impact investors: Nuveen, the asset management arm of TIAA (which will include the bond in the TIAA-CREF Social Choice Bond Fund), Prudential Financial, and Calvert Impact Capital. Each bought US$5 million of the notes. The bond has a maturity of 10 years and a "coupon" (that is, an annual interest payment value) of 6.5 percent. The bond was secured with the GEF providing a coupon guarantee and the WB a repayment-guarantee of US$5 million, covering a third of the principle.

Belize

Another debt instrument of sorts are debt-swap agreements, in which concessional ("blue") loans are used to help a developing country convert its outstanding debt at a discount ("haircut") and use the savings to invest in ocean conservation. Debt-swap arrangements are of specific interest after the COVID-19 pandemic, which created havoc for the balance sheets of many developing countries. A recent example is provided by the Government of Belize, which announced the conversion of US$ 553 million of its debt (about 10 percent of the total) with the help of a "blue loan" (a loan raised through a corporate Blue Bond arranged by Credit Suisse) from The Nature Conservancy. Creditors accepted a haircut of 45 percent so that the actual cost of the conversion was US$ 364 million. The reduction in principle brought savings amounting to US$189, which the Government of Belize committed to funding protection of 30 percent of its exclusive economic zone (TNC 2021). More broadly, the Belize debt-swap arrangement also points to a new trend of seeking out financial opportunities for private sector investors from public finance instruments or (as in the case of Belize) philanthropic funds. Under blended-finance structures, donors—governments, multilateral development banks, and philanthropy—create credit enhancement and other risk-reduction and/or revenue-boosting incentives to crowd in private capital.

CHAPTER

4 Scaling Blue Carbon Opportunities:

Creating a Blue Carbon Readiness Framework

Over the past decade, there has been impressive progress on placing blue carbon at the center of international policymaking, and there is a growing set of funds and tools tailored to blue carbon investments. Yet, the gap between action and investment potential and reality, could hardly be more pronounced. Let us take the example of the African continent. As the Africa Carbon Market Initiative (ACMI) pointed out in the report accompanying its launch at COP27 in Sharm El-Sheikh, while Africa's carbon credit potential—across sectors and including blue carbon—stands at 2.4 billion tCO_2e per year (calculated for the period 2030 onwards), the current annual output is 22 million tCO_2e (number of retired credits in 2021). In Africa and elsewhere, there are technical reasons for today's dismal carbon-finance performance outside the control of governments, including slow methodological uptake and below-cost carbon prices. Yet, there are important enabling conditions that governments can control and that may enhance blue carbon habitats, while catalyzing carbon market activities.

The creation of a bespoke Blue Carbon Readiness Framework—bringing together data and analytics, regulatory and institutional aspects on the one hand, and financial and investment aspects on the other—will put conservation and restoration of Blue Carbon ecosystems at the center of a country's sustainable Blue Economy transformation, and rapidly scale Blue Carbon investments. The framework can, and should, be built into the NDC architecture as today's guiding and most comprehensive plan for combatting climate change. Integrated land and seascape management—including MSP, ICZM and REDD+—should become the cornerstones of NDC implementation, facilitating both better legal protection and financial opportunities. Figure 10 provides countries with an overview and a stepwise approach to building their Blue Carbon Readiness Frameworks. The checklist (in Appendix 1 of this report) provides further guidance for execution of Blue Carbon readiness.

Figure 10 Blue Carbon Readiness Framework

Blue Carbon Readiness Framework

Welcome to the Blue Carbon Readiness Framework - a decision tree approach to assessing and identifying steps in pursuing blue carbon readiness within your country. Starting with Pillar 1, move your way through the tree using the below legend as a guide. Pay special attention to 'Checklists' which may correspond to a specific action/step. Checklists provide in-depth descriptions of steps to continue along your journey to readiness (refer to Appendix 1.) complementary actions can be completed in tandem with moving onto the next section of the tree.

PATHWAY | ACTIONS/ STEPS | SECTION COMPLETE | COMPLEMENTARY ACTIONS | REDD+ COUNTRIES | PRIVATE SECTOR | NO ACTIONS/ STEPS

PILLAR
1
A B
2
3

PILLAR 1

DATA & ANALYTICS

A EVALUATE BLUE CARBON ACTIONS

Does your country currently have any of the following blue carbon ecosystems (BCEs)?

NO

NOT SURE

Use the links in Checklist 1 to determine if any of the listed BCEs are present within your country.

Has your country previously had any of the established BCEs?

YES | NO

NO BLUE CARBON ACTIONS AVAILABLE

EMERGING BCEs

Macroalgae | Benthic Sediments | Mudflats

YES

ESTABLISHED BCEs

Mangroves | Salt Marshes | Seagrasses

YES

PERFORM ACTIONABILITY ASSESSMENT

Mangroves, salt marshes, and seagrass beds are considered the established or "actionable" Blue Carbon ecosystems. Some emerging Blue Carbon ecosystems may be on their way to actionability if they meet all the following requirements:

1. SCALE – The scale of greenhouse gas removals or emissions is significant;
2. LONGEVITY – The ecosystems can store the CO2 sequestered long-term;
3. THREAT – Anthropogenic impacts on the ecosystems are leading to CO_2 emissions;
4. VIABILITY – It is practically viable to manage the ecosystems concerned sustainably and reduce CO2 emissions or enhance existing carbon stock;
5. KNOWLEDGE – The science behind these findings is sufficiently robust.

Does your country have the following data for the established BCE(s):

- BCE extent/ area (maps, spatial data)
- Human activity data

NO

1. Follow Checklist 2 for GHG inventories steps to gather the necessary data and;
2. Check if relevant data can be extrapolated from existing policy and/ or knowledge frameworks, such as the Ramsar Convention or National Adaptation Plan

YES

RECOMMENDED

Economic valuation of BCEs

NO

Conduct economic valuation using global regional or local data

USE RESULTS FROM COMPLETED ACTION/ STEPS TO:

- Build up your country's capacity to collect blue carbon data by funding and/or collaborating with technical and scientific organizations
- Leverage collaborations – inter-agency as well as the private sector – to further development of robust and relevant datasets on BCE's for your country
- Pilot or encourage non-state-actors to pilot Blue Carbon projects by providing access to site and data

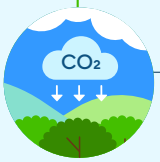
YOU CAN MOVE ON TO PILLAR 1-B

PILLAR 1 A B 2 3

PILLAR 1

DATA & ANALYTICS

B ASSESS GHG INVENTORIES



1 GHG INVENTORIES

Are BCEs included in your country's GHG inventory?

NO → Use the Wetland Supplement and Tier 1 default values (or Tier 2/3 depending on available data) to determine carbon stock values for your country's BCE(s). Refer to Checklist 3 for steps and guidelines.

YES

Does your country apply the 2013 Wetlands Supplement (WS13)/2019 Refinement (R19)?

NO → Improve your GHG Inventory via integration of WS13/R19
- Identify where bottleneck(s) are – e.g., soil carbon data
- Review Checklist 3 for ways to improve your existing inventory

YES

If you are engaging in REDD+

2 REDD+ FOREST REFERENCE LEVELS

Has your country submitted a Forest Reference Level (FRL)/ Forest Reference Emission Levels (FREL)?

NO →
- Consider developing a REDD+ FRL/FREL with Blue Carbon integration
- Decide to build a separate blue carbon framework (using synergies)

YES →
- Review Checklist 4
- Confirm and iterate consistency between your Forest Reference Levels (FRL)/ Forest Reference Emission Levels (FREL) and your GHG inventory

USE RESULTS FROM COMPLETED ACTION/ STEPS TO:
- Strengthen calculated carbon stocks by substituting regional/ local values in place of Tier 1 default values
- Compare calculated carbon stock values to existing activity data, and use results to improve your GHG inventory
- Integrate calculated carbon stocks into your FRL/FREL

GHG INVENTORY IS DONE!

YOU CAN MOVE ON TO PILLAR 2

while improving inventory capacities

PATHWAY
ACTIONS/ STEPS
SECTION COMPLETE
COMPLEMENTARY ACTIONS
REDD+ COUNTRIES
PRIVATE SECTOR
NO ACTIONS/ STEPS

PILLAR 2

POLICY & INSTITUTIONS

NDC COMMITMENTS & IMPLEMENTATION

1 IDENTIFY COMMITMENTS

Are emissions and removals from BCE(s) included in your country's NDC?

YES | YES | NO

CONSIDER | Extending the scope of your NDC to account for BCE(s)

- Make sure your GHG inventory can accurately report emissions and removals from BCE(s). If your country cannot yet do this, you can still acknowledge the mitigation impact of BC interventions → **Move to Box 2 below.**

- Turning this procedural milestone into a target, e.g., by [Year] or when submitting the second Biennial Transparency Report, [Country] will use the WS13 and account for all anthropogenic carbon stock changes in [BC Habitat] and [BC Habitat 2].

FOCUS ON | Acknowledging mitigation impact of BC interventions Formulating stand-alone (action) targets:

- Halt and reverse all degradation in [BC Habitat]
- Restore [#] hectares of [BC Habitat]

Synchronize and refine with existing policy instruments beyond mitigation (and/or climate change), notably National Adaptation Plans NBSAPs

Does your county have a REDD+ framework that integrates BCE(s)?

FOCUS ON | Accounting for Emissions Reduction/Removals
[Review Checklists 5 and 6]

FOR REDD+ COUNTRIES
Build reference levels for conservation aligned with REDD+ targets, and define sequestration targets for restoration

1. Consider inclusion in economy-wide or sector-wide (AFOLU) targets and/or
2. Include action-specific target such as "restore x hectares of mangroves by [date]".

2 IMPLEMENT YOUR NDC

If you are engaging in REDD+ → Review integration of BCE(s) in your REDD+ policy framework

Do you have an NDC Implementation Plan?

NO | NO | YES

NEXT STEPS

1. Where feasible, prepare a cost-benefit analysis for conservation and restoration options (use CWON and other datasets for valuation)
2. Develop a bespoke Blue Carbon Strategy
3. Work through MSP and ICZM
4. Focus on land tenure and community involvement
5. Tackle bottlenecks to implementation
6. Design the plan with Section 4 (Financing) in mind
7. create a benefit sharing arrangements
8. Policy reforms for BCEs conservation, restoration, or sustainable management (NBS).

Refer to Checklist 7 for a detailed list of next steps

ADDRESS THE PRIVATE SECTOR:

Set out investment parameters and clear guidance for the private sector engagement (cf. Section 4: Financing, see below)

Promote private sector initiatives and create institutional structures for private sector and community involvement (planning, decision making, implementation

Does your plan incorporate appropriate institutional/governance frameworks?

NO | YES

FOCUS ON | Design of Bespoke Governance Framework
[Review Checklist 8]

FOR REDD+ COUNTRIES
Checking if your REDD+ framework provides key structures (to be adjusted as needed)

1. Identifying and using or synchronizing with parallel governance frameworks on adaptation/resilience, private sector initiatives, technology transfer, and more.
2. Developing an institutional/ governance framework:

- Technical governance (task force / technical unit) for FRL calculation, MRV, and other
- Institutions & policy governance
- Financial governance (receiving and distributing funding in line with benefit sharing arrangements)
- Community governance models to drive implementation

USE RESULTS FROM COMPLETED ACTION/ STEPS TO:

- Use input data to inform biennial NDC reporting and accounting
- Design commitments for subsequent rounds of NDCs and long-term plans
- Seek synergies with policy actions across the board (SDG focus)

YOU CAN MOVE ON TO PILLAR 3

PATHWAY | ACTIONS/ STEPS | SECTION COMPLETE | COMPLEMENTARY ACTIONS | REDD+ COUNTRIES | PRIVATE SECTOR | NO ACTIONS/ STEPS

PILLAR 3

FINANCE

LEVERAGE BLUE CARBON FINANCE

Does your country have a blue carbon finance and investment framework in place?

YES | NO

FOCUS ON | Developing a framework that integrates with the implementation plan

1. Scrutinizing existing funding flows to benefit/disadvantage Blue Carbon investments
2. Conduct Stock-take of financing approaches (including the use of mechanisms such as Article 6 and jurisdictional REDD+/RBCF) and sources/instruments (concessional and non-concessional, considering innovative business models, see further below)
3. Set out stable investment parameters for the private sector, including with respect to carbon finance: Define and allocate carbon rights, create mandates for carbon trading, and present models for community involvement and benefit sharing

FOCUS ON | Accessing Grant Funding

Accessing grant funding for capacity-building and related needs, namely:

- Design and operationalize the governance framework
- Inventory work
- BCEs mapping, carbon stock assessments
- Preparation of a pipeline of shovel-ready projects
- Conceptualization of blue infrastructure finance

Have you operationalized specific funding tools?

NO

YES

CONSIDER | Operationalizing in line with survey above – leverage tools such as:

- Concessional instruments, including blended finance instruments and philanthropy
- Dedicated sovereign and/or corporate debt finance instruments (blue loans, blue bonds)
- Blue infrastructure /NBS finance
- Business models that stack multiple revenue streams
- Results Based Carbon Finance (RBCF)
- Blue carbon project finance (carbon markets)

Review Checklist 9 for examples and guidelines on leveraging investment.

Does your country intend to use carbon markets as a means of investment?

YES | NO

CONSIDER |

- Using Article 6 of the Paris Climate Agreement;
- Allowing Voluntary Carbon Markets with corresponding adjustments

PILLAR
1 A B 2 3

PATHWAY
ACTIONS/ STEPS
SECTION COMPLETE
COMPLEMENTARY ACTIONS
REDD+ COUNTRIES
PRIVATE SECTOR
NO ACTIONS/ STEPS

Pillar One: Data and Analytics

4.1 Blue Carbon Data Requirements for Nationally Determined Contributions

Nationally Determined Contributions (NDCs) have gained importance as they reflect a country's climate mitigation vision, as well as its technical and sustainability plans. NDCs were first designed as a technical tool for countries to formulate their GHG mitigation targets (or "commitments"). Yet, they quickly evolved as both comprehensive high-level visions for short-term and long-term action on climate and sustainable development, and as technical—sometimes extremely detailed—implementation plans. As such, NDCs have become gatekeepers for formulation of high-level policies; provision of technical capacity and expertise; and international investment in climate action, including Nature-based Solutions. Donor governments and private-sector funders alike are increasingly likely to check a country's NDC, and how a specific measure fits into the wider context of country targets and policies and measures, before making a funding decision. It is important to note that Blue Carbon ecosystems have multiple and deep exposures to NDCs —including for their climate mitigation density. Their close integration into NDCs and the definition of clear and ambitious, but realistic and implementation-ready, targets is essential.

As described in Figure 10, the Blue Carbon Readiness Framework should focus on Blue Carbon integration in NDCs and, in the process, follow four steps:

Determine actionable Blue Carbon habitats, extent, condition, and economic value of goods and services;

Technically assess a country's inventory and REDD+ reference level;

Define tailored Blue Carbon targets and provide an NDC implementation plan that outlines both a Blue Carbon strategy (in line with a country's REDD+ framework, where available) and an institutional (governance) framework to lead on technical, policy, financial, and community aspects; and

Design financial mechanisms to leverage finance.

4.1.1 Determine actionable Blue Carbon ecosystems and their economic value

Coastal countries should determine their actionable BCEs in accordance with available data. When preparing their GHG reporting (GHG inventories), formulating NDC updates (specifying the scope, accounting rules, and actual targets and actions), and accounting for NDCs, governments should take stock of the existing science on BCEs along their coastline and their exclusive economic zones (EEZ). Then, if datasets such as the World Bank Technical Report Estimating Global Carbon Storage In Mangrove Ecosystem from the CWON 2.0 (forthcoming), Ocean+, and others presented in this Blue Economy Data and Tools Guidance Note[1] are available, they should map the different Blue Carbon habitats and determine which are considered actionable (see Chapter 1) and offer mitigation opportunities. At present, actionable Blue Carbon habitats are limited to mangroves, seagrass beds, and salt marshes.

Governments are also advised to develop a holistic assessment of the value of their blue natural capital and the specific natural capital value of their coastal wetlands to 1) inform planning efforts (e.g. MSP and ICZM) in general, and environmental impact assessments in particular; 2) better understand costs and benefits of managing BCEs; and 3) direct policymaking (see Box 20). Valuation will help frame the case for conservation and restoration differently: less as an opportunity cost, and more as an opportunity *value*. It will also allow governments to identify value hotspots and priorities for action that ultimately enhance, not hamper, the Blue Economy. Finally, it will promote investments in BCE protection and restoration that yield the greatest returns in enhanced ecosystem services (including carbon storage and sequestration) as well as tourism, fisheries, coastal risk-reduction, and more.

BOX

20 Valuating blue ecosystem services

Belize

For the past two decades Belize has pursued efforts for innovative, evidence-based target setting for coastal zoning and management purposes, by accounting for and valuating the multiple benefits of its coastal ecosystems, specifically mangroves and—more recently—seagrass beds. The quantification of carbon storage and sequestration, and of optimized co-benefits, permitted the discussion of realistic, high-value, time-bound targets and the identification of priority locations for mangrove protection and restoration.

As part of the assessment, locations were mapped that at the time lacked protected status and where prioritizing Blue Carbon strategies would provide the greatest delivery of co-benefits to communities. These findings informed Belize's updated NDCs (submitted to the UNFCCC in fall 2021) to include an additional 12,000 ha of mangrove protection and 4,000 ha of mangrove restoration, respectively, by 2034.

1 World Bank. 2022. Blue Economy Data and Tools. https://documents1.worldbank.org/curated/en/099610006152282116/pdf/P1750970004c390c60b64707db29cb15a4c.pdf.

4.1.2 Technical assessment of inventories and REDD+ reference levels

Governments are advised to test the completeness and accuracy of their inventories of actionable BCEs and—if available—of their REDD+ reference levels. It is important to verify whether the (previous or current) NDC has yet made a commitment to use the IPCC's 2013 Wetland Supplement. The guidelines for wetlands provide a standardized framework for estimating and reporting GHG emissions and removals from wetlands, including Blue Carbon. While the tool is generally considered to be user-friendly and, importantly, offers a wide range of default emission factors for countries to use, governments that commit to reporting on Blue Carbon emissions and removals in line with the guidance will need to have the capacity to collect, analyze, and apply data on Blue Carbon stocks and fluxes. This requires technical expertise in areas such as remote sensing, GIS, and carbon accounting, as well as the ability to collect field data on Blue Carbon ecosystem characteristics and carbon stocks.

In addition, governments will need to have robust institutional systems in place for data management, quality control, and reporting, to ensure that their estimates are accurate and transparent. Building this capacity can be a complex and resource-intensive process; but it is essential for improving a country's inventory, allowing governments to formulate precise mitigation targets for these ecosystems, and tracking action in the long run.

At the level of REDD+ accounting, it is important to first check the scope of coverage. Many systems will cover emissions and removals from mangroves, but other BCEs are likely left out. Then, the attention should shift to the extent to which all relevant carbon pools for mangroves are addressed. Often, REDD+ reference levels still exclude soil carbon in mangrove forests or generally. Reference level documents are outspoken about the exclusions, so there is little room for ambiguity.

4.1.3 Defining country-tailored Blue Carbon targets

Each (coastal) country has an interest in formulating Blue Carbon-specific commitments and actions, and each country can put forward a commitment to action, not only on adaptation but also on mitigation. In other words, no country should refrain from putting forward a Blue Carbon-specific initiative. If a country has no reliable data on the existence or distribution of BCEs, or if a country lacks the capacity to use the 2013 Wetland Supplement, all these items should become accountable action items. When noting the scope of emissions and the reporting guidelines used, the country concerned should specify that

"the inventory holds at present no [robust] [complete] data on emissions and removals from coastal wetlands. Relevant data will be gathered by [add year] and the NDC scope and accounting approach will include coastal wetlands and the 2013 Wetland Supplement by [add year]" **(see Box 21).**

BOX 21

Planning for the 2013 Wetlands Supplement

Seychelles

For the past years, Seychelles has been mapping the seagrass beds spread across its exclusive economic zone (EEZ). When the country submitted its NDC update in 2021, consolidated data was not yet available, and the Government assessed that it was not yet able to apply the 2013 Wetlands Supplement for its inventory reporting.

As a result, Seychelles kept the NDC scope restricted to energy, industry, and waste sectors. However, it made an important concession on future steps, with the following statement:

"Seychelles is committed to recognizing within its climate goals the interlinked climate, ecosystem and biodiversity benefits provided by its mangrove and seagrass ecosystems, including fully mapping their extent and assessing their carbon stock capacity. The 2013 IPCC Wetlands Supplement provides a framework that allows countries to measure the rate at which coastal and marine ecosystems sequester and store carbon. Through the application of cutting-edge technologies in partnerships specifically designed to strengthen local, scientific, methodological and governance capacities, Seychelles intends to map the full extent of seagrass and mangroves (Blue Carbon) habitats within Seychelles' territorial sea and EEZ and assess carbon storage capacity within these ecosystems."

A similar approach should apply to REDD+ reference levels and—more broadly—the integration of Blue Carbon in a country's REDD+ framework (see also below, Section 4.3). If sufficient data (for instance, on the coverage of soil carbon) is not available, the constructive solution is to make a commitment concerning coverage and integration by a specific year, or for the next iteration of the NDC.

On content, similarly, a country may not have sufficient data confidence or may hold structural reservations about integrating Blue Carbon targets into an economy-wide or land-use sector target. That does not mean that Blue Carbon should be ignored for the formulation of (mitigation) targets. Countries can always set action-specific targets: for example,

***"Halt [all] [net] seagrass loss by a specific date or restore a specific area or an area size of mangroves by the NDC's target date"* (see Box 22).**

BOX 22

Action-specific Blue Carbon targets

Belize

Since first mentioning coastal wetlands in its intended NDC in 2015, delving into the topic of its NDC in 2016, and an update in 2021, Belize has extended the coverage of Blue Carbon emissions and removals and has built on the list of interventions planned. Among the list of action items, the latest NDC iteration includes the following commitment:

"Restore at least 2,000 hectares of mangroves, including within local communities, by 2025, with an additional 2,000 hectares by 2030..."
(from Belize's NDC 2021).

4.1.4 Nationally Determined Contributions' references on finance

In their NDCs, countries can reflect the financial and non-financial support they need for specific actions. For actions with Blue Carbon relevance, a country can outline, for instance, what type of support it needs to implement the application of the 2013 Wetland Supplement for its inventory. With such specific requests of support, governments can navigate international donors and grant facilities to establish technical assistance programs, including the one offered under NOAA's Blue Carbon Inventory Program. Apart from technical assistance needs, governments can use the NDCs to outline their financing approaches for specific interventions. Belize, for instance, included a section in its latest (2021) NDC that reads as follows:

"Explore alongside Article 6 of the Paris Agreement, new financing options to support forest protection and restoration, including REDD+ performance-based payments, multilateral and bilateral funds, insurance products, debt-for-nature swaps, private investment, carbon credits and bonds, and other innovative conservation financing mechanisms..."

While this is not very detailed or specific, the commitment provides other governments as well as private investors with basic—yet extremely useful—information on its high-level vision for international finance and the use of specific tools and mechanisms. If a country wishes to add more detail, the approach to carbon finance would particularly benefit. As countries are piloting transactions under Article 6[2] of the Paris Agreement, no country has yet committed to a transaction based on a Blue Carbon intervention. Clarifying at the NDC level that Blue Carbon is a priority for an Article 6 transaction, would provide a powerful signal to partner and/or other donor countries.

For (project-based) carbon finance, countries are advised to clarify:

- Whether and how they see Blue Carbon projects integrated into their REDD+ efforts (for example, through "nesting")
- How they see carbon finance as part of their targets (for instance, carbon finance accounts towards conditional NDC targets, which are set subject to international funding)
- Whether they foresee a domestic regulatory framework to accompany voluntary carbon standards (for example, on corresponding adjustments), or not.

2 Article 6 of the Paris Agreement allows countries to voluntarily cooperate with each other to achieve emission reduction targets set out in their NDCs.

4.2 Institutional and Legal Framework for Blue Carbon

Pillar Two: Policies and Institutions

Governments and regulators play a crucial role in establishing the enabling environment for Blue Carbon development through policies and regulations that level the playing field. For the sustainable management of BCEs and for channeling investments into their enhancement, it is crucial to work within a robust institutional framework, with a clear legal basis, and to have all stakeholders participate and co-design the effort. Public law (command-and-control), community-based, and individual (private law) protection measures are critical and often lacking. Successful planning can help overcome isolated zoning, permitting, and policymaking more broadly. The baseline often is non-integration. Holistic planning can also help overcome overlapping, if not dysfunctional, administrative responsibilities. For this to happen, it is important that governments choose hard legal and institutional frameworks, with a permanent design, combined, as appropriate in the country context, with soft law or project-based approaches. Within these frameworks, it is crucial to establish clear and specific targets for Blue Carbon conservation, restoration, and management—including in terms of monitoring and tracking.

1.1.1 **These past decades have seen dramatic improvements when it comes to adopting and installing legal protection regimes.** Many countries have introduced protective bans, such as the ban on cutting mangroves (Slobodian and Badoz, eds. 2019) and—less frequently—a ban on cutting or deteriorating seagrasses (Griffiths et al. 2020). Aside from bans, many countries have specific protection through MPAs and legal frameworks for community-based mangrove management. While governments have made improvements throughout the past two decades, overall efforts still do not match the threat, especially in countries with the highest rates of degradation, including Southeast Asia. It is hoped that the new protection targets agreed under the GBF will specifically benefit coastal systems, and that governments employ community-based management tools for the operation of protected areas.

4.2.1 Blue Carbon and integrated spatial planning

Policy makers often struggle to formulate comprehensive regulatory frameworks beyond the demarcation of protected areas. Planning laws (including on infrastructure planning); agricultural policies; water and waste regulation all yield a massive regulatory imprint for natural habitats, including coastal habitats. Yet, these laws, regulations, and policies are rarely harmonized with the specific aim of boosting conservation and restoration.

Several integrated planning tools—including marine spatial planning (MSP), integrated coastal zone management (ICZM) and other effective area-based conservation measures (OECMs)—help governments regulate the coastal and marine space through more holistic and collaborative approaches. The Blue Carbon Readiness Framework should use them. MSP refers to the process that helps to guide the use and management of ocean and coastal resources in a coordinated and sustainable manner. It is a tool for balancing competing uses of marine space, including coastal development; (commercial) fishing; shipping; energy production; as well as conservation and restoration, taking into account economic, social, and ecological considerations. ICZM, on the other hand, refers to the management of the coastal zone with respect to the marine environment, as well as economic usages of land and water. It aims to achieve sustainable development by integrating the management of coastal and marine habitats with economic activities, across sectors, from agriculture to urban planning and tourism. Similar to MSP, ICZM seeks to balance environmental, economic, and social objectives, and to promote stakeholder participation and collaboration. It typically involves the identification of coastal issues and problems, the development of management plans, and the implementation and monitoring of management actions. Lastly, OECMs are gaining attention in international policy discussions as new conservation approaches, that go well beyond the established protected areas such as MPAs. OECMs are distinguished from protected area management by not having a primary conservation objective, while at the same time being capable of delivering *in-situ* conservation of biodiversity (IUCN, 2019). Owing to their importance, they have also been included in the GBF as means to reduce biodiversity threats.

MSP and ICZM are used to inform new policies and regulations for, among others, the sustainable use of marine resources (including BCEs), and to support future investments that promote growth, generate jobs, and support local communities (see Figure 11)**. OECMs can be additional tools for promoting biodiversity conservation, while regulating BCE preservation and other sectors (for example, water and waste).** Integrated marine spatial planning and management de-risks the wide range of economic sectors for future investments and has the potential to mobilize additional financial resources, including through the private sector. Overall, MSP and ICZM can provide a valuable tool for the conservation and restoration of BCEs, which are important for mitigating climate change and supporting biodiversity and ecosystem services. By integrating Blue Carbon considerations into marine-planning processes, MSP can help ensure that these ecosystems are effectively protected and managed for future generations. On the other hand, OECMs, materialized through government actions that have biodiversity conservation benefits as secondary objectives (such as policies to protect or sustainably manage water bodies, for example) can contribute to enforcing the ecological connectivity between protected areas or other areas of high

biodiversity, adding to the viability of preserving these. In other words, OECMs can be used to increase synergies between mitigation and adaptation actions, by combining co-benefits of BCEs and biodiversity conservation with adaptation activities, such as the sustainable management of water resources.

Figure 11 MSP and ICZM informing new policies and regulations for the sustainable use of marine resources, and job generation

Source: World Bank 2022

The World Bank, supported by PROBLUE, produced the Marine Spatial Planning for a Resilient and Inclusive Blue Economy Toolkit, comprising a series of guidance notes and factsheets related to the different MSP phases, and the data and tools to inform these efforts. This toolkit closes some of the knowledge gaps and highlights countries' opportunities to take advantage of planning and investment options to improve food security and livelihoods, and to strengthen community resilience to natural and economic shocks.

4.2.2 MSP and ICZM process and use

The legal nature of MSPs and ICZM—and their legal implications—can differ considerably. While the process as such often has a mandatory legal character, and while there are often preset institutional linkages (executive or advisory boards with heads of various agencies as pre-set members), the MSP/ICZM outputs may be binding for government agencies or have indirect legal value (for instance, to guide administrative discretion or the interpretation of law), or they may merely be recommendations. Whatever the legal structure, MSP and ICZM can provide considerable opportunities for the conservation and restoration of Blue Carbon habitats, while generating a wide array of positive effects for users of coastal environments, benefitting the blue economy at large (see Box 23).

In the MSP Guidance Note, the World Bank makes recommendations on the strategic use of MSP/ICZM for BCEs conservation and restoration, including:

- **Identification of important Blue Carbon areas:** MSP and ICZM can help identify and prioritize BCEs, including those that are particularly resistant to global sea-level rise or that can easily migrate inland as a result of sea-level rise. This can help ensure that these areas are protected and managed effectively, contributing also to the GBF and its fresh 2030 targets.
- **Integration of conservation and restoration goals in broader national strategies:** MSP and ICZM can facilitate the integration of conservation and restoration goals into broader marine management strategies. This can help ensure that Blue Carbon habitats are not overlooked in marine planning processes and that management efforts are coordinated across different sectors and jurisdictions.
- **Improved monitoring and research:** MSP and ICZM can provide a framework for monitoring and research to better understand the ecological functioning and carbon storage capacity of BCEs. This information can help inform management decisions and conservation efforts.
- **Support for ecosystem-based management:** MSP and ICZM can facilitate the implementation of ecosystem-based management approaches, which aim to protect and restore the ecological integrity of marine ecosystems. This can help promote the health and resilience of Blue Carbon habitats and the services they provide, such as carbon storage, erosion control, and support for fisheries.

BOX

23 Marine spatial planning and Blue Carbon: Examples from Indonesia and Mozambique

Indonesia

Following years in which Indonesia's government agencies moved without a clear legal framework on marine spatial planning (resulting in ad hoc engagement, long delays, and a reluctance to design specific targets and plans), Indonesia adopted its Marine Spatial Planning (MSP) framework in 2017. The MSP framework, adopted through the Indonesian National Ocean Policy by the Ministry of Marine Affairs and Fisheries in collaboration with other government agencies and stakeholders, aims to promote sustainable use and management of Indonesia's marine and coastal resources, through a spatial planning approach. The MSP process is ongoing and aims to identify and manage marine and coastal areas for various uses, including conservation, fisheries, aquaculture, shipping, and tourism, among others. The MSP framework is also designed to enhance coordination among various sectors and stakeholders (including government agencies, local communities, and the private sector) to ensure the sustainable development of Indonesia's marine and coastal resources.

Mozambique

Mozambique has developed an MSP framework, which goes under the name of POEM, to promote sustainable use and management of its marine and coastal resources. Approved in November 2021, the POEM set out a vision and guidelines for the development and management of Mozambique's national marine space, as defined under the United Nations Convention on the Law of the Sea, considering both current and potential marine uses. The POEM was developed through a broad participatory process led by the Ministry of Sea, Inland Waters and Fisheries, involving the engagement of more than 15 ministries at national and subnational level, and consultations with dozens of organizations from the private sector, civil society, and academia. The POEM spatially defined priority areas for considering the establishment of additional marine protected areas, in line with the High Ambition Coalition for Nature and People's goal of achieving the protection of 30 percent of the world's oceans by 2030.

4.2.3 Marine protected areas and Blue Carbon

Blue Carbon should be considered in Marine Protected Areas (MPAs) designation and management. MPAs are areas in the ocean that are set aside and managed for the protection and conservation of marine ecosystems, species, and habitats. They represent a key benchmark for measuring the success of coastal countries against the 30 percent protection target agreed under the Global Biodiversity Framework. They are also a key MSP component. This is not only in the sense that MSP must respect existing MPAs, and may provide for future MPAs, but in the sense that MPAs can be used in combination with other measures (such as zoning, fisheries management, and ecosystem-based approaches) to achieve multiple objectives, balance competing demands for ocean space and resources, and create synergies. For example, strict conservation MPAs can be used to restore depleted fish stocks for areas outside the MPAs and reinvigorate the local fishing industry. The integration of MPAs into MSP

requires careful consideration of ecological, social, and economic factors, and engagement with stakeholders to ensure effective implementation and management (see Box 24).

BOX

24 Designing and managing marine protected areas

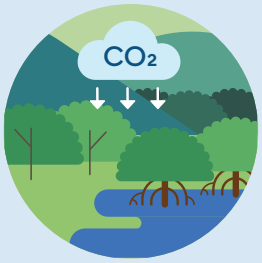
Belize

The Turneffe Atoll Sustainability Association (TASA), a local not-for-profit entity, has since 2012 co-managed the Turneffe Atoll Marine Reserve (TAMR), a marine protected area (MPA), under a power-sharing agreement with the Belize Government. TASA has recently secured "blended" funding (grants and loans) to pursue a strategy that combines classic MPA management with wider sustainable economic activities in the region.

The strategy covers surveillance, monitoring, and enforcement, while addressing the wider context of classic tourism (mostly visits from cruise ships) and more targeted eco-tourism ("sea safaris"). It also includes a carbon finance element to support TASA's long-term financial sustainability. The MPA-specific initiative speaks to broader marine spatial planning (MSP) objectives and can serve as blueprint for MPA engagement through MSP.

Philippines

Under the auspices of the Department of Environment and Natural Resources and using broad powers provided by the Philippine Fisheries Code of 1998, the National Integrated Protected Areas System Act of 1992, and the Clean Water Act of 2004, the Philippines has developed an EAFM-based (Ecosystems Approach to Fisheries Management) network of MPAs that cover over 1.4 million hectares of coastal and marine habitats. These MPAs are managed by local communities, with support from the government and non-governmental organizations. In addition to MPAs, the Philippines has also implemented a system of fisheries management that includes the establishment of closed seasons, size limits, and gear restrictions, as well as the promotion of alternative livelihoods to reduce fishing pressure. One of the key factors contributing to the success of MSP in the Philippines has been the active involvement of local communities in the planning and management process.



4.3 Blue Carbon and REDD+

Within the Blue Carbon Readiness Framework, governments should focus on both the integration of Blue Carbon into their REDD+ frameworks *and* the design of a separate Blue Carbon strategy.

This is not a contradiction but rather the foundation for using the policy tools in the most synergetic and even synchronized way.

4.3.1 Technical REDD+ integration

Many coastal countries have gone through years of REDD+ preparations (REDD+ readiness), building everything from governance tools to REDD+ reference levels, from forest monitoring systems to community engagement modes, and from business plans for alternative land use to safeguards protocols (including redress mechanisms). These procedures and protocols can and should be used *and refined* to include mangroves**—and** perhaps salt marshes, seagrass beds, and even kelp forests (should the latter become actionable BCEs).

4.3.2 Institutional REDD+ integration

Over the past two decades, REDD+ has dramatically changed forest governance in many developing countries. Technical units were created at central government level, and sometimes at regional level, to gather data, establish monitoring systems, and oversee implementation. Cross-ministerial REDD+ policymaking bodies emerged to set out strategies and steer through the REDD+ readiness process. Administrative responsibilities were re-assigned in line with REDD+ needs, including with respect to results-based finance responsibilities. Many REDD+ systems have given rise to multilayered institutional "nesting" arrangements (Lee 2018). A growing number of countries has chosen to define a bespoke REDD+ funding and benefit-sharing architecture (see Box 25). Platforms for PPP engagements within REDD+ frameworks can be found across countries.

These structures can be used to define a Blue Carbon governance framework either by integrating Blue Carbon into the existing structures, or by replicating institutional templates that have proved successful in the REDD+ context. Navigating Blue Carbon responsibilities among core ministries— namely forestry, fisheries and water—should receive specific attention. Hierarchies for technical and policy units should be clear and, while these bodies must act with broad buy-in from across government levels, functional coherence and efficiency remains the goal. The creation of a new, independent agency—reporting to the prime minister or the president—may be a suitable way forward for many countries.

BOX

25 Mangroves REDD+ frameworks

Madagascar

Madagascar is a biodiversity hotspot with significant areas of mangroves, seagrass beds, and other coastal forests. As in many other coastal areas around the world, these habitats have been threatened by a range of factors, including deforestation, overfishing, and climate change. To address these challenges, Madagascar has developed a national REDD+ program that includes a focus on mangrove conservation and restoration, as well as conservation and restoration of other coastal forests. The program has a strong emphasis on securing land tenure for local communities, and on promoting community-based natural resource management. The national REDD+ program in Madagascar includes a range of activities related to mangrove conservation and restoration, such as the development of community-based management plans, the establishment of community-based monitoring systems, and the implementation of sustainable livelihood activities for local communities. To support these activities, the Madagascar Government has also established legal frameworks for community-based mangrove management, such as the national policy on community-based forest management, which recognizes the rights of local communities to manage and benefit from mangrove forests. Overall, Madagascar's REDD+ program for mangrove conservation and restoration has been recognized as a successful example of integrating climate-change mitigation and adaptation with community-based natural resource management. It has the potential to contribute significantly to global efforts to address climate change.

4.3.3 International REDD+ support

While overall REDD+ financial flows may remain modest, there is a strong network of international partnerships on capacity-building and bilateral and multilateral funding frameworks, including the World Bank's Forest Carbon Partnership Facility (FCPF). They should be used to offer windows for Blue Carbon interventions. Many existing REDD+ programs will provide the framework for jurisdictional Blue Carbon interventions, securing size and reducing the risk of leakage. The mitigation density of Blue Carbon interventions should help navigate more funding per area for Blue Carbon habitats than terrestrial habitats. Credits may also be stacked with unique co-benefits, which raise the level of interest from donors, and local communities that may benefit from them.

The development of benefit-sharing schemes, such as the ones developed under the Enhancing Access to Benefits while Lowering Emissions (EnABLE) multi-donor trust fund from the World Bank, are critical for social equity, and long-term sustainability of carbon investments. These efforts enhance the inclusion of marginalized communities and disadvantaged groups as beneficiaries in Emission Reductions Programs (ERPs) under the different carbon finance trust funds, to maximize their carbon and non-carbon benefits. Achievement of this objective is expected to contribute to broader outcomes, including improvement in the resilience of livelihoods, biodiversity conservation, and climate change mitigation (see Box 26).

BOX

26 Community participation, and land and marine tenure

It is estimated that communities hold as much as 65 percent of the world's land area through customary, community-based tenure systems, even though only some 10 percent of land ownership by indigenous peoples and local communities (IPLCs) is formally recognized (Rights and Resource Initiative 2015). In coastal zones, small-scale fishers play a significant role in the global fisheries sector. They represent about 90 percent of the world's nearly 51 million capture fishers, of whom about half are women. Small-scale fishers produce half of all global fish catch and supply two thirds of the fish consumed by people (USAID N.D.).

Despite their social and economic relevance, land and coastal habitats suffer from a low rate of (customary) tenure recognition. This also has ramifications for the state of (sustainable) habitat management. Community ownership not only correlates with, but leads to, positive habitat outcomes (Viet 2021). Ecosystems held by IPLCs with secure land rights are generally associated with lower rates of deforestation, reduced greenhouse gas emissions, better biodiversity protection, and improved livelihoods.

Simplified tracks for legal recognition of IPLCs, and the design of community governance tools, can help address these gaps, and provide a strong basis for the sustainable management of critical coastal Blue Carbon habitats. MSP and ICZM frameworks are particularly suitable for ensuring social inclusion. Building on smart, disaggregated data (providing information according to sex, age, specific groups, and so on) and integrating culturally sensitive consultation and respect for existing cooperatives, they also unlock the potential of women and marginalized groups as employees, leaders, and decision-makers (World Bank 2021).[3]

REDD+ support frameworks also offer community-based management approaches that focus on the recognition of land tenure and equitable benefit-sharing. The **EnABLE program,** for instance, set up in December 2020 with a EUR 20 million grant from Germany, aims to mobilize up to US$200 million for commitment and disbursement between 2021 and 2030, including US$100 million earmarked to support inclusion in Forest Carbon Partnership Facility (FCPF) REDD+ programs. EnABLE-funded activities are guided by the notion that:

- REDD+ programs must contain strong benefit-sharing plans that recognize community tenure and stakeholder efforts, while being socially inclusive
- The design and execution of the programs and benefit-sharing plans are stakeholder- and community-driven.

3 World Bank 2021, "Gender, Marginalized People and Marine Spatial Planning," at https://documents1.worldbank.org/curated/en/924011636704855990/pdf/PROBLUE-Gender-Marginalized-People-and-Marine-Spatial-Planning-Improve-Livelihoods-Empower-Marginalized-Groups-Bridge-the-Inequality-Gap.pdf.

4 https://www.worldbank.org/en/topic/climatechange/brief/enable-enhancing-access-to-benefits-while-lowering-emission.

4.3.4 Blue Carbon stand-alone approaches

There are two main areas for independent Blue Carbon development. One concerns habitats that fall outside the scope of a country's REDD+ framework; this will often be the case for seagrass beds and salt marshes. The other concerns the importance of Blue Carbon restoration. A multitude of factors make BCE *restoration* a global priority:

- High degradation trends (past and present);
- High economic value of BCEs, including the resilience value for coastal communities faced with sea-level rise and coastal erosion;
- High mitigation density of BCEs; and
- Simplicity of mangrove restoration (Ellison et al. 2020).

As they may not be easily integrated into REDD+ strategies and governance models, specific policy frameworks are needed to access and convert degraded lands, mitigate the risk of conflicting use, manage leakage, and much more.

Therefore, stand-alone Blue Carbon approaches are needed. As in the case of forest landscape restoration (Sapkota and Hoang 2020), these approaches should be designed to closely resemble existing REDD+ frameworks but with their own strategy and governance, as well as their own technical framework. Potential conflicts from overlapping policy frameworks (as in the case of mangroves, which may be covered a priori by both REDD+ and a bespoke Blue Carbon framework) should be solved through nesting models.

4.4 Financing Approaches

Pillar Three: Finance

As stated above, in order to position BCEs at the heart of the Blue Economy and accelerate the implementation of Blue Carbon strategies, there needs to be recognition of the economic value of blue natural capital and scaling up of available financing.

4.4.1 Scaling up Blue Carbon finance

Leveraging Blue Carbon finance, which includes investing in conservation and restoration-focused Nature-based Solutions in the most effective and efficient way, requires scaling up of available funding. This can be achieved by simplifying access to finance, fostering sustainable private investment, and providing an enabling environment for investors. A national Blue Carbon framework should prioritize the following on the finance front:

- **Regularly analyze existing fiscal allocations and financial flows in the Blue Economy, to better spend the resources available and thereby achieve results focused on sustainability and integration.** The World Bank developed the Blue Public Expenditure Review to guide countries in their assessment of how public expenditures address issues related to coastal and marine resources, environmental degradation, and development aspirations that depend on these blue resources and environments—including Blue Carbon development. The financial analysis should consider positive funding, such as funding for the development and management of MPAs, NbS, sustainable supply-chain development, and law enforcement. It should also identify and withdraw direct and indirect funding of key drivers of national degradation of BCEs (such as environmentally harmful subsidies) or other traditional financial support for aquaculture and agriculture that does not effectively mitigate degradation risks.

Figure 12 Figure representing budgetary allocations for the Blue Economy development

Source: World Bank 2022. "Blue PER Factsheet".

- **Conduct a stock-take of complementary funding mechanisms and specific financial instruments that induce sustainable funding for BCEs.** This includes policy; debt and non-debt instruments such as taxes and fees; Blue Bonds (e.g. commercial or multilateral banks); multilateral development banks' concessional/ non-concessional loans; grants (e.g. trust funds, philanthropy), private sector investments (e.g. corporate social responsibility, or corporate climate and nature commitments); as well as jurisdictional (regional or state-level) mechanisms like Blue Carbon-focused jurisdictional REDD+. Multilateral development banks play an important role in bringing together multiple actors, building technical capacity, and mobilizing finance through non-concessional and concessional instruments (for example, PROBLUE, PROGREEN, Global Partnership on Sustainability, Global Environment Facility, and so on) (See Box 27). Non-state-actor-

driven sustainable business models and initiatives that monetize ecosystem services by "stacking" multiple revenue streams from ecosystem-generated goods and services should also be considered. Examples include initiatives on waste and energy infrastructure linked to mangrove restoration, sustainable shellfish-farming, tourism-funded MPA management in public-private partnership, climate-resilient seaweed cultivation, among others.

BOX

27 Strategic deployment of concessional resources: PROBLUE

In 2018, the World Bank announced PROBLUE, a Multi-Donor Trust Fund that supports the sustainable and integrated development of marine and coastal resources in healthy oceans. PROBLUE supports SDG 14 (Life Under Water) and is aligned with the Bank's twin goals to end extreme poverty and increase income and welfare in a sustainable way, by providing financial support, advisory services, and technical expertise across all ocean sectors.

PROBLUE focuses on four main themes:

- Sustainably managing fisheries and aquaculture;
- Addressing and preventing the threats posed to ocean health by marine pollution;
- Supporting a sustainable economy, with a focus on tourism, shipping, and offshore renewable energy; and
- Helping governments build capacity to manage their marine and coastal resources in an integrated fashion (including the development of Blue Carbon as a Nature-based Solution to climate change), to deliver more and longer-lasting benefits to their respective countries and communities.

- **Develop blended finance mechanisms to make Blue Carbon investments attractive.** When traditional finance is insufficient to attract investment for nascent projects, blended finance can come into play. Blended finance is a model that allows investment of different types of capital alongside each other—such as grants and concessional finance (for example, low-interest loans and price guarantees). These funds come from governments, multilateral development banks, private sector, and philanthropic elements within civil society (such as not-for-profit organizations or high-net-worth individuals) and are used in a way that removes uncertainty or risk (IFC 2023).[5] (see Box 28).
- **Identify large-scale Blue Carbon opportunities to attract investments.** Larger-scale opportunities are the main draw for asset owners and managers to increase their exposure to natural capital investments. Aggregating several projects, and pooling services and expenses, would help lower costs and increase the overall ticket size of the investments.

5 International Finance Corporation. 2023. *Deep Blue—Opportunities for Blue Carbon Finance in Coastal Ecosystems.*

BOX

28 Blue Carbon opportunities for financial institutions: International Finance Corporation

There are opportunities for financial institutions to support the development of the Blue Carbon markets, including:

- Revising existing guidelines for blue finance to add red (*No-Go*) and green (*Go*) lists for the blue finance areas, ensuring that no new deforestation or degradation of coastal wetlands happens and clarifying that coastal wetland ecosystem interventions have generally high (three-star) impacts for mitigation and adaptation;
- Supporting insurers in developing markets (through financial assistance and advisory services) to tailor flood-risk policies to wetland enhancement interventions;
- Building on experience with issuing Green Bonds, designing "blue" bond products to focus on coastal wetland conservation and restoration activities, and defining workable metrics and impact frameworks to evaluate the use of relevant proceeds; and
- Revising definitions and metrics for climate-related activities to define direct and nested coastal wetland conservation and restoration activities.

(Source: International Finance Corporation 2023. *Deep Blue—Opportunities for Blue Carbon Finance in Coastal Ecosystems*.)

Blue Carbon interventions depend on key building blocks to ensure their effectiveness. Blue Carbon regulatory and investment frameworks can learn from decades of REDD+ experience (Table 6).

Table 6 REDD+ building blocks and reference resources

Element	Description	Resource
Legal and institutional framework	Legal and institutional frameworks are required to enable access to results-based climate finance and carbon finance. These include frameworks for institutionalization of measurement, reporting, and verification system (MRV).	The FCPF's Readiness Fund has created a normative framework for REDD+, formulating core elements which can be used, mutatis mutandis, for establishing Blue Carbon frameworks: https://www.forestcarbonpartnership.org/resources Useful literature sources on legal and institutional readiness include the Little Book of Legal Frameworks for REDD+: https://globalcanopy.org/wp-content/uploads/ 2020/12/ LittleBookofLegalFrameworksforREDD_EN.pdf The WB's REDD+ Nesting Manual provides guidance for the design and implementation of accounting systems, which may include integration of project-level activities into national accounting frameworks (also known as "nesting"). This manual provides guidance on multiple dimensions including institutional frameworks and legal frameworks, benefit sharing, safeguards, registries, which could be applicable to BCE. It includes a decision-support tool to help decision-makers in defining the most suitable nesting framework.
MRV system	Measurement, Reporting and Verification system that is able to report verified Emission Reductions in accordance with a defined standard.	The Global Forest Observation Initiative (GFOI) has developed different guidance materials for REDD+ countries, but it could also be applicable to Mangroves and other BCE: • Methodology and Guidance Document (MGD) which provides guidance for MRV design and implementation, including definition of institutional arrangements: https://www.reddcompass.org/mgd • Open MRV which provides practical learning modules for estimating the Activity Data with different operational tools: https://openmrv.org/home/measurement/ activitydata

Land tenure and carbon rights	Land tenure represents one of the most significant challenges for successfully implementing integrated land use initiatives. The identification of carbon rights promotes the recognition of customary tenure and the active stewardship role of communities for natural habitats.	There are various sources available to help navigate land tenure and carbon right claims, including from the World Bank's BioCarbon Fund: https://biocarbonfund-isfl.org/integrated-land-use/land-tenure. The FCPF has issued a useful "guidance note" on the ability of program entities to transfer title to emission reductions: https://www.forestcarbonpartnership.org/sites/fcp/files/2019/July/FCPF%20Guidance%20Note%20on%20the%20Ability%20of%20Program%20Entity%20to%20Transfer%20Title%20to%20Emission%20Reductions_2018.pdf. For the FCPF's legal documents on transfer of title, see https://www.forestcarbonpartnership.org/standards-and-management.
Benefit Sharing Arrangements	Equitable sharing of carbon and non-carbon benefits is important to provide rewards to sustainable and expansion of mitigation actions.	The World Bank's FCFP and ISFL have developed some resources for the design of benefit-sharing arrangements for REDD+ and integrated-landscape programs, including guidance documentation and collection of lessons learned. https://www.forestcarbonpartnership.org/bio-carbon/en/index.html
Safeguards	In the planning and implementation of mitigation actions, countries require that safeguards be put in place to ensure that mitigation activities take into account a range of policies and rights, including those related to conservation, stakeholders, and their access to sustainable livelihoods.	REDD+ countries have developed a number of systems to manage safeguards including: • Safeguard Information Systems for providing publicly available information on how safeguards are being addressed and respected in REDD+ Readiness and implementation activities. • A Strategic Environmental and Social Assessment (SESA) helps to ensure compliance with relevant safeguards by integrating key environmental and social considerations covered by the relevant safeguard policies and procedures at the earliest stage of decision making. Feedback and grievance redress mechanism (GRM) needs to be effectively available, and if necessary strengthened, as part of the country's REDD+ institutional arrangements. The World Bank developed the Environmental and Social Framework to support the sustainable development vision of the countries' projects: https://thedocs.worldbank.org/en/doc/837721522762050108-0290022018/original/ESFFramework.pdf More information may be found at https://www.forestcarbonpartnership.org/topics and https://www.un-redd.org/work-areas/safeguards-multiple-benefits.

Registries

An emissions trading registry is an online database that issues, records, and tracks the carbon units that are exchanged within market mechanisms or financed through Results-Based Climate Finance (RBCF) programs.

The World Bank's Partnership of Market Readiness (PMR) and the FCPF developed guidance on regulation, development and administration of emission trading registries: https://openknowledge.worldbank.org/entities/publication/02603f21-25b1-538a-af49-01ab11ed51cd

The Partnership for Market Implementation (PMI) developed an open Measurement, Reporting, and Verification system that supports capturing emissions, emission reductions and finance received by each mitigation activity, and tracks these at individual project, sector, and national level: https://pmiclimate.org/.

CHAPTER

5 Recommendations for Action

Propelling Blue Carbon to its full potential requires governments to undertake a harmonized response that combines technical, institutional, regulatory, and financial aspects. This is to tap into the many opportunities presented by Blue Carbon development—for climate mitigation as well as for the rich portfolio of ecosystem services beyond carbon.

Adopting such a comprehensive response will help countries shift to a more productive and resilient Blue Economy that gives stability to natural habitats and predictability to the private sector. Practical and actionable recommendations for governments are proposed to improve readiness and to help accelerate Blue Carbon investments.


Pillar One: Data and Analytics

Recommendation 1

Strengthen country enabling environment to develop GHG inventories for above and below-ground carbon.

GHG inventories are the backbone of all climate mitigation actions, yet emissions and removals from coastal wetlands that include above and below-ground carbon, are often omitted from them. Integrating coastal Blue Carbon ecosystems requires considerable technical and institutional capacity. Yet, practical guidelines (chiefly in the form of the 2013 Wetlands Supplement) are available, and governments can access various technical assistance programs for capacity-building purposes. Ideally, governments add a training program for the existing GHG inventory team, prepare a gap analysis for available data points on GHG emissions and removals from coastal BCEs (focusing on coastal BCE mapping and human activity data), and use the timeframe until the next major NDC update in 2025 to build or complete the inventory section on coastal BCEs.

Recommendation 2

Promote the Use of Ecosystem Valuation in Decision Making.

Developing and implementing natural capital and ecosystem valuation is a critical step to shedding light on the significance of nature at the macroeconomic policy level and engaging economic decision-makers (including ministers of finance and planning) in the global response to the climate change and biodiversity crises. The availability of such data would also greatly benefit the private sector, helping to inform the decisions of firms and financial institutions at the project and portfolio levels, and assisting them to engage with sovereigns in an effort to manage BCEs more sustainably. These ecosystem valuation assessments can include a true price mechanism for Blue Carbon credits linked to the degree of permanence achieved and co-benefits such as ecosystem services, gender, indigenous peoples, and local communities. Such assessments—which can draw from the ongoing Changing Wealth of Nations (CWON) work, the Global Ocean Accounts Partnership, or other tools presented in the Blue Economy Data and Tools Catalogue—will be important features to allow stakeholders to identify win-win investment opportunities. These are opportunities that promote Blue Carbon protection and restoration, while creating sustainable returns from fisheries, tourism, coastal risk-reduction, and more.

Pillar Two: Policies and Institutions

Recommendation 3

Strengthen existing national institutional structures, and design specific policies that facilitate the implementation of Blue Carbon commitments.

Activities should include legal screenings and option assessments for better and smarter protection, including through community governance formats, fit-for-purpose assessments of enforcement agencies, legal mandates for governments (local, state, national) to engage in Blue Carbon (project) development, and the design of legal tools that recognize title to emission reductions and removals, link such title to the participation of local communities in decision making, and trace any transfers and monetization actions in transparent and publicly accessible registries. Community stewardship arrangements should include formats and institutional structures for rewarding individuals and communities for efforts to enhance BCEs, including through the development of benefit-sharing plans (e.g. for example, EnABLE). Other measures could be on re-purposing subsidies to prevent BCE degradation, or implementing tax/policy reforms for deforestation-free products.

Recommendation 4

Adopt integrated planning and Blue Carbon Strategy to enhance local benefits.

Plans for Blue Carbon interventions must address the cross-sectoral nature of BCEs and must be underpinned by effective benefit-sharing mechanisms, and unified with livelihoods development. It is important to integrate Blue Carbon considerations into the broader context of national policy planning, for example by using governance tools such as Marine Spatial Plans (MSPs) and Integrated Coastal Zone Management (ICZM) plans. Such tools will inform policies and regulations that are key to leveling the playing field for Blue Carbon investments and to incubating a pipeline of bankable projects. In terms of institutional strengthening, leadership on technical, policy, and finance matters requires that operational units are defined and clear responsibilities carved out. In this process, the preparation of a Blue Carbon strategy that takes into account integrated planning would provide a roadmap to support Blue Carbon investments at the national level and leverage the many co-benefits of these investments.

Recommendation 5

Leverage partnerships between governments, private sector, international financing institutions, and philanthropies.

This could help address the systemic risks stemming from BCE loss and influence global agendas. Multiple economic and financial sector initiatives focused on climate change and sustainability have emerged in recent years and have convinced economic and financial policy makers of the need to integrate climate into their respective agendas. The climate and biodiversity crises have not only a local dimension, but also regional and global public goods dimensions. As a result, a broad stakeholder engagement is required to provide ambitious solutions for a swift response to climate change and biodiversity loss. Consensus needs to be built around bold yet realistic targets, a systemic response, and appropriate support mechanisms that harness sufficient technical and financial resources for implementation. An effective and coordinated response requires active engagement of the UN system, multilateral development banks, bilateral donors, and philanthropies. There are also opportunities to strengthen dialogue with financial institutions and regulators on Blue Carbon and biodiversity, and the role of trade policy as a means to curb BCE degradation.

Pillar Three: Finance

Recommendation 6

Adopt a holistic approach to mobilizing finance.

A combination of suitable innovative or emerging funding mechanisms, including “blended” finance, concessional resources, and infrastructure finance are critical to scale up Blue Carbon investments. The financial gap analysis (for instance, the Blue Public Expenditure Review) should inform the opportunities for mobilizing finance for Blue Carbon development. Blending public and private funds, including private sector, and philanthropic funds, offers opportunities for alleviating and repurposing public debt towards actual Blue Carbon investments. Blended finance can support the development of proof-of-concept business models and make the risk- return profile of the private sector more competitive, allowing for expansion to other locations. A phased approach can be considered that blends concessional and commercial capital and uses innovative funding mechanisms to enhance coastal resilience for communities and put countries on a net-zero emissions path.

Recommendation 7

Access international funding for Blue Carbon readiness.

International grant-based support, which is available under many bilateral (for example, UK Blue Planet Fund, Norway's Oceans for Development), international (for example, PROBLUE, PROGREEN, Global Partnership on Sustainability, GEF, and so on), and philanthropic programs, as well as private sector finance (corporate climate and nature commitments, and corporate social responsibility programs) should be used for capacity-building at the government level; inventory work; technical infrastructure for mapping; carbon stock assessments; and monitoring of GHG fluxes (emissions and removals). This institutional infrastructure can be built together with weather information and warning systems (sea-level rise and extreme drought and/or flooding) to inform policymakers and directly enhance coastal resilience for communities. Funding should also be used to prepare a pipeline of shovel-ready projects and ready-to-use platforms for community-governance formats, on the one hand, and public-private partnerships on coastal management and investment, on the other hand.

Recommendation 8

Promote public-private partnerships (PPPs) for Blue Carbon market development.

Through these partnerships, additional funding can be mobilized for the capacity building and science needed to scale the supply of high-quality Blue Carbon credits to the market. PPPs could help overcome key policy barriers to scaling private investment in Blue Carbon ecosystems in an equitable and transparent manner.

APPENDICES

Appendix 1: Checklist (Blue Carbon Readiness Framework)

Checklist | Blue Carbon Readiness Framework

PILLAR 1

DATA & ANALYTICS

EVALUATING BLUE CARBON ACTIONS

CHECKLIST 1

Identifying Established Blue Carbon Ecosystems Within Your Country

The first step in the process of evaluating blue carbon actions is identifying if your country currently has, or has had, any of the following blue carbon ecosystems (BCEs). BCEs fall into one of two categories: Established or Emerging.

ESTABLISHED BLUE CARBON ECOSYSTEMS –
Mangroves, seagrass beds, and salt marshes are recognized as falling into an established inventory category of wetlands. These ecosystems are considered "actionable" because they are eligible for Blue Carbon crediting instruments.

Salt Marshes – explore the UNEP Global Distribution of Salt Marshes map located at the link below. From the link you can download spatial data on the baseline inventory containing global seagrass distribution. Data used to develop this map covers studies from 1973 – 2015.
https://data.unep-wcmc.org/datasets/43

Seagrasses - explore the UNEP Global Distribution of Seagrass map located at the link below. From here, you can zoom to your country to view salt marsh distribution or download spatial data to view distribution across a customizable area. Data used to develop this map covers studies from 1934 – 2015.
https://www.unep.org/resources/publication/global-distribution-seagrasses

Mangroves – Global Mangrove Watch (GMW) provides a variety of data on the global distribution of mangroves at yearly intervals going back to 1996. Using their online mapping portal, you can view the distribution of mangroves within your country, as well as a variety of different data layers on carbon storage, mangrove type, and mangrove area change over time.
www.GlobalMangroveWatch.org

EMERGING BLUE CARBON ECOSYSTEMS –
The following BCEs are considered emerging as they are "likely" actionable, meaning they meet some of the actionability criteria. In the future, these ecosystems may be eligible for Blue Carbon crediting instruments. Currently, there is limited data on the global extent of emerging BCEs, and as such, there are few resources available for countries looking to assess national extent/area of these ecosystems.

Checklist | Blue Carbon Readiness Framework

CHECKLIST 2

Resources for Gathering Required Data for GHG Inventories

References: *The Blue Carbon Initiative's BC & NDC Guidelines on Enhanced Action, Landsat data available from the U.S. Geological Survey*

There are several datasets required for the development of an effective GHG inventory. The requirements fall into two general categories: Location and extent of BCEs, and activity data. No matter your level of capacity, the prevalence of global datasets and methodologies – such as the IPCC Wetlands Supplement – mean there are still actions your country can take to improve existing inventories and work towards policy and financing actions for your BCE(s).

Location and Extent of BCEs – For inventory reporting purposes, maps, or spatial data on the distribution of BCEs within your country is critical. This data can be used to calculate all required carbon stocks (above and belowground biomass and soil organic carbon (SOC)) and change in carbon stocks over time using default values from the IPCC Wetlands Supplement. This information is also valuable in determining carbon stock gains and losses over time when paired with land use and land use change (LULUCF) data, and for identifying a baseline for BCE location and extent. With knowledge of location and extent of BCE(s) within your country, you can then estimate the amount of carbon stored, sequestered and/or released from the BCE(s) based on land conversion or change.

✓	**1.** Determine the current, and historic location and extent of BCE(s) – Satellite imagery is an effective solution for this step. Note: Your country may already account for mangroves as part of their National Forest Inventory.	**a.** Landsat (and similar satellites) supply free, open-source imagery at a global scale, and across various timeframes – check the link below for further information: ⓘ https://landsat.gsfc.nasa.gov/data/where-to-get-data/ **b.** Map the location and extent of all BCEs present within your country ⓘ Refer to Checklist 1 for resources on location of established BCEs **c.** Incorporate data from new technologies, such as drones, as they become available
✓	**2.** Determine the baseline year for assessing location and extent your country's BCEs	**a.** Identify the earliest year the Landsat imagery covers for your nation, ensuring this coverage includes any present BCEs **b.** This year will serve as your baseline year – e.g, 2005 is the first year where you can clearly identify BCE within your country
✓	**3.** Calculate changes in BCE location and extent over time	

Checklist | Blue Carbon Readiness Framework

ACTIVITY DATA –
Activity data refers to rates of carbon accumulation and loss based on uses of, and impacts upon, BCEs. Specifically, activity data refers to the magnitude of human activities or actions which result in emissions or removals during a designated timer period. As a result, activity data is highly country specific.

✓	**1.** Obtain spatial layers on land use and land use change (LULUCF) for regions of your country where BCE(s) are present	
✓	**2.** Follow guidance laid out in Chapter 4 of the Wetland Supplement to estimate activity data	**a.** Established BCEs are included within the Wetlands Supplement in the "Coastal Wetlands" category. Emissions factors and methodologies are provided for various categories of BCE use/ impacts upon BCEs such as mangrove management practices, revegetation, aquaculture, and drainage.

CHECKLIST 3

Applying the IPCC Tier 1 Default Values

References: *The Blue Carbon Initiative's BC & NDC Guidelines on Enhanced Action*

TIER 1 DEFAULT EMISSION FACTORS –
Chapter 4 of the IPCC Wetlands Supplement provides global default emission factors for designated activities within established BCEs: mangroves, salt marshes and seagrasses. These global default values are referred to as Tier 1 estimates. Tier 1 emission factors can be used in conjunction with data on BCE extent and change in extent over time to estimate carbon stock values at a national level. Tier 1 factors as especially important when it comes to estimates of SOC stocks or changes in stocks, as lack of data on SOC is a common bottleneck country run into.

TIER 2/3 DEFAULT EMISSION FACTORS –
When available, country specific emission factors can provide more accurate estimates of national BCE carbon stocks.

Checklist | Blue Carbon Readiness Framework

CHECKLIST 4

Updating & Improving GHG Inventories

References: *The Blue Carbon Initiative's BC & NDC Guidelines on Enhanced Action*

Accurate reporting and accounting of emissions and removals of coastal wetlands must be complete before a country can incorporate coastal wetlands within the mitigation section of their NDCs. Development and continued maintenance of GHG Inventories is an important tool in meeting evidence-based climate mitigation policy requirements.

✓	**1.** Determine the location and extent of the BCE(s) habitat within your country	**a.** Calculate the approximate area of the habitat
✓	**2.** Map the distribution and change of the BCE habitat coverage over time	**a.** Identify a baseline year – commonly the earliest year with complete data on ecosystem extent – and compare extent from subsequent years to this baseline. **b.** Quantifying change over time is important for inventory and reporting purposes.
✓	**3.** Estimate the BCE's existing carbon stock – now that we know the habitat extent and change over time, it is important to understand the amount of carbon sequestered and stored by the BCE(s).	**a.** Gather data on the relevant carbon pools pertaining to the BCE(s) (ex: aboveground biomass, soil organic carbon (SOC), standing deadwood, etc.). **b.** Utilize the calculated area of the BCE(s) to estimate a carbon stock value
✓	**4.** Estimate the BCE's emissions rates	
✓	**5.** Estimate the rate of carbon accumulation and loss over time	**a.** Pay attention to potential changes in land use, and how this will affect existing and future carbon stocks

Checklist | Blue Carbon Readiness Framework

PILLAR 2
POLICY & INSTITUTIONS
NDC COMMITMENTS & IMPLEMENTATION

CHECKLIST 5

Accounting for BCE in NDCs

References: *NDC Guidelines on Enhanced Action; NDC Partnership: Opportunities for Ocean-Based Climate Action*

There are various options for countries to include BCE in their NDC accounting framework. Depending on the state of the GHG inventory and the capacity to report emissions and removals in line with the 2013 Wetlands Supplement, countries may include BCE within their economy-wide target or not. In the latter case, countries can still present stand-alone, action-based targets for BCE. They can and should also set out a timeframe for when they will be able to report GHG emissions and removals from coastal wetlands in their inventory and, hence, when they will be able to account for emissions and removals from BCE under their NDC.

✓	**1.** Check Government Roles and Responsibilities over BCEs	**a.** Does your country have a central agency for coordinating ocean/coastal and BCE management **b.** Is there a clear division of roles and responsibilities regarding BCE management and protection among relevant government entities and other stakeholders **c.** Are there comprehensive laws and regulations, at various levels, that specifically protect or conserve BCEs? **d.** Which agency(ies) are responsible for enforcing such laws and regulations, and are they adequately resourced and mandated to do so?
✓	**1.** Check if BCE are (already) included in a country's NDC accounting scope.	**a.** Refer to explicit language ("all sectors" include in scope, as well as "2013 Supplement"). **b.** In case all sectors fall within the abstract scope, but IPCC guidance is not referenced beyond the 2006 Guidance, there is a good chance that the de facto accounting framework ignores GHG emissions and removals from wetlands.
✓	**2.** Confirm that BCE are included or clarify that they will be by a certain date, referencing the capacity to use the 2013 Supplement.	
✓	**3.** Check if BCE habitats are covered in your REDD+ framework (and target setting), if applicable (see below, Checklist 6).	

Checklist | Blue Carbon Readiness Framework

✓	**4.** Describe the type of BCE-related (mitigation) target, applying principles of clarity, unambiguity, and ambition.	**a.** If full BCE inventory reporting occurs, a mitigation target may be included in a country's cross-economic or cross-sector target.	
		b. If full BCE inventory reporting does not occur or if a country wants to highlight a specific target for BCE, check which action-based targets you can set out:	**i.** Consider a commitment to a complete halt of deforestation (mangroves) and/or degradation (all BCE). **ii.** Alternatively, consider a commitment to net-zero deforestation of degradation, or BCE-positive conservation. **iii.** In addition, set restoration targets for BCE habitats (ideally, expressed in hectares) **iv.** In addition, make a commitment for BCE area coverage under sustainable management.

CHECKLIST 6

Accounting for BCEs in your NDCs as a REDD+ Country

References: *The Blue Carbon Initiative's BC & NDC Guidelines on Enhanced Action*

REDD+ countries are well placed to expand their NDCs to include BCEs. The following steps can be taken when considering how to account for BCEs in existing and upcoming NDCs

✓	**1.** Determine if mangrove forests are accounted for in existing NDCs and as part of your country's REDD+ program using the following questions as a guide:	**a.** Review your National Forest Definition – are mangroves referenced or included? **b.** Is the project area included in the RAMSAR list of wetlands of international importance? **c.** Does the Forest Reference Layer incorporate all relevant mangrove carbon pools, including soil carbon? Are there separate measures specifically for soil carbon stocks that can be included within the NDC? **Note:** Often REDD+ reference levels will exclude soil carbon pools **d.** Are there MRV/FREL or alternative GHG accounting methodologies used within the REDD+ program for my country that can be applied?

Checklist | Blue Carbon Readiness Framework

✓	**2.** Identify the following:	**a.** which governmental department(s) oversee forests and coastal ecosystems and GHG reporting to ensure streamlined action for including this data within new/existing NDCs **b.** relevant legal/policy governance involving BCE(s) **c.** clear division of roles and responsibilities among BCE entities and stakeholders **d.** BCE agencies are adequately resource
✓	**3.** Determine how to effectively keep data on GHG emissions/ removals relevant – source new data as it becomes available, identify ways to improve existing data sources so they account for all carbon pools, especially soil organic carbon.	

✓ CHECKLIST 7

NDC Implementation

Implementing your NDC targets for BCE usually requires concise and multi-layered planning and the creation of an inducive regulatory and institutional (governance) framework. Please take into consideration the time-frame required to strengthen the legal and governance systems. Relevant steps include:

✓	**1.** Review the integration of BCE in your REDD+ framework (if applicable).	**a.** Often, mangroves are included in REDD+ approaches, and it is important to clarify to what extent BCE-specific targets on conservation and restoration are compatible with REDD+ targets and whether reference level calculations include BCE (or mangroves) in full. **b.** Often, soil carbon accounting is excluded from REDD+ forest reference levels. Make sure that are included and specify dates by when this will happen.
✓	**2.** Develop a bespoke Blue Carbon strategy that includes a list of actions as well as financing opportunities (see below Checklist 9).	**a.** The strategy should come with a list of (priority) interventions and project-sites. **b.** It should clarify administrative responsibilities and mandates, including for engaging in RBCF and/or blue carbon project finance, if applicable. **c.** It should set out predictable investment parameters for the private sector, which include clarity on land-based carbon rights and the authority to transfer emission reductions/removals and the underlying carbon rights, as well as clarity on land tenure, community involvement, and benefit sharing. **d.** It should address structural drivers of degradation and conflicting land use. And **e.** It should present a template for how to use the Blue Carbon investment framework (see Checklist 9 below).
✓	**3.** BCE needs to be valuated for the ecosystem services they provide. That includes GHG mitigation services but covers adaptation-focused services as well as other services to coastal communities and others. CWON 2.0 has made a strong start with valuating mangroves. It should be extended to cover other BCE in the future.	

Checklist | Blue Carbon Readiness Framework

✓	**4.** Key planning tools are marine spatial planning (MSP) and integrated coastal zone management (ICZM). It is recommended to use the Marine Spatial Planning Toolkit: https://www.worldbank.org/en/programs/problue/publication/marine-spatial-planning-for-a-resilient-and-inclusive-blue-economy-toolkit	**a.** Check if your country or its regions have MSP/ICZM procedures and capacity in place. **b.** Check to what extent BCE conservation, restoration and management are part of these procedures and enshrined as decisive planning and management objectives. **c.** Check what role valuation plays for MSP/ICZM. **d.** Check what level of regulatory compliance MSP/ICZM gives rise to and how compliance for BCE conservation and restoration targets can be improved.
✓	**5.** The recognition of land tenure and community tenure is essential for the success of many planned BC interventions.	**a.** Check how land tenure over BCE is defined in your country. **b.** Check what role fishing and other coastal communities have for BCE use and management. **c.** Check community governance and stewardship options.
✓	**6.** Establish a comprehensive list of bottlenecks and concerns and keep the list updated through implementation.	**a.** Lack of planning capacity and funding are often systemic and should be tackled as a priority (see this Checklist 7 and Checklist 8). **b.** Uncertain and limited legal protection – including with respect to special protection regimes (marine protected areas or "MPAs" and community governance – represent another frequent bottleneck of structural nature. **c.** So do gaps in knowledge (of BCE maps, drivers and magnitude of degradation, economic value), and so do limitations in comprehensive monitoring.

✓ CHECKLIST 8

Developing and Incorporating Governance Models

Successful governance models will commonly incorporate the following:

1 TECHNICAL GOVERNANCE –
It is important to employ a team to handle all necessary data, such as carbon stock values or spatial data on ecosystem extent. This team is integral to ensuring Section 1 of the decision tree is fully built out. This unit will handle: FRL/ FRLE calculations, MRV, and other activities.

2 POLICY GOVERNANCE–
This team will guide implementation, focus on creating a functional decision-making process and will help ensure inter-magisterial cooperation and participation. Effective communication with all magisterial groups managing or working nearby coastal wetlands will be critical to ensuring permanence of carbon stocks in restoration or conservation projects, as one example.

3 FINANCIAL GOVERNANCE–
Focus on distributing funding in line with appropriate benefits sharing arrangements.

Checklist | Blue Carbon Readiness Framework

4 PRIVATE SECTOR ENGAGEMENT–

It is paramount to set out investment parameters and the governance framework for engaging the private sector (establishing the "rules and the structures of the game") defining involvement in planning and decision making and address key aspects, notably carbon rights, the authority to, and the terms for (including in terms of taxes), transfer(ing) emission reductions/removals and the underlying carbon rights, and that define models for the involvement of communities and benefit sharing.

5 COMMUNITY GOVERNANCE –

Community involvement, input and engagement are crucial, and identifying a community role within any project is important to ensure the permanence of carbon stocks, especially when restoration or conservation is involved.

PILLAR 3

FINANCE

LEVERAGE BLUE CARBON INVESTMENT

CHECKLIST 9

Developing a Carbon Finance and Investment Framework

Any such framework should start with an assessment of how existing funding flows (including government, and private funded ones) benefit or disadvantage BCE. It is recommended to apply the Blue Public Expenditure Review: https://documents1.worldbank.org/curated/en/789491639977748921/pdf/Blue-Public-Expenditure-Review-Guidance-Note.pdf

1.	Check for positive flows:	a. MPA design and management b. Law enforcement c. Capacity-building d. Sustainable supply chain investment, and more
2.	Check for negative flows: recommended publication as guidance https://openknowledge.worldbank.org/entities/publication/4217c71d-6cbc-46b6-942c-3e4651900d29	a. Subsidies into industrial fishing b. Subsidies for non-sustainable aquaculture c. Agricultural subsidies that incentivize the extension of farmland d. Agricultural subsidies that incentivize the overuse of fertilizers e. Other.

Checklist | Blue Carbon Readiness Framework

✓	**3.** Then, survey financing approaches and sources/instruments Recommended literature as guidance: https://thedocs.worldbank.org/en/doc/916781601304630850-0120022020/original FinanceforNature28Sepwebversion.pdf https://documents1.worldbank.org/curated/en/099060123121542587/pdf/	**a.** Existing, planed, or potential investments in restoration, conservation, or sustainable management of BCEs. **Note:** Promote private sector initiatives and create institutional structures for private sector and community involvement. Use of mechanisms such as Article 6 **b.** Jurisdictional REDD+/RBCF **c.** Concessional instruments (including blended finance models) **d.** Non-concessional models (including payment for ecosystem services and innovative business)
✓	**4.** Set out stable investment parameters for the private sector	**a.** Carbon finance and the use of markets **b.** Taxes, fees, charges **c.** Definition and allocation of carbon rights **d.** Government mandate for carbon trading (especially for government owned coastal lands) **e.** Models for community involvement and benefit sharing for Benefit sharing arrangements please visit https://www.worldbank.org/en/topic/climatechange/brief/enable-enhancing-access-to-benefits-while-lowering-emission
✓	**5.** The actual implementation and scale-up will be linked to the deployment of actual financing tools: government-driven and private sector-focused.	**a.** Are there plans to use blended finance, i.e., funding that combines public and private funds? **b.** Can private finance be mobilized for blue carbon project development? (consider private sector engagement for operational costs, restoration, management, etc) Recommended IFC report: Deep Blue: Opportunities for blue carbon finance in coastal ecosystems https://climatefocus.com/wp-content/uploads/2023/05/DeepBlue-OpportunitiesforBlueCarbonFinanceinCoastalEcosystems-Optimized.pdf
		b. Are structures and templates available to guide the design and implementation of blended finance opportunities? — **i.** Is a regulatory framework in place for public-private partnerships? **ii.** Can you use MDB-funded programs to promote blended finance opportunities for BCE?
		c. Are independent debt finance solutions being drawn up, or can they been drawn up? Blue bonds and debt-for-nature swap agreements with a focus on BCE would be prominent examples.

Checklist | Blue Carbon Readiness Framework

✓	**6.** Does your country plan to use carbon markets for BCE interventions?	**a.** Consider prioritizing BCE for Article 6 Paris Agreement programs Consider prioritizing BCE for Article 6 Paris Agreement programs and transactions. and transactions.	**i.** Can the current legal and regulatory framework accommodate Article 6 transactions, and is this desirable? **ii.** What needs to be put in place to create enabling environment for Article 6 transactions? **iii.** Should rules be adopted regarding approval of programs, monitoring, reporting and verification (MRV) of blue carbon ERs, authorization of ITMOs, registries, corresponding adjustments for Article 6 activities? **iv.** Is there a comprehensive legal and regulatory framework that specifies who owns blue carbon ERs, and how related property rights and interests can be transferred domestically and/or internationally? **v.** Does the relevant agency have the capacity to access blue carbon ER markets, engage with potential buyers or brokers, and negotiate agreements for their sale?
		b. Consider incentivizing the development of voluntary carbon projects through	**i.** Earmarking government-owned land for carbon market integration **ii.** Creating administrative powers and responsibilities to engage in voluntary carbon markets **iii.** Consider the adoption of a BCE project recognition procedure that provides developers with a guarantee to perform corresponding adjustments.

APPENDICES

Appendix 2: Blue Carbon Habitats

A. Established Blue Carbon systems

Mangroves

Mangroves are a group of trees that grow in coastal saltwater zones in at least 124 tropical and subtropical countries around the globe (Spalding et al. 2010; Giri et al. 2011). They are the only trees in the world that can tolerate salt water and excrete the excess salt through their leaves. Often located at the boundary between land and sea, mangroves are among the most carbon-rich tropical forests and cover an approximate global extent of 14,735,900 hectares (ha) (Bunting et al. 2022). Estimates suggest that mangroves can store on average between 6 and 8 Mg Coe ha^{-1} annually—about two to four times as much as mature tropical forests. Because of threats in tropical regions, and because of the potential overlap with REDD+ programs, mangroves have received particular attention as a Blue Carbon mitigation opportunity. Fifteen countries contain 75 percent of all mangrove areas globally (Fries et al. 2019). A global study by Hamilton and Fries (2018) estimated mangrove carbon stock (assuming 1 meter soil depth) over the period 2000 to 2012. They estimated global mangrove carbon stocks of 4.19 Pg C in 2012, with Indonesia, Brazil, Malaysia, and Papua New Guinea accounting for 50 percent of the stock. More recently, Kauffman et al. (2020) estimated that mangroves globally store about 11.7 Pg C, based on soil profiles greater than 1 meter in depth. Globally, 20 to 35 percent of mangroves were lost between 1980 and 2000 (Millennium Ecosystem Assessment 2005; Polidoro et al. 2010), although deforestation trends seem to have decreased since the turn of the twentieth century: from a mighty 2 percent or more in global annual losses to a (still substantial) 0.4 percent. The main causes of loss include conversion to agriculture; development of industrial and urban areas; conversion to fish and shrimp ponds; logging for wood and charcoal; and conversion to open water due to climate change (Servino et al. 2018; Sippo et al. 2018). Most of today's emissions occur in Southeast Asia (0.18 percent per year; Richards and Friess 2016), though hotspots in deforestation rates can be traced also in Latin America and Africa.

Tidal salt marshes

Tidal salt marshes are formed by an accumulation of mineral sediments and organic material, which is then flooded with salty tidal waters. These marshes accumulate almost all of their carbon in their soils (which can be several meters deep) at a rate up to 55 times faster than tropical rainforests, and—under optimal conditions—can store it for thousands of years (McLeod et al. 2011). Tidal marshes have not systematically been mapped globally, though technology exists to do so. A total estimated tidal salt marsh extent of 5,495,089 ha is provided by McOwen et al. (2017), of which 4,548,200 ha are non-arctic tidal salt marshes (Greenberg 2006). Tidal marshes are largely found outside of the tropics, with those in the United States (1,723,410 ha), Canada (111,274 ha), Europe (356,947 ha), and Australia (1,325,854 ha) enjoying a relatively high level of regulatory protection. For these countries, inventories of change exist. Argentina (118,870 ha), Mexico (272,527 ha), and Russia (700,719 ha) host major extents of tidal salt marshes with lesser degrees of protection. Southern Brazil and Uruguay (37,858 ha) hold extents of marshes within estuaries.

The sustainability of tidal salt marshes as a carbon sink is continuously threatened by environmental disturbances, linked to both human-driven changes in land use and global climate change (Gilby et al. 2021). Land-use changes affect the supply of freshwater, nutrients, and sediments from coastal watersheds to tidal salt marshes, influencing carbon cycling (Colombano et al. 2021; Gilby et al. 2021). Emissions from converted tidal salt marshes on organic soils can be prolonged, with examples from locations such as the drained agricultural soils of Sacramento-San Joaquin Delta continuing for over a century (Deverel and Leighton 2010). Emissions patterns resemble those from peat forests, with emissions continuing decades—if not centuries—after initial conversion to agriculture.

In most industrialized countries, tidal marshes are heavily degraded. The installation of levees, train tracks, and roads has severed the connection to the sea and altered the hydrology. Apart from draining and filling, tidal marshes are diked, grazed, harvested for fodder, and otherwise used for agriculture. The loss of tidal marsh habitats resulting from these disturbances can result in Blue Carbon loss through greenhouse gas (GHG) emissions back into the atmosphere (Beckett et al. 2016; Himes-Cornell et al. 2018).

While there is comprehensive data on human-induced habitat losses, including the impact on carbon stocks, for a number of estuaries, jurisdiction-wide information and information on global degradation (ongoing annual losses and carbon flux changes) is less readily available. While protecting and maintaining tidal salt marshes to avoid GHG emissions is a high priority for climate change mitigation efforts, quantification of their carbon stocks and flux changes is equally as important to minimize carbon loss.

Seagrasses

Seagrasses are slender, green, underwater flowering plants that form extensive meadows in shallow coastal waters worldwide and accumulate carbon—almost all of which is stored in soils measuring, in some species, up to four meters. As a coastal ecosystem, seagrass plays a significant role in purifying ocean water; battling disease; supporting food security; protecting coastlines; and storing carbon (United Nations Environment Programme (UNEP) 2020). Seagrass meadows are often largest in estuaries and bays where harbors and cities are conjoined. It is estimated that seagrasses globally store 140 Mg organic carbon per hectare in the top meter of soils, accumulated over centennial-millennial time-scales, and that the seagrass beds are up to 40 times more efficient at capturing organic carbon than land forests' soils (Serrano et al. 2021).

Seagrass habitats represent a significant carbon sink in the global carbon cycle, with meadows found from subpolar to tropical climatic zones (Duarte et al. 2005). Meadows cover an estimated area of between 16,000,000 and 60,000,000 ha (Oreska et al. 2020; McKenzie et al. 2020), though modeling studies of potential seagrass area hint that this may be a substantial underestimation (Jayathilake and Costello 2018). Australia has the most extensive areas (8,301,300 ha), representing 31 percent of global known seagrass area, followed by Indonesia (3,000,000 ha), and the Gulf of Mexico (1,934,900 ha) (Green et al. 2003; McKenzie et al. 2020). Seagrasses are spread across 209 countries and territories located within global seagrass bioregions, including along the Mediterranean and East African coast, and elsewhere (McKenzie et al. 2020).

At the global scale, seagrasses are estimated to annually sequester 4.2 to 19.9 Pg C (Fourqurean et al. 2012). However, seagrasses still represent the largest source of uncertainty in global Blue Carbon stocks and inventories owing to incomplete and poorly resolved maps of seagrass extent and changes in extent (Chmura et al. 2016; Oreska et al. 2018). There is a lack of detailed baseline information on former coverage extent, and mapping is challenged by the submerged nature of seagrasses. Carbon-stock data is globally patchy and shows a high degree of regional heterogeneity (Fourqurean et al. 2012). With that caveat in mind, seagrass loss is believed to be significant (29 percent global loss since 1980s), resulting in emissions of potentially 0.65 Gt CO_2 per year, according to Hoegh-Guldberg et al. (2018). This is roughly equivalent to the annual emissions of the entire global shipping industry (UNEP 2020). With 40 percent of the world's population living in coastal areas (Seas and Plans 2011), the magnitude of human pressure on seagrasses is increasing. Exacerbated by global climate change, this means that seagrasses continue to be lost at a rate of 1.4 percent per year (Short et al. 2011).

The 2013 IPCC Wetlands Supplement (IPCC, 2014) allows reporting of GHG emissions or sequestration from seagrass conversion and restoration in country national inventories, and carbon standards have been developed as well so that restoration projects can benefit from carbon credits (for example, the Verified Carbon Standard since 2015). However, there are mainly gaps in data, regulations, and incentives that prevent their implementation. Notably, no emissions reduction projects for seagrasses have been carried out to date.

B.
Emerging Blue Carbon systems

Seaweeds

Seaweeds, another macro algae, are plant-like organisms that generally live attached to rocks or other hard substrates in coastal areas. Seaweeds capture a significant amount of CO_2 from the marine environment and provide various ecosystem services, including bioremediation of coastal pollutants, coastal protection, food security and carbon storage. Despite all these benefits, seaweeds have not been incorporated into Blue Carbon strategies or seriously evaluated as a permanent carbon sink because of the preconception that seaweed decomposes completely in the ocean and does not store carbon. However, several studies (Krause-Jensen and Duarte 2016; Duarte and Cebrian 2017; Barron and Duarte 2015) have suggested that, since a considerable part of seaweed production gets exported outside its natural habitat and remains as shelf sediments in the deep ocean for extended time periods, seaweeds are globally relevant contributors to oceanic carbon sinks and can help combat the local impacts of ocean acidification (Duarte and Krause-Jensen 2022; Yong et al. 2022). With these new findings about seaweeds' involvement in carbon storage, seaweed is now emerging as a nature-based climate-change- mitigation strategy, because seaweeds are incredibly efficient at absorbing CO_2: they pull more GHG from the water than seagrasses, mangroves, and salt marshes combined, based on biomass (Krause-Jensen and Duarte 2016). Seaweed farming has a potential carbon sequestration intensity of about 1500 tCO_2/km^2/year (Duarte and Krause-Jensen, 2017), highlighting its role as a major player in climate- change mitigation (with challenges, however, on securing permanence).

Kelp forests

Kelp forests are extensive underwater habitats dominated by large algae and they cover a narrow strip along 26 percent of the world's coasts (Wernberg and Filbee-Dexter 2019). They grow in dense groups, much like a forest on land, and provide food and shelter for thousands of fish, invertebrates, and marine mammals. Kelp forests harbor a variety of plants and animals. Many organisms use the thick leaves as safe shelter from predators or storms (Steneck and Johnson 2013). It is still unclear to what extent kelp forests act as a sink (Johnson 2021), but they can sequester significant amounts of carbon. Kelp forests export on average as much as 80 percent of their production (Krumhansl and Scheibling 2012), much of which leaves the nearshore and gets stored in the deep sea as allochthonous detritus (Ortega et al. 2019). Research has shown that Australia's kelp forests contribute to more than 30 percent of the total Blue Carbon sequestered by marshes, mangroves, and seagrass beds; and about 3 percent of the total blue carbon worldwide (Filbee-Dexter and Wernberg 2020). However, they are treated as non-accumulating coastal vegetative ecosystems and are not considered by the IPCC as Blue Carbon ecosystems (BCEs) (Macreadie et al. 2019). A key

challenge of including kelp forests in Blue Carbon assessments and policy is accounting for carbon that is mainly stored as allochthonous detritus in the deep ocean, because it is difficult to trace the source to the site of storage. There is a risk of overestimating the carbon that ends up in other BCEs, and also because sink habitats in the open ocean do not fall within national jurisdictions (Macreadie et al. 2019).

Similar to other BCEs, kelp forests have been declining globally, and this decline is projected to continue in the coming decades (Wernberg et al. 2019). Degradation does not stop at kelp forests: in the North Atlantic alone, ocean warming has caused 85 to 99 percent of kelp biomass to decline over the last 50 years (Filbee-Dexter et al. 2016). At least 140,187 ha of Australian kelp forests have been lost due to extreme marine heatwaves, coastal pollution, and overgrazing by sea urchins and herbivores (Wernberg et al. 2016; Verges et al. 2016).

Benthic (marine) sediments

If left undisturbed, seafloors hold vast amounts of carbon on geologic timescales: from thousands to millions of years (Estes et al. 2019). Globally, seafloor sediments are believed to store between 2239 and 2391 Pg of carbon (C) in the top meter, or nearly twice the carbon stocks in the top meter of terrestrial soils (Atwood et al. 2020). The amount of C stored within exclusive economic zones (EEZ)—the 200 nautical mile area (from the coast) for which coastal nations hold special rights—is roughly the same as the amount stored in the high seas (Atwood et al. 2020).

A likely major cause for disturbance is bottom trawling, whereby large, weighted nets are dragged across the ocean floor, clear-cutting a swath of habitat in their wake. When that happens, sediment becomes suspended, exposing organic carbon to remineralization into the water column. The process may also further acidify ocean water and thus reduce the ocean's capacity to absorb CO_2 (Sala et al. 2021). In terms of protection, there are few legal restrictions to bottom trawling and dredging. Even in countries with generous marine protected areas (MPAs) bottom trawling and dredging is permitted almost everywhere. The UK, for instance, which protects some 300,000 km^2 of its territorial waters, bans trawling only in about 5 percent of those areas (Marine Conservation Society 2020). Ninety-nine percent of fish caught by bottom trawlers is caught in EEZ waters (Steadman, D. et al. 2021). Within the EEZ, the average trawling intensity in territorial seas is double the average trawling intensity in EEZ overall (ibidem).

While significant uncertainties remain concerning the quantitative atmospheric impact of trawling and dredging (Pidgeon et al. 2021), tentative assessments have been forthcoming. Hutto et al. (2021) estimate that emissions are in the range of 36 million tons of carbon, or 132 million tCO_2, every year. A feasibility assessment—and draft methodology—tracing mitigation benefits from avoided trawling is under way.

Coastal mud flats

Coastal mud flats (or tidal flats) are tidal habitats that are often adjacent to vegetated coastal wetlands. Accounting for at least 127,921 km^2 across the Americas and Asia, they are areas of intertidal sand or mud accumulation on gently sloping coastlines with heavy sediment inflows (Murray et al. 2019). Like their vegetated peers, mud flats provide coastal communities with critical ecosystem services, including storm and shoreline protection and food production. Mud flats have generally high C sequestration capacity, similar to that of vegetated coastal ecosystems—especially in estuaries where the hydrodynamic environment promotes C burial and riverine sediment supply provides large quantities of organic matter. Their global average carbon stock and accumulation rate has been calculated by Chen and Lee (2022) at 129.8 g C m^2 yr^{-1}, with the top-meter sediments containing on average 86.3 Mg C ha^{-1}. Globally, the authors find that tidal flats can bury 6.8 Tg C (24.9 Tg CO_2) per year and can store 0.9 Pg C (3.3 Pg CO_2) in the top meter sediment. Assuming the same rate of tidal flats loss as in the past three decades, and assuming that all disturbed sediment C is re-mineralized, 4.8 Tg C are lost from mud-flat sediments annuallyequivalent to emissions of 17.6 Tg CO_2 to the water column and atmosphere. The calculations come with several caveats. The current datasets are limited; the knowledge about CO_2 and other GHG emissions from lost mud flats is particularly limited; and the (long-term) temporal trajectories for carbon storage require more analysis.

APPENDICES

Appendix 3: Examples of Multilateral Funding for Oceans

Table 7 Examples of blue/coastal projects from international funding agencies (top five in each case)

Name	Where	Amount (US$ million)	Type	Approved
WORLD BANK				
Mangroves for Coastal Resilience Project	Indonesia	400	Grant	2022
Blue Economy Program for Results	Morocco	350	Loan	2022
National Cyclone Risk Mitigation Program–II	India	308	Loan	2015
Sustainable Coastal and Marine Fisheries	Bangladesh	240	Loan	2018
West Africa Coastal Areas Resilience Investment Project	Western and Central Africa	190	120 Loan / 70 Grant	2018
GREEN CLIMATE FUND				
Global Fund for Coral Reefs	Global	125	Equity	2021
Integrated Flood Management to Enhance Climate Resilience	Samoa	57,7	Grant	2016
Enhancing Climate Resilience of India's Coastal Communities	India	43,4	Grant	2018
Coastal Adaptation Project (TCAP)	Tuvalu	36	Grant	2016
Enhancing Climate Change Adaptation in the North Coast and Nile Delta Regions	Egypt	31,4	Grant	2018
GLOBAL ENVIRONMENTAL FACILITY				
Blue Nature Alliance to Expand and Improve Conservation of 1.25 Billion Hectares of Ocean Ecosystems	Global	22,6	Grant	2021

Name	Where	Amount (US$ million)	Type	Approved
Protecting and Restoring the Ocean's Natural Capital, Building Resilience and Supporting Region-Wide Investments for Sustainable Blue Socio-Economic Development (PROCARIBE+)	Regional / Caribbean	15,4	Grant	2021
Pacific I2I Regional Project: Ocean Health for Ocean Wealth—The Voyage to a Blue Economy for the Blue Pacific Continent	Regional	15	Grant	2021
Mainstreaming Sustainable Marine Fisheries Value Chains into the Blue Economy of the Canary Current and the Pacific Central American Coastal Large Marine Ecosystems	Global	11	Grant	2022
Blue Pacific Finance Hub: Investing in Resilient Pacific SIDS Ecosystems and Economies	Regional	9	Grant	2022
ADAPTATION FUND				
Climate Change Adaptation in Vulnerable Coastal Cities and Ecosystems of the Uruguay River	Argentina, Uruguay	14	Grant	2019
Reducing Climate Vulnerability and Flood Risk in Coastal Urban and Semi-Urban Areas in Cities in Latin America	Chile, Ecuador	14	Grant	2018
Enhancing the Resilience of the Agricultural Sector and Coastal Areas to Protect Livelihoods and Improve Food Security	Jamaica	10	Grant	2012
Reducing Vulnerability by Focusing on Critical Sectors (Agriculture, Water Resources and Coastlines) in order to Reduce the Negative Impacts of Climate Change and Improve the Resilience of these Sectors	Costa Rica	10	Grant	2014
Adaptation to the Impacts of Climate Change on Peru's Coastal Marine Ecosystem and Fisheries	Peru	7	Grant	2016

APPENDICES

Appendix 4: Blue Carbon Projects (Global)

The following list shows existing wetland carbon projects (registered, under validation, or under development), structured along the different international standards:

I. Verified Carbon Standard

The most concentrated project portfolio is provided by the Verified Carbon Standard.

Table 8 Existing wetland carbon projects (Verified Carbon Standard)

ID: Project Name	Country	Methodology and year of registration	Activities	Size (hectares)	Annual emission reductions / removals (tCO_2eq)
1318: Livelihoods' Mangrove Restoration Grouped Project	Senegal	AR-AM0014 (2014)	ARR; Mangrove reforestation	10,415	30,000 (228,542 issued in 2021)
1463: India Sunderbans Mangrove Restoration	West Bengal (India)	AR-AM0014 (2019)	ARR; Mangrove reforestation	4,675	51,249 (119,139 issued in 2018)
1493: Mangrove Restoration and Coastal Greenbelt Protection in the East Coast of Aceh and North Sumatra Province	Indonesia	AR-AM0014 (Registered)	ARR; Mangrove reforestation	1,000	124,706 (125,391 issued in 2019)

ID: Project Name	Country	Methodology and year of registration	Activities	Size (hectares)	Annual emission reductions / removals (tCO_2eq)
1760: The Haidar el Ali Mangrove Initiative (HEAMI)	Senegal	AR-AMS0003 (Under development)	ARR; Mangrove reforestation	2,000	30,170
1764: Reforestation and Restoration of Degraded Mangrove Lands	Myanmar (Ayeyarwaddy Division)	AR-AM0014 (2018)	ARR/WRC; Mangrove reforestation	2,100	184,006 (59,299 issued in 2020)
2088: Mangrove Restoration and Sustainable Development in Myanmar	Myanmar (Ayeyarwaddy Division)	AR-AM0014 (Registration requested)	ARR/WRC; Mangrove reforestation	2,100 (4,500 in PD)	403,831
2250: Delta Blue Carbon - 1	Pakistan	VM0033 (2021)	ARR/WRC; Mangrove reforestation	350,000 (224,997 in PD)	2,407,629
2290: Blue Carbon Project Gulf of Morrosquillo "Vida Manglar"	Colombia	VM0007 (2021)	Mangrove conservation	7,561	31,310
2330: Protection of mangroves and community developmental activities in the biodiversity hotspot of Colombia	Colombia	VM0015 (Under validation)	REDD; Mangrove conservation	64,000	460,000
2343: Zhanjiang Mangrove Afforestation Project	China (Guangdong Province)	AR-AM0014 (2021)	ARR; Mangrove reforestation	380	4,020 (6,534 verified in 2021)
2360: Virginia Coast Reserve Seagrass restoration Project	Virginia, USA	VM0033 (Under development)	WRC; Seagrass restoration	66,452	1349
2395: OKI REDD+ Project	Indonesia (South Sumatra)	AR-AM0014; VM0007; AR-ACM0003 (2019)	Mangrove conservation and reforestation	23,500	181,986
2406: Senegal and West Africa Mangrove Programme	Senegal	VM0007 (Under development)	ARR/REDD/ WRC; Mangrove restoration and conservation	42	2,547

ID: Project Name	Country	Methodology and year of registration	Activities	Size (hectares)	Annual emission reductions / removals (tCO_2eq)
2518: Carbon Sequestration in Mangroves of the South – Central Coastal Zone of the State of Sinaloa	Mexico	VM0007 (Under development)	Mangrove reforestation and conservation	49,387	3,123,836
2568: Hainan Lingshui Mangrove Blue Carbon Project	China	AR-AM0014 (Registration requested)	ARR; Mangrove reforestation	192	75,796
2792: Mangrove Restoration and Sustainable Development in Myanmar	Myanmar (Ayeyarwaddy Division)	AR-AM0014 (Under development)	ARR; Mangrove reforestation	1,003	77,130
2842: Restoring Mangroves in Mexico's Blue Carbon ecosystems	Mexico	VM0033 (Under development)	ARR/WRC; Mangrove reforestation	32,914	868,302
2500: Bonos del Jaguar Azul	Yucatan, Mexico	VM0033 (Under development)	ARR/WRC; Mangrove reforestation	5,060	48,518
2834: Mangrove Restoration Project with Sine Saloum and Casamance Communities	Senegal	AR-AM0014 (Under validation)	ARR/WRC; Mangrove reforestation	7,020	95,470
3142: Blue Forest and Mozambique: Building Africa's Largest Mangrove Restoration Project	Mozambique	VM0007 (Under development)	ARR/REDD; Mangrove conservation and reforestation	183,000	2,965,555
3357: Climate Resilient and Community Driven Mangrove Afforestation Project	Sri Lanka	AM0014 (Under development)	Mangrove afforestation	1,000	65,000

II.
Plan Vivo

Plan Vivo, a boutique international standard tailored to focus more heavily on the positive social impact of carbon projects, as well as to accommodate smaller projects, has three wetland projects in its portfolio.

Table 9 Existing wetland carbon projects (Plan Vivo)

Project Name	Country	Methodology and year of registration	Activities	Size (hectares)	Annual emission reductions / removals (tCO_2eq)
Mikoko Pamoja	Kenya	Plan Vivo (project-specific calculation)	Avoided deforestation and forest restoration; reforestation and forest protection; restoration of eroded beach area	125	9,880 (by 2021)
Tahiry Honko	Madagascar	Plan Vivo (project-specific)	Mangrove conservation and restoration	1,400	1,375 (none yet issued)
Vanga Blue Forest	Kenya	Plan Vivo (project-specific)		460	5,000 (none yet issued)

III.
American Carbon Registry and Climate Action Reserve

In North America, both the American Carbon Registry (ACR) and the Climate Action Reserve (CAR) have coastal wetland projects in their pipeline.

American Carbon Registry

Table 10 Existing wetland carbon projects (American Carbon Registry)

ID: Project Name	Country	Methodology and year of registration	Activities	Size (hectares)	Annual emission reductions / removals (tCO_2eq)
ACR410	United States	The Restoration of California Deltaic and Coastal Wetlands, Version 1.1	Restoring palustrine emergent wetlands on Sherman and Twitchell Islands, similar to those that existed in the early part of the last century	693	6,500
ACR430	United States	Restoration of Pocosin Wetlands	Raising water levels in drained wetlands	44,920 (over 20 years)	16,000

Three cancelled projects: ACR 364 (Restoration of Coastal Wetland Forest in Louisiana); ACR 397 (Forested Wetland Assimilation in the Mississippi Delta); and ACR414 (Quimby Island / Western Delta Wetlands Restoration)

Climate Action Reserve

Table 11 Existing wetland carbon projects (Climate Action Reserve)

ID: Project Name	Country	Methodology and year of registration	Activities	Size (hectares)	Annual emission reductions / removals (tCO_2eq)
CAR1428	Mexico	Mexico Forest Protocol (version 1.5)	Mangrove restoration	692 (mangrove element)	6,000 (estimate)
CAR1429	Mexico	Mexico Forest Protocol (version 1.5)	Mangrove restoration	1,200	Not known

IV. Blue Carbon credit schemes (Japan)

Table 12 Existing wetland carbon projects (Japan)

Project Name	Country	Methodology and year of registration	Activities	Size (hectares)	Annual emission reductions / removals (tCO_2eq)
Yokahama Blue Carbon Project	Japan	IPCC and Kuwae et al. (2019)	Fossil fuel reduction by fishing boats, management of eelgrass beds, wakame kelp	Not known to authors	Not known to authors
Fukuoka City	Japan	IPCC and Kuwae et al. (2019)	Eelgrass beds	Not known to authors	Not known to authors
Offset Crediting Demonstration by the Japanese National Government (J-Blue Credit): Yokohama Bay Side Marina	Japan	IPCC and Kuwae et al. (2019)	Eelgrass and Sargassum beds		10.6 ha.

APPENDICES

Appendix 5: Methodological Details (Blue Carbon)

Blue Carbon methodologies—notably Verra's **VM0033** and **VM007**—are not unlike methodologies developed for forestry projects. They apply the same, or similar, considerations for the assessment of baseline scenarios, carbon stocks in biomass, and leakage emissions from activity shifting. This includes (for conservation projects) the fundamental consideration that a project developer must demonstrate a real, immediate, and site-specific threat of deforestation or degradation. For restoration projects, it means that the project must be implemented on degraded tidal wetlands, or mud flats, or shallow open water, in which establishment of wetland ecologic conditions is not expected to occur in the absence of the project activity (see Table 2).

However, specific components are distinctly different when assessing other carbon pools—notably soil— as well as dynamics such as the effects of sea-level rise (as the tidal zone may shift landward), ecological leakage (changes to adjacent areas due to hydrological connectivity), carbon stocks in tidal wetland soils, and methane emissions.

In 2015, the Methodology for Tidal Wetland and Seagrass Restoration (VM0033) became the first globally applicable greenhouse gas-accounting methodology for coastal wetland restoration, allowing tidal wetland restoration projects—specifically mangroves, salt marshes, and seagrasses—to generate VCS carbon credits (Verified Carbon Units or "VCUs") based on any effective restoration activity. The new methodology (an updated version was released in 2021) vastly expanded the scope of Blue Carbon interventions available under the earlier (Clean Development Mechanism-recognized) Blue Carbon methodology for afforestation and reforestation of mangroves. With VM0033, a wide set of activities—including removal of tidal barriers to re-wet degraded marshlands; improvement of water quality to increase seagrass habitats; sustainable use of dredged materials; and re-introduction of native plant communities in tidal wetlands—have become eligible to generate VCUs, thereby generating a new source of funding.

VM007 ("REDD+ Methodological Framework") received an update (1.6) in 2020, expanding its set of modules on the quantification of GHG-emission reductions and removals to include tidal wetlands at risk of deforestation or degradation. The modules in question are:[1]

- VMD0050: Estimation of baseline carbon stock changes and GHG emissions in tidal wetland restoration and conservation projects
- VMD0051: Methods for monitoring carbon stock changes and GHG emissions in tidal wetland restoration and conservation project activities
- VMD0052: Demonstration of additionality of tidal wetland restoration and conservation project activities.

1 Accessible here.

While most Blue Carbon projects to date operate under the older CDM methodology (AR-AM0014),[2] all projects listed after 2022 must utilize VM0033 or VM007 or—in the future—the consolidated tidal wetland conservation and restoration methodology (under development).

The methodologies address the key technical parameters—including on additionality, permanence, and leakage:

BOX

29 Concept of additionality[3]

A carbon finance concept is the principle of additionality. It allows carbon finance to come in only for interventions that would not have occurred in the absence of carbon market incentives—in other words, that they were not the most likely or profitable option and there were barriers to implementation. The underlying rationale behind the additionality principle is twofold.[4] First, it is an expression of environmental integrity, specifically in the context of carbon crediting (offsetting). If an intervention that would be realized in the normal course of action is accounted for as a mitigation effort, the latter's ambition is put in doubt, and any offsetting function really increases the overall emissions balance. Second, it addresses the need for efficient resource allocation. Carbon finance should be a means to an end. Allocating it to interventions that have no need creates an inefficient windfall for the recipient and leaves legitimate beneficiaries with less cash to distribute.

While the motivation is clear, the issue in practice is one of the most contentious ones for carbon markets. A 2016 study for the flagship crediting standard of the Kyoto Protocol, the Clean Development Mechanism (CDM), claimed that the additionality in about 85 percent of CDM projects across a range of sectors—excluding the land-use sector—was in doubt (Cames et al 2016). The study ascribes this to the wide availability and cost-efficiency of relevant low-carbon technologies as an alternative.

The question of additionality becomes particularly acute—and contentious—when the mitigation activity involves commercial usage such as industrial processes; renewable energy generation; and energy efficiency measures; but, also, sustainable agriculture and sustainable forest management.

BLUE CARBON RELEVANCE

For interventions on habitat conservation and restoration, the risk of non-additionality—if it exists at all—is much lower. While there are approaches on the commercial and sustainable use of mangrove, salt marsh and seagrass products, the barriers (on investment/finance, technology, and capacity- building) are typically too high to make these approaches viable without carbon or other finance. VM0033 and VM007 deem conservation and restoration activities as additional (positive list) (Verra 2021a). Note, however, that special eligibility criteria apply—for forest as much as for wetland restoration. These include that project developers must provide evidence that land was not cleared to generate carbon credits. This condition is deemed met if clearing happened 10 years or more before the project start date.

3 Cf. Streck 2020; for ecological leakage cf. VCS Module VMD0044: Estimation of emissions from ecological leakage (LK-ECO).

4 World Bank 2016, "Carbon Credit and Additionality. Past, Present, and Future" (PMR Technical Paper).

2 AR-AM0014: Afforestation and reforestation of degraded mangrove habitats (version 1.0 of 2011; version 2.0 of 2012; and version 3.0 of 2013, at https://cdm.unfccc.int/methodologies/DB/KMH6O8T6RL3P5XKNBQE2N359QG7KOE.

BOX

30 Concept of leakage[5]

Leakage refers to the scenario that an activity within the intervention boundary triggers greenhouse gas (GHG) emissions on lands outside of the intervention boundary.

Two common forms are activity-shifting leakage and market-leakage. **Activity-shifting leakage** occurs when activities inside the project boundary (for example, land conversion) relocate outside of the boundary. **Market leakage** occurs when project activities affect an established market for goods (such as farmed products) and cause the substitution or replacement of that good elsewhere. Land-based projects can also come with the risk of **ecological leakage** where, due to the hydrological connectivity with adjacent areas, the intervention leads to a significant increase of GHG emissions outside the intervention boundaries.

Leakage must be monitored and controlled by mitigating (in lieu of simply displacing) the drivers of degradation. With respect to the risk of activity-shifting leakage, primary (in particular community-driven) degradation calls for both alternative resource strategies (such as more efficient cookstoves or solar energy sourcing to remove the incentive for the degradation agent to harvest biomass) and close integration of communities in the project (providing alternative livelihoods). More complicated are instances where degradation is market-driven and involves larger commercial degradation agents (commercial agriculture, aquaculture, or commercial logging). The risk of this form of ("secondary") leakage is particularly high where markets for forest land and wetland commodities (for instance, shrimp or palm oil) are inelastic, and when compensatory technology that would allow for sustainable intensification or development opportunities is absent.

Jurisdictional programs permit improved monitoring and accounting for leakage (throughout the subnational region or the whole country, though not beyond). They also offer policy-level interventions to address market leakage, which project-level interventions typically struggle to suppress.

BLUE CARBON RELEVANCE

The applicability conditions of VM0033 and VM007 (tidal wetlands) are structured to ensure that the different types of leakage must not occur. To prevent leakage, the project must be free of any land use that could be displaced outside the project area (or else relevant emissions cannot be accounted for in the baseline) or the land use can continue with the project (for example, reed or hay harvesting).

For Afforestation, Reforestation and Revegetation (ARR) and Wetland Restoration and Conservation (WRC)) projects, evidence required that land was not cleared to generate carbon credits—deemed met if clearing happened 10 years or more before the project start date.

5 Compare Streck (2020); for ecological leakage compare VCS Module VMD0044: Estimation of emissions from ecological leakage (LK-ECO).

BOX

31 Ensuring permanence

Emissions into the atmosphere and land-based carbon removals are not commensurate. While there is certainty that greenhouse gas (GHG) emissions add to the amount of GHG in the atmosphere for centuries, there is no such certainty for removals. The carbon stock they are building may last forever undisturbed. Yet, if disturbed, the sequestered carbon can easily get lost into the atmosphere (risk of reversal).

There are different strategies used by policy makers and voluntary-carbon-market stakeholders.[6] First, the installation of separate carbon markets for credits considered permanent and those coming with the risk of non-permanence. This is a choice made, for instance, by the EU policy makers, who distinguish emissions trading systems for energy- and industry-based emissions (European Emissions Trading System and the Effort Sharing Framework), on the one hand, and a cap-and-trade system for land use, land-use change, and forestry (LULUCF), on the other hand. The approach may also be used by voluntary carbon markets. Credit suppliers and credit buyers, then, would be transparent about the risk of reversal and recognize non-equivalence with permanent credit types. Removal credits are still recognized for their (at least initial) mitigation results and their contribution to advancing on the 2050 mitigation pathways. However, they will not be used as "offsets" (aiming at carbon neutrality) and they are not destined to have a trading (long-term commodity) value.

Second, the non-permanence issue can be addressed through continued and comprehensive accounting. This strategy is tailored primarily to jurisdictional approaches (both LULUCF-focused and economy-wide) but may also be applied to project-level interventions in cases in which the accounting capacity is strong and granular enough to record intervention-level changes. When a country—notably under its Nationally Determined Contributions (NDCs—commits to comprehensive emission-reduction targets, while permitting the use of credits (for results that go beyond the target), future carbon stock losses will show in the NDC accounts, and the country remains liable to over-compensate in the future. Jurisdictional approaches also come with the benefit that the risk of selective reversals can be statistically managed (accounted for).

Third, a technique used primarily by project-based carbon standards, credits from activities with a risk of reversal can be issued as time-bound (the Clean Development Mechanism used temporary Certified Emission Reductions); fragmented (the Climate Action Reserve, for instance, allows "ton/year" accounting, a metric that traces the climatic benefit of carbon storage in one-year intervals); or (the most common approach among carbon standards and the one applied by Verra/VCS), backed by a buffer pool.

The Verra buffer pool is open to AFOLU projects that meet the eligibility conditions as per the VCS Non-Permanence Risk Tool. Among the conditions is that a project developer can demonstrate project longevity of at least 30 years. Once the eligibility is met, the risk must be quantified as a share of credits issued (often 20 percent) and defined in the project documentation. Every project developer must then transfer, from every credit issuance, the specific share into a collateral or "buffer" account. The buffer guarantees that the portion of credits issued and forwarded to the project developer can be treated as permanent. Should the project for which "permanent" credits have been issued, be subsequently affected by a reversal event, an equivalent number of units will be released and retired from the standard's buffer account.

In practice, buffers have demonstrated robust collateralization. Indeed, Verra's VCS buffer system has proved remarkedly resistant. By late 2022, the buffer held more than 60 million credits, collateralizing some 190 projects.[7] A single cancellation has been registered (for less than 50,000 credits) so far; the registry shows a few more instances, where

6 Compare Carbon Credit Quality Initiative, at https://carboncreditquality.org/resources.html.

7 Cf. Verra Registry 2022: https://registry.verra.org/app/search/VCS/Buffer (accessed on 14 August 2022).

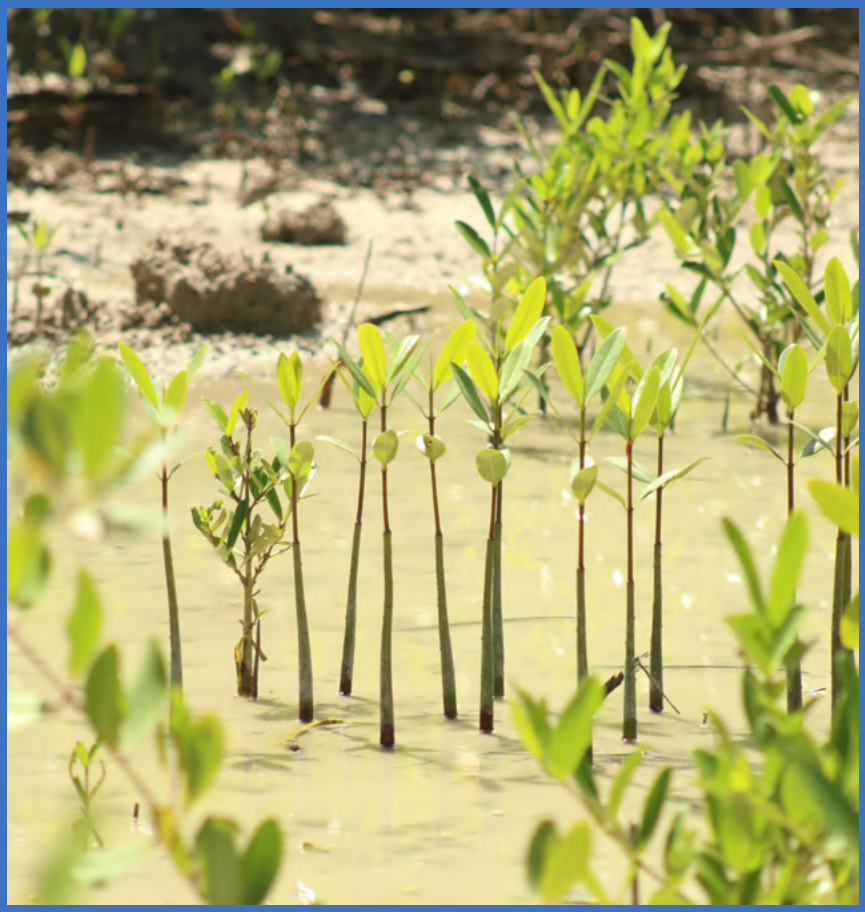
buffer credits have been put on hold, pending investigation.

The fourth strategy shares similarities with the regulator-focused strategy of designing separate trading systems but is tailored to voluntary carbon markets. Under this option, credit suppliers and credit buyers are transparent about the risk of reversal and recognize non-equivalence with permanent credit types. Removal credits are still recognized for their—at least initial—mitigation results and their contribution to advancing on the 2050 mitigation pathways. However, they will not be used as "offsets" (aiming at carbon neutrality) and they are not destined to have a trading (long-term commodity) value.

BLUE CARBON RELEVANCE

The common risks of non-permanence from natural and anthropogenic sources mostly apply to Blue Carbon projects. In addition, sea-level rise presents risks of its own, and every project under VM0033 must calculate the impact from sea-level rise for the project as well as mitigation strategies. The claim of GHG emission reductions restricted if conversion to open water is expected before t=100A.

Beyond applying relevant risk tools and set-asides, isolated single-category Blue Carbon restoration or conservation projects in the coastal zone are likely to face a significant risk of failure, if they do not explore landscape-scale interventions, including the entire sub- to supra-tidal sequence, and set out strategies for a landward shift of coastal ecosystems (Needelman et al. 2018).



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