# Innovative Options for Coastal Blue Carbon Initiatives in Small Island Developing States

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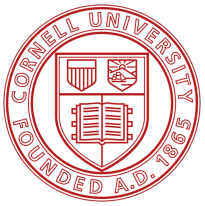


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Photo Credit: Conservation International (2020): Blue Carbon - Mitigating climate change along our coasts.

# Executive Summary

Coastal Blue Carbon Resources (CBCRs), including mangrove forests, tidal marshes, and seagrass meadows, provide a unique opportunity for Small Island Developing States (SIDS) to combat their extreme climate change vulnerabilities and achieve their Nationally Determined Contributions (NDCs). Before accessing the wealth of CBCR ecosystem services and economic opportunities, however, SIDS often struggle to access financial resources to fund coastal habitat management — the main constraint limiting SIDS climate adaptation projects.[1] In distilling information from peer-reviewed literature, governmental reports, and project assessments from NGOs, this report summarizes the biological aspects of CBCRs, ocean governance mechanisms, and innovative financial mechanisms for CBC initiatives for SIDS. To overcome the scientific and policy challenges of accessing the international CBC market, SIDS would greatly benefit from accelerating national assessments of their CBCRs through multilateral collaborations with local stakeholders and international partners. Building capacity in SIDS will enable the successful acquisition of multilateral funds and market-based mechanisms to not only develop and strengthen CBC initiatives in SIDS, but also mobilize their global climate-based commitments.

# Contents

# Introduction

Small Island Developing States (SIDS) are struggling to address their social, economic, and environmental vulnerabilities in the face of climate change. Given that their populations, infrastructure, and food stocks are concentrated in coastal zones, the United Nations Framework Convention on Climate Change (UNFCCC) warns that sea-level rise will have profound, negative impacts on the livelihoods in SIDS.[2] Coastal Blue Carbon Resources (CBCRs), including mangrove forests, tidal marshes, and seagrass meadows, act as integral carbon sinks, storm and pollution buffers, and can aid in fostering sustainable fisheries, tourism, food security, and the conservation of biodiversity. Thus, CBCRs provide a unique opportunity to not only increase the greenhouse gas mitigation potential of SIDS — but also increase their adaptation and financing capacity — helping SIDS to achieve their NDCs.

Before accessing the wealth of CBCR ecosystem services and economic opportunities, however, **SIDS often struggle to identify financial sources that can provide support in implementing ocean climate change projects, including CBCR, at a national level.** Across SIDS, building organizational capacity can strengthen institutional and governance framework efficiencies, and generate knowledge of international funding procedures. Because of their copious vulnerabilities and plentiful natural resources that require protection, SIDS are well positioned as candidates to receive international investment opportunities. However, limited national financial resources may impede capacity building. **In this report, we aim to 1) summarize the biological aspects of coastal blue carbon resources and highlight how these habitats can help SIDS reach their mitigation and adaptation goals; 2) evaluate ocean**

**governance structures that sustain CBCRs; and 3) identify and recommend innovative financing options for coastal blue carbon initiatives for SIDS.**

# Background

**The UNFCCC is an international environmental treaty that addresses climate change through collective efforts to reduce emissions of greenhouse gases, with the end-goal of mitigating and stabilizing climate change impacts, so that ecosystems can adapt naturally while sustainable development can occur.** The Paris Agreement of the UNFCCC, adopted in 2015, is the first comprehensive global agreement calling for emissions mitigation and adaptation actions by all countries. **Nationally Determined Contributions (NDCs)**, an integral part of the Paris Agreement, are non-binding commitments by countries to lower their emissions. They were submitted in advance of the 21st Conference of the Parties (COP) to the UNFCCC,[3] and must be reviewed and then renewed every five years to increase countries' emissions-reductions ambitions.[4] In the context of CBCRs, the UNFCCC has not focused much on oceans explicitly, except in 4.1(d) that calls "for the sustainable management, conservation, and enhancement of 'sinks and reservoirs of all greenhouse gases … including…oceans as well as…other coastal and marine ecosystems.'" Hence, there is scope for CBCRs to be included within the UNFCCC's existing mechanisms.[5]

**The acronym *SIDS* refers to the collective group of 58 small island and low-lying coastal developing States (38 UN Member States and 20 Non-UN Members/Associate Members) representing primarily equatorial regions of the Caribbean, Atlantic, Indian, and Pacific Oceans.** SIDS were first recognized as having unique social, economic, and environmental vulnerabilities at the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, Brazil.[6] Occupying only about 3% of Earth's terrestrial surface,

SIDS are home to over 63.2 million people and sustain 20% of the world's plant, bird, and reptile species.[6] Taking the global aggregate of all SIDS, about 26.2% of land area and 9.8% of the total population lies below 5 m above mean sea level.[6] However, the island States of Tuvalu and the Maldives lie entirely below 5 m above mean sea level.[6] Therefore, SIDS represent a wide range of vulnerability to climate change and sea level projections.

**According to the Intergovernmental Panel on Climate Change (IPCC), *vulnerability* is the combination of a system's exposure, sensitivity, and adaptive capacity.**[7] Thus, vulnerability is exacerbated in the absence of a capacity to adapt.[8] The main constraint for climate adaptation in coastal developing countries is capacity building because it relies on financial backing.[1] According to the UNFCCC, "Opportunities for countries to build capacity to successfully implement their NDCs and National Adaptation Plans" depends on their *means of implementation*. Developing countries could identify their technology, finance and capacity-building gaps and needs to understand the effectiveness of the actions taken, as well as resources needed to mobilize resources.[9]

**The *Alliance of Small Island States (AOSIS)* preceded the term SIDS, but refers to the formal UN coalition of 44 SIDS, including five observers.** Formed in 1990 at the Second World Climate Conference in Geneva, Switzerland, AOSIS helps strengthen the capacity and provides a platform for the marginalised voices of SIDS leaders and citizens to have adequate and equitable representation during UN negotiations. The organization was especially influential during the COP23 and Paris Agreement proceedings. In creating valuable partnerships with organizations including the United Nations Development Programme (UNDP) and the European Commission, AOSIS is able to better leverage UN negotiations in the General Assembly and

UNFCCC. As a result, AOSIS can increase the probability of SIDS meeting their main goals on climate change mitigation and adaptation, sustainable development, and ocean conservation.

**Article 6 of the Paris Agreement establishes a policy foundation for an international emissions trading system, which could lead to a global price on carbon.** Through this global framework on assessing the value of carbon sinks, SIDS could benefit from capacity building initiatives to improve their domestic capacities for data collection and enhanced transparency in accounting of CBCRs, in order to successfully unlock climate finance. Additionally, trading allows flexibility for cooperating countries to define the scope and extent of cooperation. Nevertheless, the ethical dilemmas of trading remain, including the issue of unclear property rights[1*] in sub-national policies. As a starting point, SIDS may benefit from assessing the biological and geo-physical characteristics specific to their contexts in order to effectively mobilize financing options.

## The Biological Aspects of Coastal Blue Carbon Resources

**Coastal Blue Carbon Resources (CBCRs) refer to any marine or coastal ecosystem — principally mangrove forests, tidal marshes, and seagrass meadows — that captures and sequesters carbon.** These habitats are extremely widespread and occur on all continents excluding Antarctica (Figure 1). Due to their large spatial distribution, even mediocre estimates of their current global extent remain poorly articulated. However, spatial ecologists are confident that mangroves cover 13.8–15.2 million hectares (Mha)[10] and occur in 118 countries globally, with approximately 75% of the total area restricted to only 15 countries and 23% in Indonesia

[1*] "The overlapping of marine and terrestrial resources in blue carbon itself creates tenure ambiguities, making resource management and coastal decision-making challenging. In addition, land tenure issues … pose a risk to blue carbon project development and management." (Mangora & Shalli, 2014)

alone.[11] Tidal marsh stocks, which are estimated to cover 2.2–40 Mha, have only been mapped in a little over 40 countries — representing a mere 14% of the potential global area.[12] Lastly, the global extent of seagrass area is the least defined,with estimates ranging from 17.7–432 Mha of potential habitable area.[10,13] **The remaining unevaluated stocks,[2*] imprecise estimates, and general lack of global spatial understanding of CBCRs highlights the need for SIDS to proceed cautiously when evaluating the importance of their local CBC habitats. The potential exists that these ecosystems are much more widespread, and therefore important, than is currently documented.**

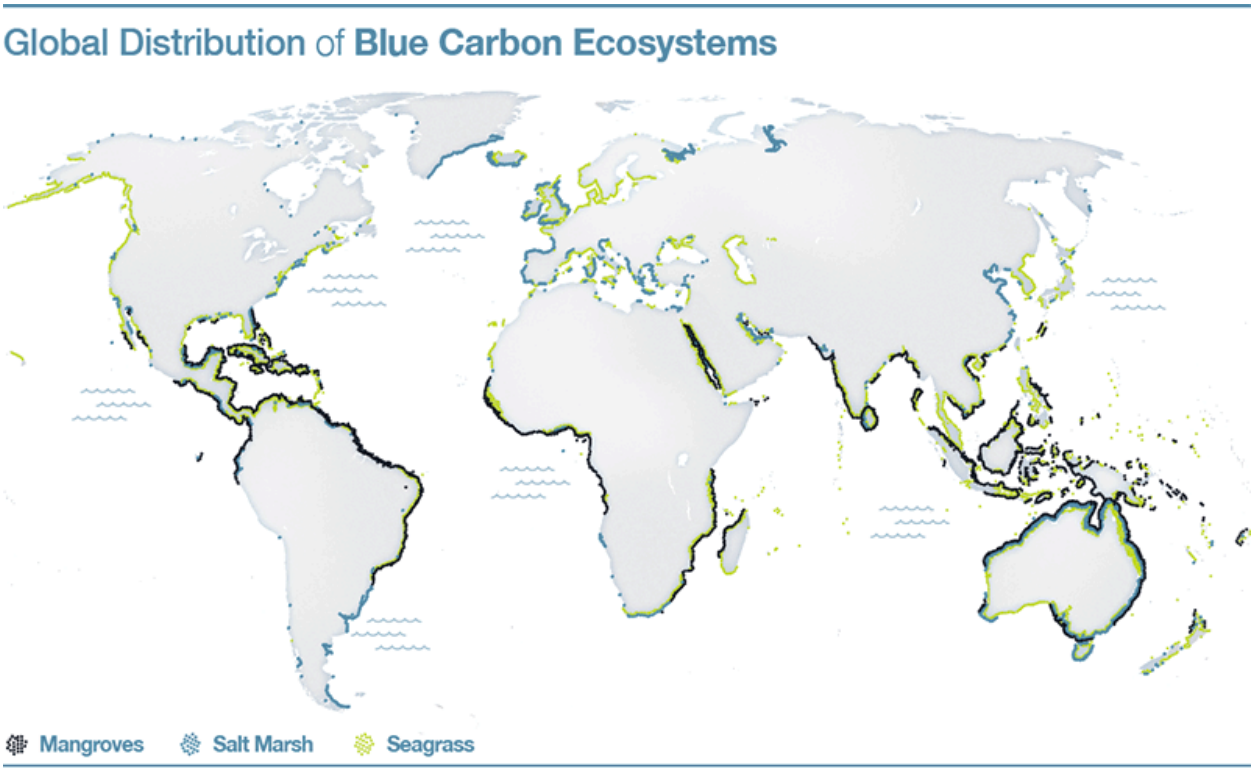


**Figure 1.** A visual representation of the general global distribution of CBCRs. Reposted from the Blue Carbon Initiative.[10]

[2*] The Nature Conservancy, Global Mangrove Alliance, Blue Carbon Initiative, and NASA, are currently improving and revising CBCR accounting

## *GHG Mitigation Potential*

**Mangrove forests, tidal marshes, and seagrass meadows can aid in climate change mitigation by incorporating atmospheric carbon directly into biomass, as well as facilitating sedimentation and the associated deposition of carbon. Global estimates of carbon stocks for these ecosystems range from 10,400–25,100 teragrams of carbon (Tg C)[3*], but this is likely a conservative estimate because most studies only account for carbon in surface sediments.[14]** As with global spatial evaluations, the global carbon budget for CBCRs is most well defined for mangroves. These coastal forests absorb 700 Tg C/year and respire 75% back to the atmosphere as $CO_2$ (525 Tg C/year).[15] Sequestering 175 Tg C/year, the global carbon stock held within mangrove forests is estimated to be between 5,617–6,186 Tg C.[14] While understudied, there is also some evidence that mangrove forests can act as $N_2O$ sinks, which would enhance the overall mitigation potential of this CBCR.[16] Tidal marshes, one of the most biologically productive habitats per area on the planet, sequester between 5–87 Tg C/year, making the total global carbon stock between 570–10,360 Tg C.[14] Lastly, seagrass meadows sequester between 41–83 Tg C/year, and have a global carbon stock between 4,260–8,520 Tg C.[14]

These figures, however, usually only consider the carbon that CBCRs sequester directly into their vascular tissues or the topmost meter of sediment — ignoring the deeper soil profiles. Due to their extensive root systems and/or submerged canopies, CBCRs also have the ability to influence sedimentation and the associated deposition of carbon. All types of CBCR are positively correlated with wave attenuation, or the dissipation of wave energy, which is one of the primary ecosystem services associated with coastal habitats. As waves become less powerful,

[3*] For reference, in 2018, the United States produced 1,821 Tg C — https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#:~:text=Transportation%20Sector%20Emissions,Tons%20of%20CO2%20equivalent.

the rate of sediment accretion and organic carbon accumulation increases.[17] The dense root systems of mangroves may even accrete 80% or more of total suspended sediments[18] — expediting the carbon trapping and immobilization process.

**Mangrove forests, tidal marshes, and seagrass meadows are effective carbon-sequestering habitats in isolation; however, their mitigation potential is heavily influenced by human activities, the frequency and severity of climate change impacts, as well as the distribution of other CBCRs.[17]** Globally, an estimated 450 Tg $CO_2$/year is released as a result of CBCRs disturbance by storms, and an estimated 1,020 Tg of converted $CO_2$/year is released as a result of CBCR degradation by anthropogenic activities.[17] As a result of global coastal development and habitat conversion to agri- or aquaculture, mangroves decline at a rate of 0.7–3%/year and tidal marshes decline at a rate of approximately 1–2%/year — resulting in the release of approximately 144–681 Tg of converted $CO_2$/year, and 21–760 Tg of converted $CO_2$/year, respectively.[14] For seagrass meadows, the reduction of water quality caused by sediment and nutrient pollution runoff from human activities, compounded by dredging and bottom-trawling by boating and fishing industries, results in a loss of seagrass habitat of 0.4–2.6%/year.[19] This in turn releases between 62–813 Tg of converted $CO_2$/year.[14] **In other words, CBCR degradation potentially emits much more carbon than these habitats can sequester on an annual basis — highlighting the need for long-term protection of blue carbon habitats globally.**

Sea level rise can potentially increase carbon sequestration as CBCRs shift inland and sediment accretion increases, but decrease carbon sequestration following the temporary or permanent drowning of CBCRs and the subsequent release of stored organic matter during decay.[17] As there are associated damages and recovery times, more frequent and severe storms

can decrease the capacity of CBCRs to effectively sequester carbon and mitigate climate change — and even act to release stored carbon.[17]

Finally, as many ecosystems often function synergistically, the distribution and health of adjacent carbon-sequestering ecosystems can impact the carbon-sequestering capacity of CBCR.[17] A prime example is a wave attenuation feedback loop. A mangrove forest would be more effective at sequestering carbon directly into woody biomass, as well as promoting organic carbon sedimentation, if it was surrounded by an external buffer of seagrass meadows. These meadows would act to attenuate wave energy before ever reaching the mangrove stand; thereby, preventing potential damage to the mangrove forest and increasing sediment accretion. **In recognizing both the individual and combined importance of coastal habitats, working to preserve remaining habitat, and reallocating coastal land for CBCR recolonization, SIDS stand to maximize the mitigation potential of CBCRs, which would enhance their reputation as an attractive investment opportunity.**

## *Adaptation Potential*

**Mangrove forests, tidal marshes, and seagrass meadows can aid in climate change adaptation principally by providing a buffer against floods and storms — while also providing numerous intrinsic and economic benefits.** As fisheries and natural-resource-based tourism play an important role in many SIDS economies, BCR management not only conserves the natural resources SIDS rely upon, but also provides insurance against natural disasters which threaten future economic prosperity. Since many SIDS are located in equatorial regions, they are prone to more frequent tropical storms and natural disasters. Yet, due to their low economic status on average, they often do not have adequate resources to rebuild and provide complete relief before

the next storm strikes. Losing between 1–9% of their GDP each year, SIDS make up two-thirds of the countries in the world that suffer the highest relative losses from natural disasters annually.[20] Natural disasters in the Pacific islands have claimed more than 10,000 lives and more than $3 billion worth of damages just in the last 50 years.[20] With figures like these, it is no surprise that SIDS struggle to achieve sustainable development. However, investing in CBCR can protect financial resources on multiple fronts.

The management and protection of CBCRs provides an obvious means to climate change adaptation, first, through the direct impacts of ecosystem services. CBCRs provide coastal protection principally through the attenuation of wave transmission onshore[21] — thus decreasing the power of storm surges and floods. This can be achieved through a variety of processes including: reducing flow, speed, and velocity [22,23] and dissipating energy through bottom and porous friction.[24,25,26,21] In other words, waves are dampened when they pass over seagrass meadows or through the exposed root systems of mangroves. This creates a positive feedback loop where slower, attenuated wave energy promotes sedimentation, which raises the sediment floor, creates even more bottom friction, and wave damping.[27] A global analysis of wave attenuation methods and a synthesis of 52 nature-based defence projects indicates that coral reefs[4*] and tidal marshes have the highest overall potential to decrease wave heights.[28] They also show that CBCRs are some of the most cost-effective storm management solutions, with tidal marshes and mangroves remaining 2–5 times less expensive than submerged human-made structures for wave heights greater than or equal to 0.5 m. **The science is clear that CBCRs provide a cost-effective and multi-faceted solution for SIDS to fortify their coastlines and best adapt to rising sea levels and ever-frequent natural disasters.**

[4*] Currently, the UNFCCC only recognizes mangrove forests, tidal marshes, and seagrass meadows as CBCRs

**CBCRs can also help insure financial resources and profits, which can be allocated towards relief efforts in the case of disaster.** Many SIDS rely on a wealth of natural resources to attract tourism and boost their economies, however, given the high economic variation between SIDS, it intuitively follows that there are different primary contributors to their respective GDPs. In 2012, travel and tourism accounted for over 50% of the GDP of Aruba, Antigua and Barbuda, the UK Virgin Islands, Anguilla, Seychelles and Vanuatu, including direct and indirect tourism contributions.[6] While in Haiti, Suriname, and Papua New Guinea, travel and tourism accounted for a much lower percentage of GDP.[6] In any case, most SIDS host tourists that engage in activities that integrate CBCRs, such as snorkeling, scuba diving, spearfishing, surfing, and bird watching. By protecting CBCRs, SIDS are thereby protecting their economies.

Most of these activities rely on the presence of living organisms associated with CBCRs, which are becoming increasingly threatened. There are 48 bird, 14 reptile, 1 amphibian, and 6 mammal species endemic to mangroves worldwide, and over 40% are threatened.[29] Worldwide, there are a total of 25 terrestrial vertebrate species, including turtles, snakes, small rodents, sparrows, and rails, that are endemic to tidal marshes, or recognized subspecies restricted to tidal marshes.[30] Of the global species extinctions that have occured, 95% of bird, 90% of reptile, 69% of mammal, and 68% of plant extinctions have occurred on islands, justifying the Secretariat of the Convention on Biological Diversity's claim that the species of SIDS have the greatest extinction risk.[6] **Thus, the protection of CBCRs provides a unique opportunity to not only protect the biodiversity that depends on these habitats and upholds their functionality, but also to ensure and even increase future tourism engagement. By protecting a large source of their national incomes through ecotourism, SIDS governments can increase the likelihood of being able to fund other efforts that can increase their national quality of life**.

In 1998, the High-level Panel of External Experts in Fisheries stated that, in response to overfishing and low financial resources, SIDS are highly vulnerable to food insecurity and will be "disadvantaged in obtaining and maintaining access to fish."[31] Fishery harvest accounted for 7.2% and 10.1% of the GDP for Tuvalu in 2011 and the Federated States of Micronesia in 2010, respectively, while for Trinidad and Tobago, fisheries made up only 0.07% of GDP in 2006, 2007 and 2008.[6] Even though fisheries make up a small percentage of total GDP, many SIDS are heavily dependent on fish consumption, import, and export. Fish are a primary source of protein for many SIDS, and per capita fish consumption rates rank high internationally.[31] According to FAO: Committee on Fisheries, "In 2013, the average seafood consumption in SIDS was 12.4 kg/capita/year, with national figures ranging from 1.4 kg/capita/year in Guinea-Bissau to 185 kg/capita/year in Maldives."[32] The most current data from over two decades ago indicates that fish accounts for more than 20% of animal protein intake in 22 SIDS, more than 30% in 15 SIDS, and more than 50% in six SIDS.[31] In addition, fish accounts for more than 10% of total protein intake in 22 SIDS and for more than 20% in nine SIDS.[31] All three types of CBCRs recognized by the UNFCCC act as a nursery for young marine life, providing shelter from predation and increasing the probability of individuals reaching adulthood — to then later be harvested by communities. In protecting CBCRs, SIDS can increase their fishery yields[5*] and therefore protect the food stocks and livelihoods that their communities depend on for survival.

**For years, the science demonstrating the numerous co-benefits of CBCRs has been clear. CBCRs are cost-effective carbon sinks and storm buffers that can provide SIDS with a path to a more sustainable future. CBCRs ensure that infrastructure, financial resources, biodiversity, food stocks, and the livelihoods of community members remain intact — all**

[5*] In the Gulf of California, USA, mangrove forest abundance was highly correlated with fisheries landings (Aburto-Oropeza et al. 2008)

**while assisting SIDS in reaching the mitigation and adaptation goals specified in their NDCs.** However, there remains a gap in implementation that can be addressed through the inclusion of coastal blue carbon ecosystems in national-level policy, which could be furthermore enhanced through connections with international policies to unlock financing potentials.

## Biological Take-Home Messages

1. **SIDS should exercise caution when evaluating local CBC stocks because precise global estimates have not been fully defined.**
2. **The mitigation and adaptation potential of CBCRs is harmed by human development and the frequency and severity of climate change impacts.**
3. **CBCRs provide SIDS with a cost-effective and multi-faceted solution to fortify their coastlines and best adapt to rising sea levels and oceanic storms, while also ensuring financial resources and profits — which can be allocated towards relief efforts in the case of disaster.**
4. **The protection of CBCRs provides a unique opportunity to protect the biodiversity that depends on these ecosystems and upholds their functionality, ensure and even increase future tourism engagement, increase fishery yields, and therefore protect the food stocks and livelihoods of SIDS communities.**
5. **In recognizing both the individual and combined importance of coastal habitats, working to preserve remaining habitat, and reallocating coastal land for CBCR recolonization, SIDS stand to maximize the mitigation and adaptation potential of CBCRs — building their reputation as an attractive investment opportunity and assisting SIDS in reaching their NDC goals.**

# Ocean Governance Mechanisms

Transformative changes in ocean governance within national jurisdictions could contribute to fostering sustainable fisheries, tourism, food security and conservation of biodiversity in the face of climate change. The utilization of coastal blue carbon in climate change adaptation and mitigation depends on the effectiveness of global, national, regional and local-scale ocean governance. National and sub-national governments can benefit from strengthening their regulatory and financial institutions, enabling conditions to significantly accelerate private sector actions and finance for conservation of CBCRs and associated biodiversity.

## *UNFCCC & NDCs*

**As a part of the Paris Agreement negotiations, Parties submitted their NDCs to the UNFCCC, and only a few included specific conservation efforts for CBCRs as mitigation or adaptation solutions.** "151 countries contain at least one coastal blue carbon ecosystem (seagrass, saltmarshes or mangroves) and 71 countries contain all three."[4] Of these, 28 Parties referred to mitigation effects of coastal wetlands, while 59 referred to adaptive capacity through coastal ecosystems. Some, like Seychelles, included CBCRs in accounting for greenhouse gas emissions and removals but overlooked methodological approaches to sustain these ecosystems.[4]

UN-based programmes, such as **Nationally Appropriate Mitigation Actions (NAMAs)** launched at COP 18, support countries to reach their NDCs through sustainable development. NAMAs include any emissions-reducing actions that developing countries include in their governance through technology, financing and capacity-building.[33] Since **NAMAs provide countries the freedom to choose mitigation pathways and funding mechanisms, this is a unique opportunity to include CBC projects in national plans.** The Dominican Republic is

planning a mangrove restoration project, pioneering CBCR conservation through NAMA.[34]

As development may encroach on coastal ecosystems, especially in the context of SIDS, countries may include CBCRs in their **Land Use, Land Use Change, and Forestry (LULUCF) commitments** in their NDCs. Angola, for example, includes mangroves and wetlands to recognize the mitigation potential for reforestation of degraded forests and mangrove habitats through Forest Carbon Options. Bangladesh includes mangrove plantation in LULUCF mitigation efforts, but are not specific about the construction or effectiveness of plantations compared to natural forests.[4]

Countries that include mangroves in the national definition of forests are eligible for **Reducing Emissions from Deforestation and Forest Degradation (REDD+)** climate credits. REDD+ is a UN-based mechanism that encourages countries to protect their forests and nature-based solutions. Hence, if mangroves are included as forestry-related afforestation/reforestation activities, SIDS could benefit from REDD+ projects. Suriname included mangrove protection in their laws, promoting adaptation and mitigation capacity through sustained sedimentation and subsequent mangrove forest regeneration.[4] While salt marshes and seagrass are not included in REDD+, AOSIS could advocate for their inclusion in future global policy making platforms.

**The co-benefits of conserving CBCRs are plentiful, hence, SIDS can benefit greatly from assessing and outlining context-specific benefits in their next NDCs, to be submitted at COP 26.** CBCRs provide ecosystem services, such as coastal protection, and support marine and avian biodiversity. They are also crucial sources of food and job security for local fishing communities, and form an integral part of their socio-cultural fabric. However, due to limited assessment of CBCRs in SIDS, these co-benefits are often overlooked and the conservation of CBCRs is not explicitly prioritized by the UNFCCC. With capacity building efforts and funding support, SIDS will have the opportunity to conduct more robust assessments of their CBCRs.

## *Identifying Opportunity Countries*

**International financing institutions and NGOs evaluate the effectiveness of investing in countries with CBCRs and may prioritize partnerships and development of CBCRs in "opportunity countries."** Every country has a range of conditions that will make some CBCRs relatively easier to mobilize.[35] For instance, the integration of coastal blue carbon into Marine Protected Area (MPA) design and management indicates strong political willingness to conserve CBCRs by including them in local governance structures. Leading countries may include references to planning tools for the conservation of marine ecosystems, such as Integrated Coastal Zone Management (ICZM) in their NDCs. They may also broadly include the co-benefits of prioritizing adaptation in their national and international commitments, as maintaining CBCRs creates jobs and nutrition security through fisheries.

**Assessing institutional structures in SIDS across scales can improve organizational understanding of their vulnerability, and capacity to mobilize BCRs for adaptation and mitigation. According to Conservation International, several factors determine an opportunity country:**

1. **The State's ability to access and protect its BCRs**
2. **Commitments to global conventions**
3. **Level of influence in terms of global governance**
4. **Political willingness to include BCRs into their local governance, and**
5. **Engagement of external organizations (e.g. NGOs) with governments and communities on the ground to scope and protect the future of BCRs.[4]**

## *International Governance Framework*

**Climate change poses a "collective action challenge that ideally requires a joint policy response beyond the aggregation of uncoordinated domestic policies"[36] hence, international ocean governance structures can strengthen national responses.** Specifically, "implementing blue carbon projects and programs helps countries to reach international commitments and pledges."[37] Hence, it is important to discuss international law and policy development, and agenda setting through various multilateral governing structures, in addition to the UNFCCC, which countries may commit to:

1. *Convention on Biological Diversity (CBD)*
2. *Ramsar Convention on Wetlands*
3. *International Seabed Authority (ISA)*
4. *UN Convention for the Law of the Sea (UNCLOS)*
5. *UN Sustainable Development Goals (SDGs)*

These international laws and commitments may be relevant in the planning of CBC projects:

1. *Convention on Biological Diversity (CBD):* A part of COP to conserve biodiversity and productivity, 193 countries committed to conserving at least 10% coastal and marine ecosystems through their National Biodiversity Strategies and Action Plans (NBSAPs). While CBD provides other policy and financial instruments, it does not address national Greenhouse Gas (GHG) reduction strategies. CBD COP 11 produced Aichi Targets, with Targets 11, 14, and 15 being the most relevant to CBCRs.[37, 6*] Expiring in 2020, SIDS have

[6*] Target 11: By 2020, at least 17% of terrestrial and inland water, and 10% of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

an opportunity to impact renewal of the Global Biodiversity Framework that influence the significance of ecosystem-based adaptation (EbA), wherein the value of CBCRs is realized.

2. *Ramsar Convention on Wetlands:* Intergovernmental treaty in which Parties commit to work towards the wise use of all their wetlands, designate suitable wetlands for the list of Wetlands of International Importance and ensure their effective management, and cooperate internationally on transboundary wetlands, shared wetland systems and shared species.[38]

3. *International Seabed Authority:* Coalition of 168 States with authority to protect the seabed and ocean floor beyond the limits of national jurisdiction from harmful effects from deep-seabed related activities. [38]

4. *UN Convention for the Law of the Sea (UNCLOS):* Established States' sovereignties over marine waters up to 200 nautical miles (Exclusive Economic Zone (EEZ)) in order to manage deep-sea related activities that may threaten ecosystems and biodiversity.[39]

5. *UN Sustainable Development Goals*: SDG 14 represents a voluntary commitment by UN Parties focusing on the conservation and sustainable use of the oceans, seas and marine resources for sustainable development.

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Target 14: By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods, and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.
Target 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15% of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification (Sutton-Grier et al., 2018).

In protecting their CBCRs, SIDS could reach multilateral commitments, which might encourage financial institutions and NGOs to engage with them as opportunity countries.

## *National Assessments of CBCRs*

**It is recommended that SIDS include the assessment of their CBCRs in their national and regional policies such that they can meaningfully establish pathways unique to their context.** Identifying socio-economic conditions that may make certain CBCRs easier to mobilize may also encourage collaboration with the communities or local governance structures responsible for regulating access. For instance, this may be relevant in the context of designing and adaptively managing Marine Protected Areas (MPAs), or simply quantifying the benefits gained from implementation of mitigation and adaptation strategies;[7*] both of which local communities may be able to support through knowledge and action.

While international commitments stress the significance of mobilizing national and regional actors, **initiating conservation projects usually begins with the question of access to CBCRs. This is because the "legal or de facto ownership of mangroves, salt marshes, and seagrasses are not always well-established, yet the definition or pattern of ownership in individual countries will likely affect the design of payment systems."[35]** While UNCLOS has enabled the determination of areas for marine activities per EEZs, exclusivity within state

[7*] "The National Capital Accounting (NCA) has been a key tool for assigning value to nature and ecosystem services in monetary and alternative terms at (sub)national level. In addition, it has encouraged the "mainstreaming of biodiversity" in policy making and implementation processes. Most importantly, it can be relevant in the framework of setting a global price on carbon." https://seea.un.org/home/Natural-Capital-Accounting-Project

boundaries is a property rights issue that raises several institutional questions. **In establishing rights to CBCRs, SIDS could plan projects by clarifying these fundamental questions:**

- **How do these rights relate to the global politics of international carbon transfers?**
- **How do they affect current habitat conversion behavior?**
- **How can national institutions be designed to efficiently mobilize carbon protection?**[35]

Efforts to assess the effectiveness of conservation efforts will also enable SIDS to show financing institutions their ability to meet international commitments, such as the Aichi Targets.

## *Significance of Partnerships*

**Given the vulnerable state of our ocean, partnerships across all scales are crucial, hence, the UN declared 2021-30 as the Decade of Ocean Science for Sustainable Development.** To facilitate transformative action, the UN aims to bring scientists, policymakers, the private sector, and civil society together to overcome "conceptual, organizational, and technical scientific challenges" in the conservation of our oceans. Improving research and development is another key component of this initiative, in which funding plays a crucial role. Therefore, it may be beneficial for SIDS to look into partnerships with academics, researchers and industries that may be interested in helping protect  CBCRs, such that in-kind contributions can support the assessment of, and conservation strategies, for CBCRs. Multi-sectoral interactions can lead to transfer of institutional and technological information that permeates across industries and benefits infrastructure in "spatial planning, fishing, energy exploration and production, shipping, coastal development, tourism, and others."[40]

**NGOs are integral actors in implementing national-level ocean governance efforts through collaboration with both local communities and state institutions, to forge policy change, strengthen institutions, and develop capacity.** Pioneering such partnerships, the *Blue*

*Carbon Initiative's* recommendations regarding the conservation of CBCRs are exemplary. *The Blue Carbon Initiative* was founded in 2011 by leading NGOs "to mitigate climate change through the restoration and sustainable use of coastal and marine ecosystems" through scientific and policy-making processes.[41] Their offices are present globally and in some SIDS. Accordingly, the three high priority activities include: (1) "development of national blue carbon action plans, outlining specific national circumstances, opportunities, needs and limits;" (2) "conducting national scientific carbon, ecological and socio-economic assessments of shallow coastal marine ecosystems;" and (3) "conducting national cost-benefit analysis of including blue carbon activities into national climate change mitigation strategies."[42]

In SIDS with limited resources, international NGOs can be especially helpful in **working with communities to identify context-specific circumstances, opportunities, needs, and limits.** Simultaneously, these NGOs can also stress the benefits of conserving CBCRs through awareness campaigns. The processes of collecting, analyzing and relaying such information back to governmental organizations can help communities to appreciate the value of their CBCRs. It would also help states to include details of the carbon value of coastal ecosystems based on context-specific human-use in the accounting of CBCRs.[43] This would encourage value-based conservation through education on the role of CBCRs "in provision of ecological and human community climate adaptation and resiliency ecosystem services... [such as] buffering of storm damage, protecting water quality by filtering pollutants, provision of wildlife refuges and corridors and maintenance of biodiversity."[43]

## *Communities and Coastal Blue Carbon*

**As countries work toward their second NDCs, it is imperative that SIDS focus on forging sub-national and regional policies, strategies, and management tools through locally-based**

**projects that encourage interaction between policy-makers and practitioners.[43]** For instance in Smith et al.'s (2010) *Political economy of marine reserves: Understanding the role of opportunity costs*, scientists collaborated with local stakeholders in Hawaii to assess the value of marine resources on the basis of fishermen's activities in certain habitats.[44] This allowed policymakers to navigate the value of fishing grounds and zones of vulnerability, and meaningfully determine the site for a marine reserve. Simultaneously, the designing process accounted for fishermen's concerns and potential compromises for other stakeholders, and costs and benefits were clearly communicated. This led to amicable relations with local communities who manage conservation actions along with long-term benefits through stock enhancement, securing the interests of civil society and conservation of their CBCRs.[44] **Hence, it may be beneficial for SIDS to target community- based conservation of CBCRs to support traditional management systems that have been historically benefitting carbon storage, biodiversity conservation and livelihoods.[45]**

Several SIDS note in their NDCs that the conservation strategies for CBCRs would contribute to the achievement of other Sustainable Development Goals, including but not limited to enhancing nutrition security. In conducting the national cost-benefit analysis of including coastal blue carbon activities into climate change mitigation strategies, SIDS can also further accounting and protection of ecosystem services, energy security efforts, and improve their potential to attract ecotourism opportunities.[43] Holistically assessed, not all climate change policies are sustainable.[47] Hence, SIDS may refer to Barbier's (2014) suggestion "that a more comprehensive approach should be employed in **analyzing how mitigation policies affect the poor in developing countries, and in particular, in assessing how policy design and**

**implementation can influence the potential trade-offs between the positive and negative impacts on poverty alleviation."**[47]

**As the creation of marine reserves is often controversial,[44] SIDS can prioritize participation and equity through robust, ethical policy-making processes in the conservation of CBCRs.** Both governments and NGOs could focus their conservation efforts through a lens of advocacy for raising capacity by centering women, youth, and local and marginalized communities.[37] Conservationists note that "perhaps the most ambiguous yet crucial potential impediment to the success of blue carbon projects is land tenure."[48] Hence, an important aspect of project planning and management would be the inclusion of "indigenous peoples and local communities and their knowledge in the process."[45] Especially for international organizations in SIDS, this equitable process may offer a sense of "support to the communities' and countries' conservation efforts."[48]

## *Pathways for Climate Justice*

As market-based mechanisms for mitigating carbon emissions and funding mechanisms are often fraught with ethical concerns, especially regarding their role in exacerbating existing socio-economic disparities, **it is crucial to center environmental justice when planning and managing CBCR conservation projects. As an initial priority, vulnerability assessments could consider "biological characteristics of the ecosystem area, recent spatial changes, ground elevations and topography, relative sea level trends, sedimentation rates, adjacent ecosystem resilience, climate modeling, and local community knowledge."[49]**

REDD+ can play a significant role in mangrove conservation, however projects are often top-down, wherein governments, international agencies, carbon finance companies and large

NGOs may leave local communities uninvolved. The UN claims that REDD+ projects "go beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks."[45] Yet, few REDD+ projects plan to engage with indigenous, local and fishing communities.[45] Historically, while planning MPAs too, this has led to the marginalization and exploitation of local communities, and their "traditional sustainable uses, resulting in considerable social and economic disruption and hardship." The CBD addresses standards to establish the rights of indigenous and local communities to prevent unethical projects. Therefore, it is important to note that the positive impacts of international policy processes are not truly realized without strong national policies that also advocate for the sovereignty of local communities.[8*] **SIDS can implement rigorous policies as funds may begin to flow, since political dynamics could threaten socio-cultural fabrics.** Japan has successfully implemented national environmental policies to include its fishermen and their traditional habitat rehabilitation practices, such as seagrass planting and tree planting in watersheds. Such management systems have continued to exist in Hawaii, the Fijian vanua, the Marovo (Solomon Islands) puava and the Cook Islands tapere, to holistically manage "entire coastal zones, including coastal blue carbon habitats, from mountaintop to the sea. **Future coastal blue carbon projects would also do well to recognize, strengthen, and build upon pre-existing traditional management systems and ownership structures, which include marine tenure systems in many parts of the world**."[45]

Another successful example of governments supporting indigenous peoples to be leaders of marine conservation is in Australia, where the government is increasingly allocating coastal

[8]* In the preamble of the CBD there is a broad recognition of the contribution that traditional knowledge can make to the conservation and sustainable use of biological diversity, and the need to ensure the equitable sharing of benefits arising from the utilization of traditional knowledge.[45]

and marine areas as Indigenous Protected Areas (IPAs). This holistic conservation approach has led to maximizing co-benefits, "creating jobs and operational participation in management of areas where blue carbon management activities would be occurring."[45]

**SIDS could invest in intentional efforts to address power relations, and promote gender equity as blue carbon payment systems may implicate socio-cultural dynamics.** "This is important in the regional context where the gender roles with respect to mangrove use differ, and benefits (payments) could differentially accrue to each group based on use or ownership of the resource."[48] "There is growing evidence that integrating gender in conservation projects can increase the benefits of conservation for all people and nature. It is important to look for opportunities, not only to empower vulnerable groups, but to provide a space to share knowledge, perceptions, and experiences, and to avoid exacerbating existing inequalities."[50]

Conservationists in African SIDS suggest that international payments for coastal blue carbon "consider **the three dimensions of environmental justice:**

- **Distribution (e.g. sharing of benefits),**
- **Procedures (fairness, with particularly attention paid to the poorer and most vulnerable people; transparency; plural and inclusive participation), and**
- **Recognition (traditional knowledge, land tenure, social needs and identity claims)."[48]**

As building economies of scale in the conservation of CBCRs can prove to be unfavorable for certain local communities, **national-scale policies can be developed to ethically "promote learning across communities to:**

- **Promote awareness within communities and benefit-sharing;**

- **Continue to build on national mapping activities in order to identify key areas for climate change mitigation and adaptation; and**
- **Promote the restoration, conservation and sustainable use of mangroves at a landscape level, should carbon payments for mangrove restoration be financially viable."**[48]

**Policies that center equity can lead to the effective management of CBCRs to achieve "resilient prosperity and sustainable livelihoods."** Some approaches may include carbon-oriented opportunities for mitigation, and may provide co-benefits of protection of marine ecosystems and communities' livelihoods. There is scientific backing for the conservation of CBCRs through global policy-making initiatives that encourage holistic, sustainable development and partnerships to build capacity for measuring, reporting and managing strategies. Nevertheless, as private investment opportunities remain limited, SIDS are trapped in a vicious cycle because it is difficult to develop robust governance structures that attract private investments without initial funding to build such infrastructure mechanisms.[49]

## Oceans Governance Key Take-Aways:

1. **SIDS can include specific efforts to address CBCRs as climate mitigation or adaptation solutions in their NDCs (and LULUCF commitments).**
2. **Building partnerships at multiple scales through community-based collaborations can clarify property rights concerns, and strengthen participation and equity.**
3. **Adoption of conservation planning tools to measure the effectiveness of CBCRs could depict the potential of SIDS in mobilizing international commitments.**

# Financing Mechanisms

## *Constraints to Coastal Blue Carbon Finance*

### *Financial Limitations*

**The IPCC has estimated that climate mobilization will require between USD 1.6 trillion to USD 3.8 trillion annually between 2016 and 2050**.[51] However, the complete international financing raised between 2017 - 2018, including public and private sources, merely reached about USD 579 billion per year, on average. Globally, mitigation finance gathers the vast majority of these resources, or around 93% (USD 537 billion per year). Sectors such as renewable energies or low-carbon transportation represent around 98% of mitigation finance. On the other hand, **projects related to natural capital have scarcely received a share of about 1% of mitigation financing**. In this period, adaptation finance merely made up 5% of global finance flows, raising around USD 30 billion per year on average.[52]

Regarding global conservation finance that can also fund blue carbon projects, **a financial gap exists between the costs of environmental degradation (USD 300 billion per year), and the available global funding for restoring, maintaining, and managing these ecosystems (USD 36 - 51 billion per year).** For marine and coastal ecosystems, gross financial estimates show that annually between USD 3-8 billion are needed to meet the commitments of the United Nations Convention of Biological Diversity (CBD). The CBD aims to take action for protection and management of 10% of the ocean and marine coastal areas worldwide through implementation of MPA by 2020.[53,54] However, the current percentage of oceans with at least a minimally protected scheme of MPA is just about 5%.

## *Lack of Private Funds*

In the international context, CBCR initiatives are mainly financed by public grants or philanthropists; however, there is a consensus among CBCR stakeholders that these efforts are insufficient to bridge the gap of funding.[52] Thus, a tremendous need exists to facilitate the participation of the private sector in CBCR initiatives and improve the funding.

Currently, the conventional design of CBCR projects does not encourage participation of the private sector. For example, CBCR projects generally are not able to estimate the increase of conservation services after a particular investment, what is the market and/or non-market value, or what are the monetary and non-monetary opportunities developed by a particular investment.[57] As a consequence, new strategies have to be included in the CBCR finance to close this gap and involve the private sector. Since 2012, following the United Nations at the Rio +20 Conference on Environment and Development, through the Blueprint for Ocean Sustainability Report, the UN has advocated for the creation of "*a global blue carbon market as a means of creating direct economic gain through habitat protection.*" The capacity of the CBCR projects to provide co-benefits beyond sequestration and carbon storage has been pointed out as a strategy to make them more attractive for investments.[49]

## *Building Capacity*

Access to international funds is one of the main constraints SIDS members face in developing coastal blue carbon projects. Robinson & Dornan (2017)[55] found SIDS members have a limited capacity to get international climate funding, which has been associated with the level of experience of the national institutions handling the international requirements of the multilateral funds. In addition, there is a general lack of familiarity of potential stakeholders such as

governments and investors with the CBCR finance opportunities. This aspect becomes more relevant for countries with relatively small economies. For instance, the first blue carbon bond, a market-based strategy to fund climate mobilization, was just issued in 2018 in the Republic of Seychelles. In contrast, green bonds have been flowing in the market for about one decade.

Climate finance allocations aim to reduce net carbon emissions using mechanisms based on the Clean Developed Mechanism (CDM), which was established by the Kyoto Protocol. CDM demands expensive and complex administrative requirements that have to be met by the projects to obtain the certification of emissions reduction. This procedure can be expensive for small or short-term projects. The duration of climate initiatives that involve CBCRs range from one to five years because they frequently depend on grants and philanthropic efforts. In contrast, projects related to renewable or efficient energy production are often larger than CBCR projects, and have long-term funding, allowing them to achieve CDM certification. By 2018, only one CBCR project (mangrove afforestation in Indonesia) received CDM certification.[56]

### *Limited Information*

The interest in new strategies of blue carbon funding continues to grow rapidly, especially in countries that possess significant amounts of CBCRs, such as SIDS. To make projects more attractive to public or private investors, these projects should initially invest in rigorous systems of monitoring and validation of carbon sequestration and a clear generation of co-benefits.[57] For CBCRs the more common co-benefits include: a) regulating benefits such as coastal protection, reduction of coastal erosion, and flooding; b) provisioning benefits associated with food and natural material production; cultural benefits such as tourism; and c) supporting benefits for cycling of nutrients and biodiversity.[58] Unfortunately, for many potential areas where coastal

blue carbon projects can take place, these benefits are poorly quantified.[56] As a first-class priority, huge efforts need to be made to have a better understanding of co-benefits and a potential monetization of these resources.

**Especially for blue carbon finance, Ullman et al. (2013)[59] identified some remaining questions regarding CBCRs, which should be solved as a precondition for coastal blue carbon projects:**

- What is the rate at which carbon is naturally sequestered in the ecosystem?
- How great is the stock of sequestered carbon in the ecosystem?
- When the ecosystem is destroyed or degraded, how much of the previously sequestered stock of carbon is released to the atmosphere, at what rate, and over what period of time?
- How can changes in the rates of sequestration and emission be independently and accurately measured and monitored?
- What is the natural variation in the carbon pools of these habitats and how can this be measured and compared to human-driven changes? How do these natural variations affect the permanence of carbon stocks?
- What are the potential losses in coastal habitats brought about by climate change and how will this affect carbon stocks and sequestration?
- What are the agents and drivers of change and how can these be controlled?

Answering these questions will require long-term efforts in order to understand well enough how CBCRs work, but especially to develop robust documentation that can support and reduce the risks of investments.

# Potential Funding Sources

## *Multilateral Organizations*

The COP 21 represented a milestone for global climate finance. After the adoption of the Paris Agreement, multiple organizations, including multilateral and development agencies, have launched climate mitigation and adaptation funding to overcome climate change impacts. These efforts pay special attention to Least Developed Countries (LDCs), SIDS, and African States. Some potential public funding opportunities, especially those that may be appropriate for funding of coastal blue carbon projects, are listed below:

**Table 1.** Funding opportunities for coastal blue carbon projects from multilateral organizations.[54]

| Entity | Purpose - Year |
|---|---|
| Asian Development Bank: Action Plan for Healthy Oceans and Sustainable Blue Economies | Provides financial and technical assistance to ocean health and marine economy projects in the Asia and Pacific region.<br>USD 5 billion<br>2019-2024. Eligibility Criteria: Location, Screening, Investment, and Impact |
| The World Bank: PROBLUE | Supports sustainable economic development of marine and coastal resources (Blue economy)<br>September 2018 |
| UN Environment Program, Marine and Coastal Strategy | Supports countries and stakeholders in their national and regional actions to sustainably use marine and coastal ecosystem services and encourage adoption of innovative financing instruments for the blue economy.<br>2020 – 2030 (Ongoing) |

| | |
|---|---|
| United Nations Conference on Trade and Development (UNCTAD) | Provides support for policy development, preparation of projects on the blue economy.<br><br>A formal request can include:<br><br>● Requesting country<br>● Requesting authority and contact details<br>● Requesting date<br>● Main areas where UNCTAD technical cooperation is requested or main Toolbox product(s) requested<br>● Reasons for which the UNCTAD technical cooperation is requested<br>● How can UNCTAD technical cooperation contribute to the national development strategy?<br>● Source of funding |
| Global Environment Facility (GEF) | Provides funding to support government projects and programs. Currently, this fund is developing the project GEF Blue Forest.<br><br>USD 4.2 billion<br><br>2018-2022. Eligibility Criteria: Eligible country, National Priorities, GEF Priorities, Financing, and Public Participation. |
| REDD+ | Supports the design and implementation of National REDD+ Programs. Active since 2008. If mangroves are included in a country's definition of a forest, they are eligible under REDD+<br><br>USD 4 billion |
| Green Climate Fund (GCF) | Pays particular attention to SIDS. National and sub-national organisations can apply directly to this fund. Active since 2014.<br><br>USD 10 billion.<br><br>Projects should point to satisfy:<br><br>● Mitigation: Forestry and land use<br>● Adaptation: Ecosystem and ecosystem services |

## *Coastal Blue Carbon and REDD+*

With programs such as *Mangroves for the Future* (MMF), a partnership-based international initiative, the UNDP and IUCN have led efforts to include mangrove forests into the REDD+ strategies and agenda. In 2018, MMF developed on-field actions in different countries, including SIDS i.e., Seychelles and Maldives, to assess impacts, benefits, and opportunities to use this funding mechanism. Additionally, in September 2020, the Verified Carbon Standard Program (VCS), the world's most widely used voluntary program for greenhouse emission reduction, has updated its methodologies to include CBCRs into the REDD+ Methodology Framework. With this update, coastal blue carbon projects would be able to sell carbon credits in voluntary or regulated markets.

## *Market-Based Coastal Blue Carbon*

In the spirit of inserting coastal blue carbon into market-based finance, three phases should be completed by countries before they can start receiving payments from carbon markets. Phase 1 aims to gather project documentation and it is expected the project can address multiple questions mentioned above. This phase might include a 12-month monitoring plan for verification of the amount of carbon credits. Also, at this stage the projects should procure the engagement of stakeholders and the improvement of building capacity. Then, the Phase 2 or process of certification must involve an external organization for verification. Some of the organizations that are certificating coastal blue carbon projects are VCS, Plan Vivo, CCBS and Social Carbon, and Gold Standard (GS). Finally, Phase 3 involves credit issuance, here the carbon credits are approved and issued by the selected standard.

According to Ullman et al., (2013)[59] the regulated market is the most promising alternative to fund coastal blue carbon projects and in particular, using cap-and-trade schemes. In these schemes, a central authority established a top for the potential emitted GHGs, "the cap," and then, the cap is sold to organizations that need to compensate or want to reduce their emissions. Further, this payment or credit trade will support the management, restoration, and conservation of the CBCRs. The Global Coastal Blue Carbon Market can be, or is being negotiated, through four trading systems: 1) TheEuropean Union emissions trading scheme (EU ETS); 2) the CDM; 3) Regional greenhouse gas initiative; 4)and Kyoto assigned allowance units. However, the EU ETS is the most used mechanism, because it accumulates five times more carbon credits that all the other options together, and presents the highest price of carbon per ton.

In 2018, the Republic of Seychelles launched the "*world's first sovereign blue bond,*" a financial mechanism that aims to support sustainable development through marine and fishing projects. This country raised US$15 million from international investors to empower the local economy. This initiative also brought grants and loans to support conservation projects that are joined to the participation of local industries. Additionally, there are a series of national and international public funds to be parallely invested and make coastal management more resilient and efficient. Thanks to this new blue bond, Seychelles is expanding its marine protected area (MPA) impacting positively 95% of their economy, which is based on marine and coastal resources. Seychelles followed the three phases initially supported by HRH Prince of Wales' Charities International Sustainability Unit. The Phase 2 was verified by the Standard Chartered and finally Clifford Chance LLP acted as transaction counsel.

The Republic of Seychelles new blue bond represents an important new opportunity for financing blue carbon projects that other countries may wish to emulate in the future.

# Conclusions & Recommendations

As SIDS struggle to reach their mitigation, adaptation, and sustainable development goals in the face of rising sea levels, increasing rates of natural disasters, and relentless financial set-backs, CBCRs provide an exciting *blue* opportunity. The conservation of CBCRs can increase the mitigation potential, adaptation and financing capacity of SIDS, encouraging the achievement of their NDCs. Even though the potential for CBCRs is clearly supported by the scientific community, SIDS struggle to maximize international investment opportunities and access to financial resources even though they are on the frontlines of climate change impacts.

Although CBCRs are recognized for their ecosystem services, and other co-benefits that accrue as a result of prioritizing conservation (e.g. jobs and nutrition security), there is a distinct gap in the global spatial understanding of CBCRs. Hence, SIDS will significantly benefit from **investing in the assessments of their CBCRs to highlight quantifiable benefits of CBCRs, and building community-based knowledge about national circumstances, opportunities, needs, and limits through socio-economic assessments.** Doing so can also generate awareness about the significance of marine ecosystems' value, depict the willingness of communities to contribute to the planning of conservation projects, and highlight the potential of CBCRs as integral ecosystems that can continually improve livelihoods. This can attract both financing institutions and international NGOs to SIDS to invest resources financially or through in-kind initiatives (e.g. conducting research, and providing technological equipment and knowledge).

Building upon the initial need to conduct national cost-benefit analysis of CBCRs, SIDS can show their political will by strengthening policy-based infrastructure, through the following recommendations:

- Prioritize participation and equity through **community-based collaborations**

- **Disentangle land tenure/property rights** for CBCRs through local governing structures
- Adopt marine **conservation planning tools** such as Integrated Coastal Zone Management
- Integrate the benefits of CBCRs into **Marine Protected Area design and management**
- Assess the significance of CBCR conservation in **achieving other international commitments**, such as the SDGs
- Define measurable goals for the conservation for CBCRs in **updated NDCs**
- Include CBCRs as a part of their **LULUCF commitments**
- Include mangroves in the definition of forests in the context of **Reducing Emissions from Deforestation and Forest Degradation (REDD+)** to be eligible for climate credits; advocate for the inclusion of marshes and seagrasses in REDD+

There is a stark gap in the needs for climate financing (USD 1.6 –3.8 trillion each year) and what is actually being met (USD 537 billion, as of 2018). Financing institutions attribute this gap to the lack of experience of local policy makers regarding international climate funding programs especially in countries with small economies. In addition, SIDS experience a significant constraint in the initial assessment costs to understand the potential of CBCRs or coastal blue carbon offset sites, which financing institutions read as weak political willingness.[48]

Although carbon-based market mechanisms seem to be in the early development phase, the following funding organizations have given priority to, and supported SIDS, in their endeavors to conserve local CBCRs:

- Asian Development Bank: Action Plan for Healthy Oceans and Sustainable Blue Economies
- The WorldBank: PROBLUE Program
- UN Environment Program: Marine and Coastal Strategy

- United Nations Conference on Trade and Development (UNCTAD)
- Global Environment Facility (GEF)
- REDD+
- Green Climate Fund (GCF)

Accessing public and private funds demands rigorous monitoring and verification systems to estimate the dynamics of CBC as well as the effectiveness of developed projects. Applying to multilateral funds and participating in market-based carbon finance initiatives are significant opportunities for stakeholders in developing countries where CBCRs are presented.

It is also important to address climate justice issues that may be exacerbated by improper allocation of resources hence, SIDS can ensure locally-rooted conservation efforts. Equity and participation could empower marginalized communities, especially in the context of building economies of scale.

# Citations


1. UNFCCC (n.d.) Vulnerability and Adaptation to Climate Change in Small Island Developing States: Background paper for the expert meeting on adaptation for small island developing States. Issued by the Secretariat of the UNFCCC, Bonn, Germany.
2. UNFCCC (2005) Climate change, small island developing States. Issued by the Climate Change Secretariat (UNFCCC), Bonn, Germany. http://unfccc.int/resource/docs/publications/cc_sids.pdf
3. UNFCCC (2020) Nationally Determined Contributions (NDCs): The Paris Agreement and NDCs. Retrieved December 3, 2020 from https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/nationally-determined-contributions-ndcs
4. Herr, D., Landis, E. (2016) Coastal blue carbon ecosystems: Opportunities for Nationally Determined Contributions, Policy Brief. Gland, Switzerland: IUCN and Washington, DC, USA: TNC.
5. Vierros, M. (2017) Communities and blue carbon: the role of traditional management systems in providing benefits for carbon storage, biodiversity conservation and livelihoods. Climatic Change 140:89–100. https://doi.org/10.1007/s10584-013-0920-3
6. UN-OHRLLS (2013) Small Island Developing States in Numbers. UN-OHRLLS, Floor 32, New York, NY 10017, USA. http://unohrlls.org/custom-content/uploads/2014/04/SIDS_IN_NUMBERS_121813_FA_WEB.pdf
7. United Nations & Economic Commission for Africa (UNECA) (2014) Unlocking full potentials of the blue economy: Are African Small Island Developing States ready to embrace the opportunities? UNECA, Addis Ababa, Ethiopia. eISBN: 978-99944-62-30-8.

8. Reef Resilience Network (2020) Vulnerability & Adaptation. Retrieved December 3, 2020 from https://reefresilience.org/community-based-climate-adaptation/climate-adaptation-introduction/
9. UNFCCC (2019) Means of Implementation. Retrieved November 9, 2020 from https://unfccc.int/2nd-capacity-building-hub/Means-of-Implementation-Day
10. The Blue Carbon Initiative (2019) Mitigating Climate Change through Coastal Ecosystem Management. Retrieved December 8, 2020 from https://www.thebluecarboninitiative.org/
11. Giri, C., et al. (2011) Status and distribution of mangrove forests of the world using earth observation satellite data. Glob Ecol Biogeogr 20:154–159.
12. McOwen, C.J., et al. (2017) A global map of saltmarshes. Biodiversity Data J. 55:e11764.
13. Gattuso, J. P., et al. (2006) Light availability in the coastal ocean: impact on the distribution of benthic photosynthetic organisms and their contribution to primary production. Biogeosciences 3:489–513.
14. Howard, J., et al. (2017) Clarifying the role of coastal and marine systems in climate mitigation. Frontiers in Ecology and the Environment 15: 42–50. https://doi.org/10.1002/fee.1451.
15. Alongi, D.M. (2014) Carbon cycling and storage in mangrove forests. Annu Rev Marine Sci 6:195–219.
16. Erler, D.V., et al. (2015) Applying cavity ring-down spectroscopy for the measurement of dissolved nitrous oxide concentrations and bulk nitrogen isotopic composition in aquatic systems: correcting for interferences and field application. Limnol Oceanogr Methods 13:391–401.

17. Macreadie, P.I., et al. (2019) The future of Blue Carbon science. Nat Commun 10:3998. https://doi.org/10.1038/s41467-019-11693-w
18. Furukawa, K., et al. (1997) Currents and sediment transport in mangrove forests. Estuar Coast Shelf Sci 44: 301–310.
19. Pendleton, L., et al. (2012) Estimating global "blue carbon" emissions from conversion and degradation of vegetated coastal ecosystems. PLoS ONE 7:e43542–e43542.
20. Financing Climate and Disaster Resilience for Small Island States (2016) Global Facility for Disaster Reduction and Recovery. https://www.gfdrr.org/en/feature-story/financing-climate-and-disaster-resilience-small-island-states.
21. Duarte, C.M., et al. (2013) The role of coastal plant communities for climate change mitigation and adaptation. Nat Clim Change 3: 961–968.
22. Ackerman, J.D., Okubo, A. (1993) Reduced mixing in a marine macrophyte canopy. Funct Ecol 7:305–309.
23. Koch, E.W., et al. (2009) Non-linearity in ecosystem services: temporal and spatial variability in coastal protection. Front Ecol Environ 7:29–37.
24. Mendez, F.J., Losada, I.J. (2004) Transformation of random and non-random breaking waves over vegetation fields. Coast Eng 51:103–118.
25. Ghisalberti, M., Nepf, H. (2009) Shallow flows over a permeable medium: the hydrodynamics of submerged aquatic canopies. Transport Porous Med 78:385–402.
26. Chen, Z., et al. (2012) The wake structure behind a porous obstruction and its implications for deposition near a finite patch of emergent vegetation. Wat Resour Res 8:W09517.

27. Gacia, E., Duarte, C.M. (2001) Sediment retention by a Mediterranean Posidonia oceanica meadow: The balance between deposition and resuspension. Estuar Coast Shelf Sci 52:505–514.

28. Narayan, S., et al. (2016) The effectiveness, costs and coastal protection benefits of natural and nature-based defences. PLoS ONE 11:e0154735. https://doi.org/10.1371/journal.pone.0154735

29. Luther, D.A., Greenberg, R. (2009) Mangroves: a global perspective on the evolution and conservation of their terrestrial vertebrates. BioScience 59:602–612. https://doi.org/10.1525/bio.2009.59.7.11

30. Greenberg, R., et al. (2006) Tidal marshes: a global perspective on the evolution and conservation of their terrestrial vertebrates. BioScience 56:675–685. https://doi.org/10.1641/0006-3568(2006)56[675:TMAGPO]2.0.CO;2

31. FAO: Committee on Fisheries (1999) Fisheries and aquaculture issues in Small Island Developing States. COFI/99/7, Rome, Italy, 15–19. http://www.fao.org/3/X0463E/X0463E.htm#TAB3.

32. FAO: Committee on Fisheries (2017) Special Event on Aquaculture in the Small Island Developing States (SIDS): Blue Growth Opportunities for SIDS in a Changing Climate. COFI:AQ/IX/2017/8, Rome, Italy. http://www.fao.org/cofi/30796-045895cc12e1a3ccb58fd3384f5d6536a.pdf

33. UNFCCC (2020) Nationally Appropriate Mitigation Actions (NAMAs). Retrieved December 3, 2020 from https://unfccc.int/topics/mitigation/workstreams/nationally-appropriate-mitigation-actions#eq-3

34. Wylie, L., et al. (2016) Keys to successful blue carbon projects: Lessons learned from global case studies. Mar Policy 65:76–84. https://doi.org/https://doi.org/10.1016/j.marpol.2015.12.020

35. Murray, B.C., et al. (2011) Green Payments for Blue Carbon: Economic Incentives for Protecting Threatened Coastal Habitats. Nicholas Institute for Environmental Policy Solutions Report, NI R 11-04, Duke University, Durham, NC. https://nicholasinstitute.duke.edu/sites/default/files/publications/blue-carbon-report-paper.pdf
36. Luterbacher, U., Sprinz, D.F. (2018) Global climate policy: Actors, concepts, and enduring challenges. MIT Press, Boston.
37. Sutton-Grier, et al. (2018) In Myers, L., et al. (eds.) A Blue Carbon Primer: The State of Coastal Wetland Carbon Science, Practice and Policy, Ch. 17. CRC Press, Boca Raton.
38. Conservation International (2020). Blue Carbon Contributions by Country (Draft)
39. Ertör, I., Hadjimichael, M. (2020) Editorial: Blue degrowth and the politics of the sea: rethinking the blue economy. Sustain Sci 15:1–10. https://doi.org/10.1007/s11625-019-00772-y
40. Claudet, J., et al. (2020) A Roadmap for Using the UN Decade of Ocean Science for Sustainable Development in Support of Science, Policy, and Action. One Earth 2:34–42. https://doi.org/10.1016/j.oneear.2019.10.012
41. The Blue Carbon Initiative (2019) About The Blue Carbon Initiative. Retrieved November 8, 2020 from https://www.thebluecarboninitiative.org/about-the-blue-carbon-initiative
42. Herr, D., Pidgeon, E., Laffoley, D. (eds.) (2012) Blue Carbon Policy Framework: Based on the discussion of the International Blue Carbon Policy Working Group. Gland, Switzerland: IUCN and Arlington, USA: CI. https://www.iucn.org/sites/dev/files/import/downloads/blue_carbon_policy_framework_2_0.pdf
43. Moomaw, W.R., et al. (2018). Wetlands in a changing climate: Science, policy and management. Wetlands 38:183–205. https://doi.org/10.1007/s13157-018-1023-8

44. Smith, M.D., et al. (2010) Political economy of marine reserves: Understanding the role of opportunity costs. PNAS 107:18300–18305. https://doi.org/10.1073/pnas.0907365107

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

46. Republic of Seychelles (2015) Intended Nationally Determined Contribution (INDC) Under The United Nations Framework Convention On Climate Change (UNFCCC). https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Seychelles%20First/INDC%20of%20Seychelles.pdf

47. Barbier, E.B. (2014) Climate change mitigation policies and poverty. WIREs Climate Change 5:483–491.

48. UNEP (2016) Blue Carbon Financing of Mangrove Conservation in the Abidjan Convention Region: A Feasibility Study. United Nations Environment Programme, Abidjan Convention Secretariat and GRID-Arendal, Nairobi, Abidjan and Arendal.

49. Thomas, S. (2014) Blue carbon: Knowledge gaps, critical issues, and novel approaches. Ecol Eco 107:22–38. https://doi.org/10.1016/j.ecolecon.2014.07.028

50. Reef Resilience Network (2020) Gender Equity. Retrieved December 3, 2020 from https://reefresilience.org/blue-carbon/blue-carbon-projects/gender-equity/

51. IPCC (2018) Summary for Policymakers. In: Masson-Delmotte, V., et al. (eds.) Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. World Meteorological Organization, Geneva, Switzerland.

52. Buchner, B., et al. (2020) Global Landscape of Climate Finance 2019. Climate Policy Initiative. Retrieved December 3, 2020 from https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2019/

53. Bos, M., et al. (2015) Marine conservation finance: The need for and scope of an emerging field. Oce Coa Man 114:116–128. https://doi.org/10.1016/j.ocecoaman.2015.06.021

54. Tirumala, R.D., Tiwari, P. (2020) Innovative financing mechanism for blue economy projects. Mar Pol 104194. https://doi.org/10.1016/j.marpol.2020.104194

55. Robinson, S., Dornan, M. (2017) International financing for climate change adaptation in small island developing states. Reg Environ Change 17:1103–1115.

56. Vanderklift, M.A., et al. (2019) Constraints and opportunities for market-based finance for the restoration and protection of blue carbon ecosystems. Mar Pol 107:103429. https://doi.org/10.1016/j.marpol.2019.02.001

57. Blue National Capital Financial Facility, (2019). Blue Bonds: Financing Resilience of Coastal Ecosystems, Key Points for Enhancing Finance Action. Retrieved December 11, 2020 from https://www.4climate.com/dev/wp-content/uploads/2019/04/Blue-Bonds_final.pdf ------ Rodewald, A., et al. (2020) Innovative Finance for Conservation: Roles for Ecologists and Practitioners. Issues in Ecology, Report No. 22, Ecological Society of America.

58. Grimsditch, G., et al. (2013) The blue carbon special edition – Introduction and overview. Oce Coa Man 83:1–4. https://doi.org/10.1016/j.ocecoaman.2012.04.020

59. Ullman, R., et al. (2013) Including Blue Carbon in climate market mechanisms. Oce Coa Man 83:15–18. https://doi.org/10.1016/j.ocecoaman.2012.02.009

## *Other References*

Aburto-Oropeza, O., et al. (2008) Mangroves in the Gulf of California increase fishery yields. *Proc. Natl Acad. Sci. USA* 105:10456–10459.

Mangora, M.M., Shalli, M.S. (2014) Sacred Mangrove Forests: Who Bears the Pride?. In: Behnassi M., et al. (eds.) Science, policy and Politics of Modern Agricultural System, Ch. 20. Springer, New York.