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Interim report

Funding conservation and restoration of coastal ecosystems

Advantages and disadvantages of carbon credits compared to other funding instruments

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On behalf of the German Environment Agency

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Abstract: Funding conservation and restoration of coastal ecosystems

This report analyses the advantages and disadvantages of carbon credits compared to other financing instruments for the protection and restoration of coastal ecosystems. The report examines nine instruments: emission credits – both for use in compensation and in the context of climate contributions, climate contributions using modalities other than carbon credits, biodiversity certificates, bilateral and multilateral development cooperation, domestic public finance, philanthropic grants and donations, tourism entry and activity fees, debt-for-nature swaps, and blue bonds.

Chapter 2 presents the various financing options. Chapter 3 analyses those options based on six aspects: (1) maturity, (2) scalability of financial flows, (3) predictability and stability of financial flows, (4) carbon accounting readiness, (5) transaction costs, and (6) integrity risks.

Projects aimed at protecting and expanding carbon storage in coastal ecosystems are generally referred to as "Blue Carbon" projects. At present, almost all of these projects are implemented in mangrove habitats. While only few such projects are located in salt marshes and seagrass meadows. While carbon crediting programmes have been offering registration of these projects since 2011, they have so far captured a very small market share of less than 1%, when looking at historical issuances. Consequently, Blue Carbon projects currently play a subordinate role in the voluntary carbon market. Challenges in quantifying the mitigation impacts, risks of reversibility, and high transaction costs – especially in the early stages – have prevented a larger market share thus far. However, more than 50 additional projects are currently under development, meaning market shares are likely to shift in the future.

Carbon credits from Blue Carbon projects offer the potential to mobilize private financial resources and to establish systematic carbon monitoring. Regarding scalability, an estimate shows that, with favourable price development and corresponding project growth, substantial annual revenues could be possible. However, this potential has not yet been fully exploited. Demand for Blue Carbon certificates is high, but supply is limited. Unlike public financing, voluntary carbon markets are not constrained by government budgets, which represents a structural advantage.

In terms of predictability and stability of financial flows, an advantage of carbon credits is their long project durations (20–60 years), while public financing (e.g., budget funds, official development assistance (ODA)) often have variable project cycles and their stability depends on many factors including resilience against changing priorities due to government change. However, there has been high price volatility for carbon credits in the past. This, along with other market uncertainties, remains a significant challenge for project developers, as these factors complicate estimating expected revenues. On the other hand, ODA funds for example are stable worldwide, but the actual funds available for Blue Carbon projects depend on the priorities of donor countries, which can often change at short notice.

Carbon credits are currently the only instrument that has established systematic and detailed greenhouse gas accounting, even though its results are often associated with high uncertainty. Nevertheless, these approaches fundamentally allow for a closer monitoring and verification of projects contribution to climate protection than under other instruments. While multilateral climate funds, such as the Green Climate Fund (GCF), also measure the emission reductions and removal contributions of some of their projects, this only applies to projects whose main target is *mitigation*. For projects, such as the reforestation of mangroves as part of coastal *protection* measures, often no measurement of the mitigation contribution of these actions is carried out. In cases where projects report mitigation contributions, it is often unclear from the project documentation how these have been calculated. It is therefore assumed that the calculation

approaches are significantly rougher and less detailed than those applied for the quantification of carbon credits.

The benefits that carbon credits offer in monitoring emission impacts come with drawbacks in terms of transaction costs. Compared to other financing instruments, the costs for monitoring and verification are higher. Domestic public finance or philanthropic donations often require less formal effort but also provide less transparency regarding their climate impact. However, there are few data points and no studies that have systematically empirically evaluated the transaction costs of carbon credits. Therefore, comparability of financing instruments on this aspect is limited.

As another report under this project has shown the use of carbon credits from Blue Carbon projects in the context of offsetting is associated with high risks to environmental integrity (Jennerjahn et al. 2025). Estimation of the mitigation impact of project activities in ecosystems being a fundamental challenge here. These are often associated with high uncertainties, which can lead to overestimating the actual mitigation impact. Furthermore, the achieved reductions have a significant risk of non-permanence. Due to these risks, the use of carbon credits for offsetting may result in more emissions remaining in the atmosphere than before. When carbon credits are used in the context of climate contributions, no offsetting of emissions takes place. However, it is still important that activities underpinning carbon credits are additional and use conservative estimates of the mitigation impact and that provisions are made to minimize the risk of non-permanence and adequately compensate for any events that might reverse mitigation results. The use of carbon credits in the context of climate contributions that do not meet these criteria can undermine the credibility of such contributions.

The report concludes that revenue from carbon credits is one of several financing instruments that can be used for the protection and restoration of coastal ecosystems. Due to their significant importance for coastal protection and biodiversity, there are many reasons to finance activities such as mangrove reforestation. This is also reflected in the diversity of financing instruments that are generally available for this purpose. Carbon credits have advantages in terms of scalability and long-term revenue, as these projects are designed for a duration of 20–60 years and do not involve repayments or interest. This is particularly advantageous for countries that cannot use other instruments such as Blue Bonds or ODA loans due to high levels of debt. At the same time, the payment timeline for emission credits is further in the future compared to other financing instruments, such as grants or bonds. Funds from these instruments are often available at the beginning of a project, whereas revenues from emission credits flow only after the first verification of emission reductions. This can be a barrier for Blue Carbon projects, as the initial years are often associated with high investment costs. The suitability of using revenue from carbon credits therefore strongly depends on the integrity of the certificates used and the use case itself. Their use for offsetting carries high risks that more emissions will remain in the atmosphere than would have been the case without their use for this purpose. This risk does not exist when used for climate contributions. However, even in this case, the quality of the certificates is crucial to avoid undermining the credibility of the contributions.

Kurzbeschreibung: Finanzierung der Erhaltung und Wiederherstellung von Küstenökosystemen

Dieser Bericht analysiert die Vor- und Nachteile von Emissionsgutschriften im Vergleich zu anderen Finanzierungsinstrumenten für den Schutz und die Wiederherstellung von Küstenökosystemen. Der Bericht untersucht neun Instrumente: Emissionsgutschriften – sowohl zur Nutzung für die Kompensation als auch im Kontext von Klimabeiträgen, Klimabeiträge unter Nutzung anderer Instrumente als Emissionsgutschriften, Biodiversitätszertifikate, bilaterale und multilaterale Entwicklungszusammenarbeit, nationale Haushaltsmittel, Philanthropie, Tourismusgebühren, Tausch von Schulden gegen Naturschutz (Debt-for-nature swaps) und Blaue Anleihen (Blue Bonds).

Kapitel 2 stellt die verschiedenen Finanzierungsoptionen dar. Kapitel 3 analysiert diese anhand von sechs Kriterien: (1) Reifegrad, (2) Skalierbarkeit der Finanzflüsse, (3) Vorhersehbarkeit und Stabilität der Finanzflüsse, (4) Kohlenstoffbilanzierung, (5) Transaktionskosten und (6) Risiken für die Umweltintegrität.

Projekte, die darauf abzielen Kohlenstoffspeicher in Küstenökosystemen zu schützen und zu erweitern werden allgemein unter dem Sammelbegriff „Blue Carbon“ zusammengefasst. Derzeit werden nahezu alle dieser Projekte in Mangrovenhabitaten umgesetzt. Nur wenige dieser Projekte hingegen in Salz- und Seegraswiesen. Blue Carbon Projekte spielen zurzeit nur eine untergeordnete Rolle auf dem freiwilligen Kohlenstoffmarkt. Zwar bieten mehrere Kohlenstoffprogramme eine Registrierung dieser Projekte seit 2011 an, bisher haben diese allerdings nur einen sehr geringen Marktanteil von weniger als 1%, gemessen an historischen Ausschüttungen von Zertifikaten. Gründe hierfür sind Herausforderungen bei der Quantifizierung der Minderungsleistung, Reversibilitätsrisiken und hohe Transaktionskosten, insbesondere in der Anfangsphase, die einen größeren Marktanteil bisher verhindert haben. Zurzeit sind mehr als 50 weitere Projekte in Entwicklung, so dass Marktanteile sich in Zukunft potentiell verschieben könnten.

Emissionsgutschriften aus Blue Carbon Projekten bieten das Potenzial, private Finanzmittel zu mobilisieren und ein systematisches Kohlenstoffmonitoring zu etablieren. Bezüglich der Skalierbarkeit zeigt eine Abschätzung, dass bei günstiger Preisentwicklung und entsprechendem Projektwachstum jährliche substanzielle Einnahmen möglich wären. Aktuell ist dieses Potenzial jedoch noch nicht ausgeschöpft. Die Nachfrage nach Blue Carbon-Zertifikaten ist zwar hoch, das Angebot aber begrenzt. Im Gegensatz zur öffentlichen Finanzierung sind freiwillige Kohlenstoffmärkte nicht durch staatliche Haushalte beschränkt – was einen strukturellen Vorteil darstellt.

Hinsichtlich der Vorhersehbarkeit und Stabilität der Finanzflüsse ist ein Vorteil von Emissionsgutschriften, dass sie langfristige Projektlaufzeiten (20–60 Jahre) haben, während insbesondere öffentliche Finanzierungen (Haushaltsmittel, ODA) oftmals wesentlich kürzere Projektzyklen aufweisen. Emissionsgutschriften unterlagen in der Vergangenheit allerdings einer hohen Preisvolatilität. Diese und weitere Marktunsicherheiten bleiben eine große Herausforderung für Projektentwickelnde, da diese Faktoren eine Abschätzung der zu erwartenden Einnahmen erschweren. ODA-Mittel auf der anderen Seite sind weltweit stabil, die tatsächlich verfügbaren Mittel für Blue Carbon Projekte jedoch abhängig von Prioritäten der Geberländer, die sich oft auch kurzfristig ändern können.

Emissionsgutschriften sind derzeit das einzige Instrument, das eine systematische und detaillierte Bilanzierung von Treibhausgasen etabliert hat, auch wenn diese oft mit hohen Unsicherheiten behaftet ist. Trotzdem ermöglichen diese Ansätze grundsätzlich den Beitrag von Projekten zum Klimaschutz engmaschiger zu verfolgen und zu überprüfen als unter anderen Instrumenten. Obwohl auch multilaterale Klimafonds, wie beispielsweise der Green Climate

Fund (GCF), den Emissionsminderungsbeitrag einzelner Projekte messen, ist festzustellen, dass dies nur bedingt der Fall ist. So trifft dies nur auf Projekte zu deren primäres Ziel die *Minderung* von Emissionen ist. Projekte, die beispielsweise die Aufforstung von Mangroven im Rahmen von Maßnahmen zur Küstenbefestigung umfassen, findet in der Regel keine Erfassung des Minderungsbeitrags statt. In Fällen, in denen diese Art von Projekten Minderungsbeiträge dokumentieren, ist es aus der Projektdokumentation oft nicht ersichtlich, wie diese berechnet worden sind. Es ist daher anzunehmen, dass die Berechnungsansätze deutlich gröber und weniger detailliert sind als diejenigen, die für die Quantifizierung von Emissionsgutschriften angewendet werden.

Die Vorteile, die Emissionsgutschriften bei der Nachverfolgung der Emissionswirkung bieten, stehen im Kontrast mit den Nachteilen hinsichtlich der Transaktionskosten. Im Vergleich zu anderen Finanzierungsinstrumenten sind die Kosten für Monitoring und Verifizierung höher. Andere Instrumente, wie etwa nationale Finanzierung oder philanthropische Spenden erfordern oft weniger formalen Aufwand, bieten aber auch weniger Transparenz bezüglich der Klimawirkung ihrer Maßnahmen. Studien und Datensätze, die Transaktionskosten von Emissionsgutschriften systematisch empirisch ausgewertet haben, sind hier jedoch begrenzt. Die Aussagekraft der Gegenüberstellung der verschiedenen Finanzierunginstrumente zu diesem Aspekt ist demnach eingeschränkt.

Wie ein weiterer Bericht unter diesem Projekt gezeigt hat, ist die Nutzung von Emissionsgutschriften aus Blue Carbon Projekten im Kontext von Kompensationsmaßnahmen mit hohen Risiken für die Umweltintegrität verbunden (Jennerjahn et al. 2025). Dies hängt vor allem mit den grundsätzlichen Herausforderungen bei der Quantifizierung der Minderungswirkung von Projektaktivitäten in Ökosystemen zusammen. Diese sind oft mit hohen Unsicherheiten verbunden, was zu einer Überschätzung der tatsächlichen Minderungswirkung führen kann. Darüber hinaus haben die erzielten Minderungen ein signifikantes Risiko der Nicht-Permanenz. Aufgrund dieser Risiken kann eine Nutzung im Kontext von Kompensationsmaßnahmen dazu führen, dass mehr Emissionen in der Atmosphäre verbleiben als vorher. Bei einer Nutzung von Emissionsgutschriften im Rahmen von Klimabeiträgen besteht dieses Risiko für die Atmosphäre nicht. Es ist jedoch gleichwohl wichtig, dass hinter genutzten Emissionsgutschriften Aktivitäten stehen, die zusätzlich sind und, dass konservative Abschätzungen der Minderungsmengen geschehen. Ebenso, ist die Implementierung von Vorrichtungen erforderlich, um das Risiko der Nicht-Permanenz so gut wie möglich zu minimieren und adäquat zu kompensieren, sollten Ereignis eintreten, welche Minderungen rückgängig machen. Die Nutzung von Emissionsgutschriften im Rahmen von Klimabeiträgen, die diese Eigenschaften nicht aufweisen, können die Glaubwürdigkeit dieser unterminieren.

Der Bericht kommt zu dem Schluss, dass Einnahmen aus Emissionsgutschriften eines von mehreren Finanzierungsinstrumenten sind, die für den Schutz und die Wiederherstellung von Küstenökosystemen genutzt werden können. Aufgrund ihrer signifikanten Bedeutung für Küstenschutz und Biodiversität existieren viele Gründe, Aktivitäten wie die Wiederaufforstung von Mangrovenwäldern zu finanzieren. Dies spiegelt sich auch in der Diversität der Finanzierungsinstrumente wider, die hierfür grundsätzlich zur Verfügung stehen. Emissionsgutschriften haben Vorteile im Hinblick auf die Skalierbarkeit und Langfristigkeit der Einnahmen, da diese Projekte auf eine Laufzeit von 20-60 Jahren angelegt sind und keine Rück- oder Zinszahlungen beinhalten. Dies ist besonders für Länder von Vorteil, die aufgrund von hohen Verschuldungsniveaus andere Instrumente wie Blaue Anleihen oder ODA-Kredite nicht nutzen können. Gleichzeitig liegt der Zahlungszeitpunkt für Emissionsgutschriften weiter in der Zukunft als bei anderen Finanzierungsinstrumenten wie zum Beispiel Zuwendungen oder Anleihen. Mittel aus diesen Instrumenten sind oft bei Projektbeginn verfügbar, während

Einnahmen aus Emissionsgutschriften erst nach der ersten Verifizierung der Emissionsminderung erzielt werden. Dies kann eine Barriere für Blue Carbon Projekte darstellen, da gerade die ersten Jahre der Projektimplementierung mit hohen Investitionskosten verbunden sind. Die Eignung der Nutzung von Einnahmen aus Emissionsgutschriften hängt stark von der Integrität der genutzten Zertifikate sowie der Nutzungsart selbst ab. Die Nutzung für Kompensationsmaßnahmen ist mit hohen Risiken assoziiert, die potenziell dazu führen können, dass letztlich mehr Emissionen in der Atmosphäre verbleiben als ohne die Nutzung für diesen Zweck. Dieses Risiko besteht nicht bei der Nutzung für Klimabeiträge. Die Qualität der Zertifikate ist auch hier ein entscheidender Faktor, um die Glaubhaftigkeit der Beiträge nicht zu unterminieren.

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ADB	Asian Development Bank
CBD	Convention on Biological Diversity
CDM	Clean Development Mechanism
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COP	Conference of the Parties
CSR	Corporate Social Responsibility
DNS	Debt-for-nature swaps
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	Greenhouse gas
IAPB	International Advisory Panel on Biodiversity Credits
IFM	Improved Forest Management
IFC	International Finance Corporation
LDCF	Least Developed Countries Fund
MDB	Multilateral Development Bank
Mha	Million hectares
MPA	Marine Protected Area
NGO	Non-Governmental Organisation
NDC	Nationally Determined Contributions (in Paris-Agreement)
OECD	Organisation for Economic Cooperation and Development
ODA	Official Development Assistance
PES	Payment for Ecosystem Services
PFP	Project Finance for Permanence
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SCCF	Special Climate Change Fund
SDG	Sustainable Development Goal
TCMP	Tobago Cays Marine Park
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
VCM	Voluntary Carbon Market
VCS	Verified Carbon Standard
WTP	Willingness to Pay

1 Introduction

The importance of conserving and restoring coastal ecosystems is widely acknowledged by the international community and countries engage in different multilateral fora to coordinate global collaboration more effectively. The 2030 Agenda for Sustainable Development contains a dedicated goal for life below water (Sustainable Development Goal 14), which includes targets for the conservation and sustainable use of oceans, seas and marine resources. Further, more recently, a target of restoring 30% of terrestrial, inland water and marine and coastal environments by 2030 was set at the 15th Conference of the Parties (COP15) of the Convention on Biological Diversity (Convention on Biological Diversity (CBD) 2022).

Despite these developments, existing efforts to protect coastal ecosystems have not been successful in sufficiently halting the alarming rates of destruction (Williams et al. 2022). Currently, only 3% of the oceans are fully or highly protected (Marine Conservation Institute 2024; Humphreys und Clark 2020). While competing economic interests in coastal zones may be one prominent factor explaining these low protection rates, there is also a shortage of financial resources to implement conservation and restoration measures. The World Economic Forum (2024) estimates that SDG 14 is the least funded of all 17 SDGs, with between 2015 and 2019 only USD 10 billion being invested towards its implementation (WEF 2022). According to estimates by UN Environment Programme (UNEP) 2023, annual financial flows for Nature-based Solutions (NbS)[1] must almost triple from USD 200 billion per year in 2022 to USD 542 billion per year by 2030 to meet the targets of the three Rio conventions (UNCBD, UNFCCC, UNCCD).[2] Approximately USD 50 billion of these investment needs can be attributed to the conservation and restoration of coastal ecosystems. These numbers indicate a large financing gap.

Mobilising additional resources therefore remains an urgent priority for national governments and multilateral cooperation alike. As public funding sources are scarce, the search for additional sources also includes non-traditional policy options such as leveraging contributions from the private sector (UN Environment Programme (UNEP) 2023).

More recently, stakeholders have also begun considering approaches to raise funding via the voluntary carbon market by monetizing the carbon storage function that coastal ecosystems provide. Mangroves, seagrass meadows and tidal marshes store large amounts of carbon and constitute an important sink in the global carbon cycle. Some private sector actors are willing to pay for measures that maintain or enhance the carbon storage function of coastal ecosystems in exchange for carbon credits. In the past, the intention of these buyers often, but not always, has been to use carbon credits to make offsetting claims for their own emissions.

In traditional approaches for coastal ecosystem conservation, preserving and enhancing their carbon storage function usually does not feature in individual projects' objectives. Hence, they lack the carbon accounting infrastructure that is required for measuring the amount of sequestered carbon that can be attributed to a specific project measure. As a result, a new class of cooperation projects emerged which are referred to as "Blue Carbon projects", which form a sub-category of nature-based solutions. The term "blue" is referring to the carbon captured by marine organisms and stored in living and dead biomass as well as in organic compounds in the sediment (Reise et al. 2024).

[1] "Nature-based Solutions are locally appropriate, adaptive actions to protect, sustainably manage or restore natural or modified ecosystems in order to address targeted societal challenge(s) - such as climate change mitigation -, while simultaneously enhancing human well-being and providing biodiversity benefits.", (Reise et al. 2022.

[2] Target most recently adopted by the CBD as part on the Kunming-Montreal Global Biodiversity Framework in 2022: halt biodiversity loss by ensuring that 30 per cent of land and sea is protected by 2030 (known as the 30x30 goal).

While revenues from carbon credits of Blue Carbon projects can potentially open a new funding stream for coastal ecosystem protection and restoration, the use of Blue Carbon credits for offsetting claims is associated with risks. Researchers have frequently challenged the environmental integrity of offsets based on carbon credits from nature-based solutions (West et al. 2023; Badgley et al. 2022; West et al. 2020; Schneider et al. 2022). Criticism inter alia includes high over-crediting risks due to the lack of robust quantification methodologies and insufficient approaches to address high reversal risks of the activities (see also (Jennerjahn et al. 2025)).

This report describes different funding options besides carbon credits used for offsetting that are available to support Blue Carbon activities. It further assesses the advantages and disadvantages of using carbon credits compared with those alternative funding sources.

Chapter 2 provides an outline of nine different funding options available to support Blue Carbon activities. Chapter 3 discusses these options against six aspects that will influence to what extent the funding sources are available and practicable to proponents of Blue Carbon activities. Chapter 4 discusses the findings and draws conclusions on possible ways forward to enhance funding flows for the conservation and restoration of coastal ecosystems.

2 Overview of funding options

The reasons why governments fund measures to conserve and restore coastal ecosystems are manifold. They have high conservation values, providing important habitats for many species. At the same time, they provide important services to key economic sectors such as fisheries and tourism and help make coastal zones more resilient against erosion and sea-level rise. Governments can rely on the support of a large network of interested stakeholders when it comes to funding these measures: other governments – via bilateral and multilateral development cooperation, local and international non-governmental organisations, philanthropic foundations, and the private sector.

Support by these actors comes through different funding sources, using different instruments and delivery modalities. Not all of these necessarily have the protection of existing and the creation of new carbon stocks as their primary objective. Replanting mangrove habitat for example is a common measure to make coastlines more resilient against sea-level rise and stop coastal erosion. Initiatives in the context of bilateral and multilateral development cooperation support these measures through climate adaptation projects. While these projects do not necessarily comprehensively measure its extent, they too have a positive impact on the creation of new, or restoration of previously lost, carbon stocks.

In other contexts, the amount of carbon stored trough conserving or restoring mangrove habitat is a crucial metric for the motivation to provide funding. This applies for example for transactions in the context of emission offsetting and in the context of climate contribution claims. In these cases, carbon credits function as a central means to measure, verify and certify the emission impact of a mitigation activity.

This section of the report introduces the main funding sources which governments currently can deploy to support coastal ecosystem conservation and restoration. It includes more traditional sources such as domestic public finance as well as new ones which surfaced only recently, such as blue bonds.

The section starts with carbon credits, as their suitability vis-à-vis other funding sources is the main research question of this report. For discussing the advantages and disadvantages of carbon credits compared to other funding sources, its use case often makes an important difference. In its discussion, the report therefore distinguishes between the currently most relevant use cases for carbon credits from Blue Carbon projects. Such granular distinction is not made for the other funding sources because it would go beyond the scope of the report. For example, when discussing funding through bilateral and multilateral development cooperation, no distinction is made whether these are provided in form of grants, loans or other financial instruments or the type of development partner which is extending the support.

2.1 Carbon credits

The basic concept behind a carbon credit is the creation of a universally acknowledged unit, which represents a uniform amount of greenhouse gas emissions reduced or removed. The most common metric used for a carbon credit is one tonne of carbon dioxide equivalence (t CO_2e). Carbon credits can be used in different contexts and for different purposes. For Blue Carbon projects, the primary use case so far has been voluntary use by companies, organisations, governments and individuals. This report therefore only discusses funding streams from use cases which involve voluntary climate action. Whether or not Blue Carbon projects are a suitable project type for carbon credits which are used for NDC achievement or other international

mitigation purposes, such as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is not analysed in this report.

2.1.1 Revenues from carbon credits used for voluntary offsetting claims

The agreement of the multilateral community to limit global mean temperature increase to 1.5°C by the end of the century did not only lead to governments formulating emission reduction targets in their Nationally Determined Contributions (NDCs). It also inspired companies, organisations, and government entities to take voluntary commitments to achieve climate neutrality on the level of the individual organisation or product. Plans developed for achieving these commitments often included the purchase of carbon credits to offset portions of an organisation's remaining emissions.

The relevant market where project developers offer carbon credits for this use case is the voluntary carbon market (VCM). It is estimated that that capital expenditure for projects in the VCM amounted to over USD 40 billion between 2013 and 2023, with about 50% occurring between 2021 and 2023 (Lambert und Turner 2024). This figure however includes project development cost (e.g. for the development of project design documents). This means that not the entirety of these flows will reach stakeholders in the country of project implementation.

While in its initial years technology-based mitigation projects such as abatement of non-CO_2 gases in industrial processes, renewable energy and increasing energy efficiency made up most VCM projects, this changed in recent years. The focus of buyers shifted to projects that generate carbon credits by avoiding emissions from lands and ecosystems and by enhancing their carbon storage function. This shift is also visible in investment patterns. Of the more than 40 billion in capital expenditure between 2013 and 2023, about 54%, or USD 23 billion, has been channelled to these types of projects (Lambert und Turner 2024). Among these, investments mainly focussed on three project sub-types: afforestation/reforestation, reducing emissions from deforestation and forest degradation (REDD+) and improved forest management (IFM). Other sub-types such as peatlands and avoided conversion of grasslands received around USD 0.1 billion each over 2013-2023. Blue Carbon projects also played a small role, with investments amounting to around USD 0.5 billion over the same time horizon (Lambert und Turner 2024).

While investment in nature-based projects increased, the emission impact of these projects is often uncertain. Rating agencies which assess the risk that carbon credits generated by a specific project do not represent one tonne of removed or reduced CO_2e have put more nature-based projects in their highest risk category than for any other project type (Calyx Global 2024).

The low ratings for many nature-based projects mirror the findings by many studies that have pointed to issues with the quantification approaches applied in these projects (West et al. 2023; Haya et al. 2023; Probst et al. 2024). Additionally, these projects imply a high risk that the emissions avoided or carbon stored will be reversed at a later point in time due to natural disturbances or human activities (Schneider et al. 2024).

Carbon credits and their use for offsetting claims are subject to intensive public scrutiny. This is because if these claims are backed by carbon credits that have a high risk to not represent a tonne of removed or reduced CO_2 this will lead to higher overall atmospheric emission levels and thus undermine the environmental integrity of carbon market mechanisms (Schneider und La Hoz Theuer 2019). Next to scientific scrutiny, offsetting claims also increasingly became subject to lawsuits revolving around the question whether their use for climate neutrality claims on product level misleads consumers. Using carbon credits for offsetting claims is therefore increasingly associated with reputational risks.

Uncertainty around the robustness of offsetting claims made using carbon credits also lead to a contraction on the VCM. Transaction volumes declined by 56% between 2022 and 2023, and the market's value dropped to USD 723 million from a peak of USD 2.1 billion in 2021 (Ecosystem Marketplace 2024).

2.1.2 Revenues from carbon credits used for climate contribution claims

While it has been their predominant use case in the past decade, carbon credits cannot only be used for offsetting claims. Organisations can also use them in the context of contribution claims. In this form of claims, organisations communicate that they contribute to climate mitigation without claiming that the organisation itself or one of its products is "climate neutral". Instead, they communicate that they contributed towards the efforts to reach climate neutrality on a global level. There are different approaches for organisations to determine the size of their contribution for any given year (see Haase et al. forthcoming for a detailed discussion on the different approaches):

1. **Tonne-for-tonne:** In this approach, an organisation links the size of its climate contribution to the size of its remaining emissions in that year. Organisations usually express this in percentage of their remaining emissions. This can be any figure below or above 100%. Some organisations such as the VCMI define thresholds on the minimum share of the remaining emissions that must be used for determining the contribution to receive respective contribution claims labels (Voluntary Carbon Markets Integrity Initiative (VCMI) 2023).
2. **Money-for-tonne:** In this approach, an organisation sets itself an internal carbon price and multiplies it with its remaining emissions to determine the size of its contribution. Existing guidelines recommend setting such carbon prices at a level of at least USD 100-250 per tonne (Fearnehough et al. 2023; Kreibich et al. 2024). Another reference value could be the social cost of carbon, for which the German Environment Agency, using a discount rate of 1%, currently recommends using a value factor of EUR 300 per tonne of CO_2 (Matthey et al. 2024). The SBTi on the other hand suggests a price of USD 10 per tonne of CO_2 (SBTi 2024).
3. **Money-for-money:** In this approach, the organisation uses a financial metric such as a percentage of its revenue to determine the size of its contribution. Different than in the other two approaches, this approach does not link the contribution to the organisations emissions but to its financial capacity in any given year.

In each of the three approaches, organisations can use carbon credits as a vehicle for making their climate contribution. In the tonne-for-tonne approach, organisations would purchase carbon credits equivalent to the self-determined share of the remaining emissions. In the money-for-tonne and money-for-money approaches, the amount of carbon credits that organisations purchase is determined by the size of the financial budget calculated under each of the two approaches.

Major certifiers of climate-related labels such as SouthPole, MyClimate or Climatepartner stopped offering a "carbon-neutral" label for products and instead introduced labels based on GHG-related contribution claims (myclimate 2023; South Pole Group 2023; ClimatePartner 2024). Others, such as the Gold Standard, the World Wildlife Fund (WWF), Carbon Market Watch and Climate Action Network International have also introduced contribution claim models or voiced their support (Schallert et al. 2020; Gold Standard 2024; Carbon Market Watch 2020; Climate Action Network 2021). This might suggest that the VCM as a whole may move towards this alternative approach to offsetting in the future.

2.2 Funding from climate contributions using modalities other than carbon credits

Organisations can also use modalities other than carbon credits for making their climate contributions. This applies mostly to organisations using the money-for-tonne or money-for-money approach to determine the size of their contribution. Other than under the tonne-for-tonne approach, in these two approaches, organisations do not necessarily need the detailed monitoring of the GHG impact of the funded activities, which currently only carbon credits provide. These approaches therefore offer more flexibility on how funding is channelled.

Still, the overarching goal of any climate contribution should be to support progress in decarbonising the world economy. Next to projects that reduce or remove GHG emissions from the atmosphere, guidance on the contribution claim model however also notes that other activities such as supporting the development of new technologies or advocacy work for strong climate regulation can be eligible for climate contribution claims (Fearnehough et al. 2023). They also highlight the role that climate contributions could play for conserving and restoring ecosystems.

While organisations may make climate contributions as individual organisation, they can also pool their individual contributions into funding vehicles such as a dedicated fund to increase the impact of contributions, as this will allow providing funding at a different scale. An example for such an approach is the Milkywire Climate Transformation Fund which pools the climate contributions by Swedish fintech company Klarna and other companies (Milkywire 2024).

2.3 Biodiversity credits

Biodiversity credits aim at commodifying biodiversity for financial mechanisms that provide funding for measured, evidence-based, *positive* biodiversity outcomes that would not have occurred without the incentive provided by these credits. Conceptually, biodiversity credits are related to, but distinct from biodiversity *offsets*, which are a well-established regulatory instrument available to companies under national environmental legislation in many countries to compensate for a loss in biodiversity they cause elsewhere. Biodiversity *offset* markets are mature and generated an estimated USD 11.7 billion in investments in 2023 (UN Environment Programme (UNEP) 2023). Biodiversity credits on the other hand are an instrument for companies to make voluntary contributions to global nature protection and restoration which go beyond their own impact compensation. Many companies use this kind of engagement as a way of corporate image building, marketing, or to increase their employee job satisfaction. It may also have a positive effect on their ESG rating, which in turn can reduce capital cost (Wunder et al. 2024)

While conceptually there is a somewhat clear distinction between biodiversity offsets and biodiversity credits, in practice the terms are often used interchangeably and there are voices that argue that biodiversity credits should be eligible for offsetting purposes. The International Advisory Panel on Biodiversity Credits (IAPB) – an initiative established by France and the UK in 2023 – for example explicitly includes offsetting as a use-case for biodiversity credits, however only on local levels and when respecting the like-for-like principle (IAPB 2024). The latter means that biodiversity gains must comprise the same type of biodiversity attributes that are lost (Maron et al. 2012). Market actors on voluntary biodiversity credit markets however seek to define more generalized units that represent biodiversity gains across different regions and ecosystems (Wauchope et al. 2024). If these types of credits were eligible to comply with offset requirements under a compliance instrument this would risk a departure from the like-for-like principle.

Most of the credits of existing biodiversity credit schemes face further issues that make them unsuitable for offsetting. A systematic assessment of these schemes shows that more than half of the credits issued either purely rely on an action-based approach (i.e. without verifying results) or remain unclear in relating credits to achieved results. Further, they either do not use baselines or baselines are unclear or established by using very flexible approaches. Finally, only 41% of credit schemes require third-party auditing of the biodiversity outcomes (Wunder et al. 2024). These shortcomings reflect that quantification of biodiversity impacts is very difficult. This is particularly true for marine ecosystems, as high levels of uncertainty are involved in any attempt to quantify ecosystem losses and gains (Niner und Randalls 2021). For those credit schemes that feature ex-post verification of outcomes, challenges include limited availability of data for suitable control sites and very long time lags between action and impact (Wunder et al. 2024). An example of a Blue Carbon related biodiversity credit scheme with a more elaborate data-driven approach to crediting are the OpenEarth Foundation's Marine Ecosystem Credits (see Box 1).

The market size of voluntary biodiversity credits is currently very small. Estimates suggest that as of October 2024, less than USD 1 million worth of credits have been purchased through existing biodiversity credit schemes (Bromley 2024).

Box 1. OpenEarth Foundation Marine Ecosystem Credits

Under its Ocean programme, the OpenEarth Foundation developed a concept for a class of biodiversity credits specifically tailored for supporting the protection and restoration of ocean ecosystems. The concept covers different types of credits, including marine biodiversity, Blue Carbon, and marine plastic credits. The ambition for the marine biodiversity credits is to build a global scale credit. For this, the concept proposes to use one square-kilometre of ecosystem protected as its base unit. The number of credits issued per square-kilometre would be adjusted by modulating factors that consider the value of the conserved area, the richness of the biodiversity, the number of marine habitats included as well as the vulnerability and endemism of the species present. Another feature of the proposed credits is that they would account for the scientific uncertainty in the measurement for any of the metrics used for quantifying the impact of the proposed intervention on biodiversity. This uncertainty would be re-evaluated for every verification. Credits that hold an uncertainty level of over 60% would not be allowed to be issued. The overall robustness of this approach will depend on the detailed methodological requirements for each credit type which are not available yet. It highlights at the same time the importance of considering science-based metrics for measuring biodiversity impacts as well as properly accounting for the uncertainty associated with each metric.

Source: Source: (Margaux et al. 2022).

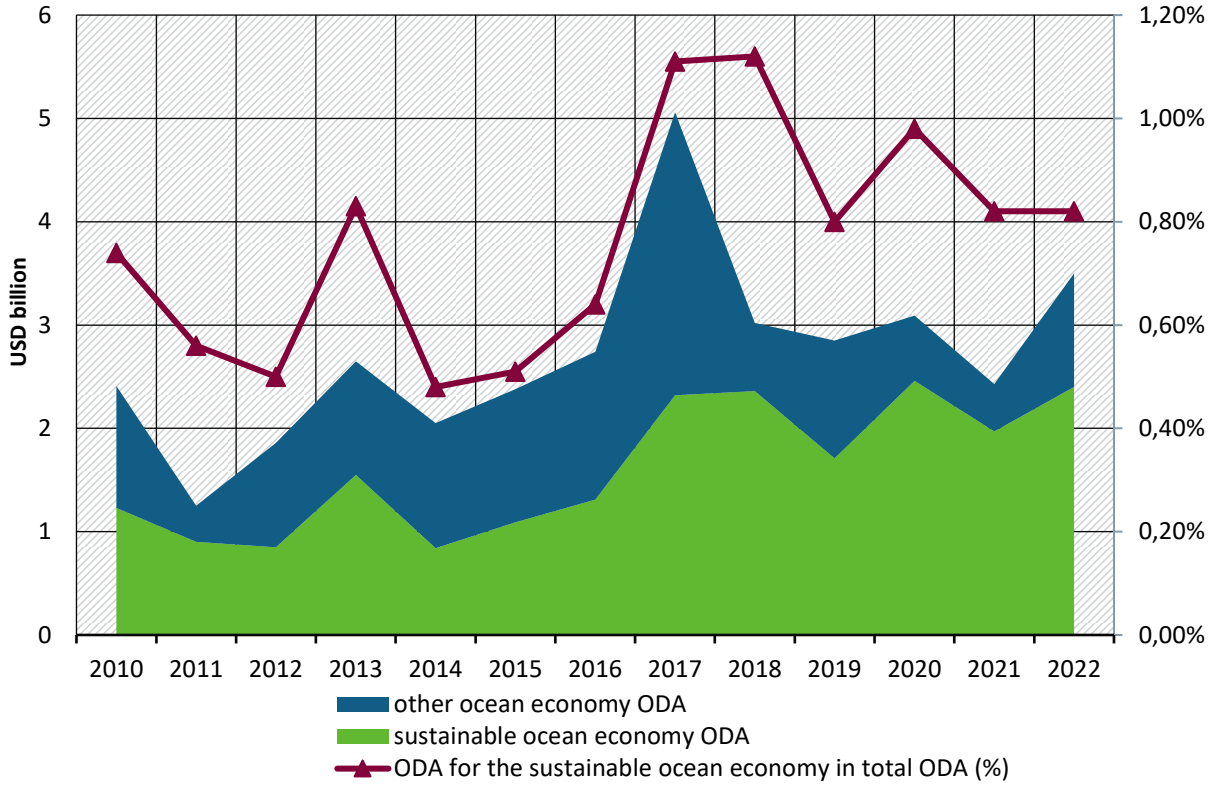
2.4 Bilateral and multilateral development cooperation

Official Development Assistance (ODA) flows that target Blue Carbon projects are comparatively small. The exact volume of these flows is difficult to determine because available ODA statistics are not sufficiently granular to quantify flows that target coastal ecosystem conservation and restoration. A look at available indicators that are related to this objective can however give a broad overview on the current state of flows.

An aggregated indicator which the OECD tracks are flows that target the "Ocean economy", which is further disaggregated into flows targeting the "sustainable ocean economy" and "other ocean economy". In 2022, ODA flows of about USD 3.5 billion targeted the Ocean economy. This

is less than 1% of all ODA flows extended during that year. About USD 2.4 billion of these flows had a sustainability objective (see Figure 1).

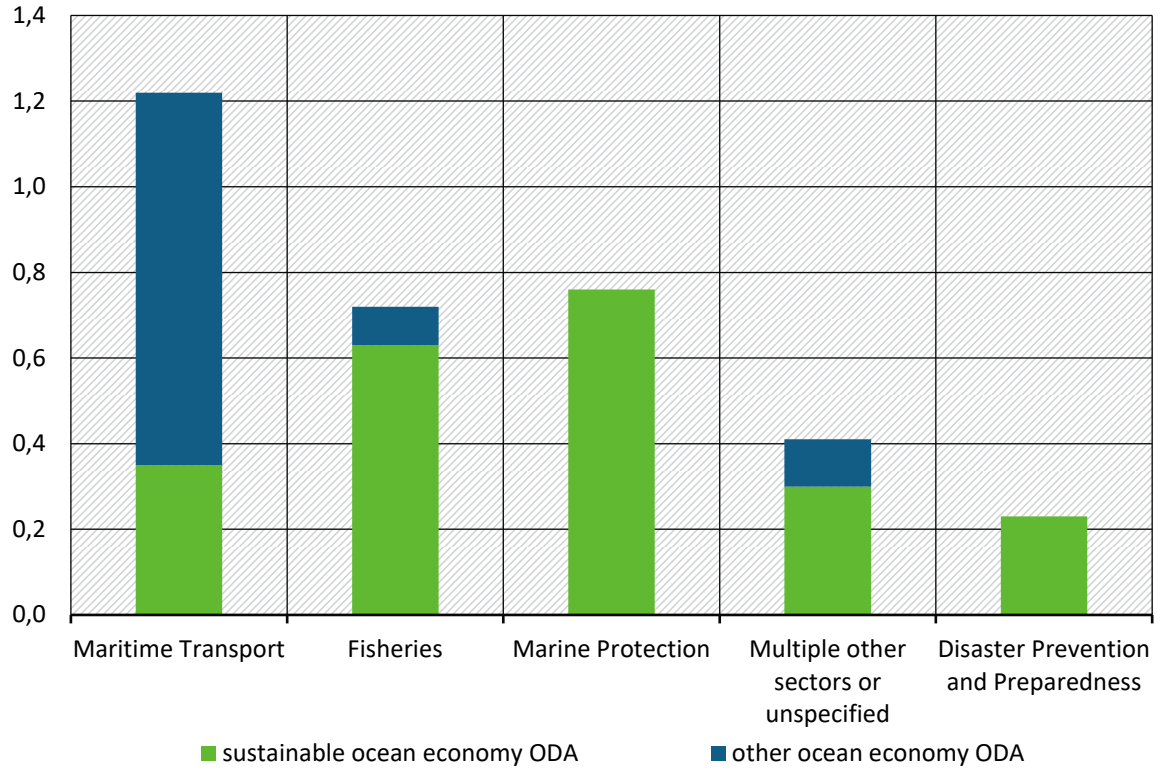
Figure 1: Time series of ODA flows targeting the Ocean economy.



Source: OECD (2024) - Data Platform on Development Finance for the Sustainable Ocean Economy.

Further indicators, such as ODA flows for the ocean economy disaggregated by sector, show that in 2022, the largest share of flows targeted cooperation around maritime transport. Most of these flows did not have a sustainability objective. The most relevant sub-sector for Blue Carbon projects is marine protection. In 2022, about USD 0.76 billion of ODA flows were targeted at this sub-sector (see Figure 2). However, it is likely that only a fraction of the flows targeting marine protection support Blue Carbon projects, as this category also includes programmes and projects that reduce marine pollution, which is a popular project type among donor countries.

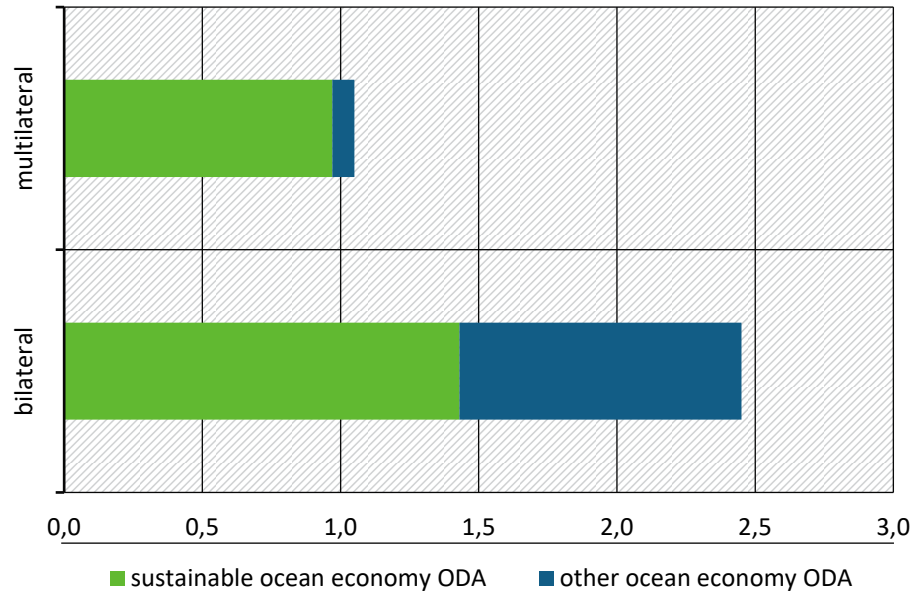
Figure 2: Top 5 sectors receiving ODA for the Ocean economy, 2022 (in USD billion)



Source: OECD (2024) - Data Platform on Development Finance for the Sustainable Ocean Economy.

In 2022, almost two-thirds of ODA flows targeting the Ocean economy were channelled through bilateral instruments. This includes almost all flows that do not have a sustainability objective. ODA flows to the Ocean economy through multilateral channels almost exclusively supported programmes and projects with sustainability objectives (see Figure 3).

Figure 3: Share of bilateral and multilateral flows to Ocean economy in 2022 (in USD billion)



Source: OECD (2024) - Data Platform on Development Finance for the Sustainable Ocean Economy.

There is a comprehensive network of multilateral organisations that support projects related to marine protection. This includes the Global Environment Facility (GEF), the Global Biodiversity Framework Fund (GBFF), as well as the Multilateral Development Banks (MDBs). Further, multilateral funds with a stand-alone climate mandate, including the Green Climate Fund (GCF), the Adaptation Fund, the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF) provide such support as well. Activities that these funds support are largely the same. All funds for example support the conservation and restoration of mangrove habitat and seagrass meadows. The rationale for supporting these activities is however different for each fund, reflecting its specific mandate. The GEF, for example has focal areas for biodiversity and international waters, which specifically support the creation and better management of marine protected areas (MPAs). As of 2025, this support led to the creation of 4.1 million km^2 in new MPAs. The core objective of programmes and projects implemented under these two focal areas is to halt biodiversity loss and contribute to sustainable management of marine ecosystems. The Adaptation Fund on the other hand supports mangrove conservation and afforestation as a solution for countries to adapt to adverse effects of climate change. The focus of these projects is to use mangrove ecosystems as a measure to stop coastal erosion and protect coastal lands from climate induced severe weather events such as storms and floods (see Table 3 in Appendix A). Most mangrove conservation and restoration projects supported by the GCF are also driven by an adaptation objective (see Table 4 in Appendix 1 and Box 2 below).

Box 2. Blue Action Fund

The Blue Action Fund is a small fund (116 Mio € in 2022) providing grants to conservation projects in marine protected areas (MPAs) in Africa, Latin America and Asia/Pacific. Eligible projects are limited to coastal ecosystems. The goals of the funded projects include the conservation of biodiversity or enhanced livelihood conditions and food security. Measurable outcomes are required, projects are supported in newly established or "better-managed MPAs" (Blue Action Fund 2023; Blue Action Fund (BAF) 2023a). One example is the project "Empowering fisher-farmer communities to adopt nature-based solutions, Mozambique". This project is financed by the Blue Action Fund and addresses multiple challenges. The project's strategic goals are to improve MPA governance, create and enhance sustainable livelihoods, contribute to disaster risk reduction and habitat conservation and restoration (Blue Action Fund 2024). The fund receives funding from the Green Climate Fund and several government agencies, including German KfW development bank (Blue Action Fund (BAF) 2023b).

A project's strategic objective matters in terms of the indicators that funds use to measure the outcome of their funded activities. The GCF result managements framework for adaptation projects for example does not include an indicator which measures the tonnes of CO_2e that these projects reduce or remove. The same is true for the GEF, which uses the number of km^2 of MPAs created or under improved management to measure the outcomes of its biodiversity and international water projects. This means that these funds make positive contributions to preserving or enhancing the carbon storage function of mangrove and seagrass ecosystems but treat it as a co-benefit that they do not comprehensively measure and report. These examples highlight that the underlying motivation for conducting mangrove conservation and restoration activities can be manifold. Increasing carbon storage capacities is only one aspect that motivates countries and donors to cooperate in them.

Multilateral funds are well positioned to support Blue Carbon projects as they have several years of experience with mangrove and seagrass conservation and restoration projects. Although they currently do not account for the CO_2e mitigation impact of most mangrove projects, they measure it for other classes of projects. In principle it would be conceivable to adapt the results-

management-frameworks of these funds to capture the CO_2e impact of mangrove projects. This would require robust quantification methodologies and cost-effective measurement approaches. A recent GEF-funded project is the first attempt in the context of a multilateral fund to develop such methodologies for carbon accounting and ecosystem valuation of mangrove forests, seagrass meadows and saltwater marshes (UNEP 2013).

2.5 Domestic public finance

Governments play a central role in financing the conservation and restoration of coastal ecosystems through their national budgets. Allocating funds for measures such as mangrove and seagrass protection and replanting can be motivated by different factors. Coastal protection is a key priority for countries that face rising sea levels and other climate-related risks. Next to coastal defense infrastructure such as seawalls, mangroves provide nature-based coastal protection which can be more cost-effective and resilient over the long term. Mangrove replanting also benefits the fisheries industry, as they provide important nursing grounds for many species. Coastal ecosystems are in most countries considered a public good and their protection and restoration is traditionally funded by state actors (Netherlands Enterprise Agency (RVO) 2022).

A typical way for governments to utilize public finance is the establishment of marine protected areas (MPAs). Contributions to MPAs are made through government budgets either at the level of the federal government, the state government, or the local government. Next to MPAs, governments also use funds to develop integrated coastal zone management plans that incorporate coastal restoration and conservation into broader land-use policies and planning. Furthermore, some governments have introduced environmental taxes or fees specifically earmarked for the restoration of coastal ecosystems. In Fiji and the Seychelles, for example, revenues from environmental taxes on the tourism sector are used as a revenues stream to repay the countries' blue bonds (Fezzi et al. 2023).

Yet, government budgets are usually constrained and only a very limited number of resources can be provided. Any countries with extensive coastal ecosystems may struggle to allocate adequate public funds for restoration, especially if they face competing needs in other sectors such as healthcare, education and infrastructure. Additionally, political instability can also lead to governments not being able to prioritize long-term environmental goals (Sohail et al. 2022; Farooq et al. 2023).

2.6 Philanthropic grants and donations

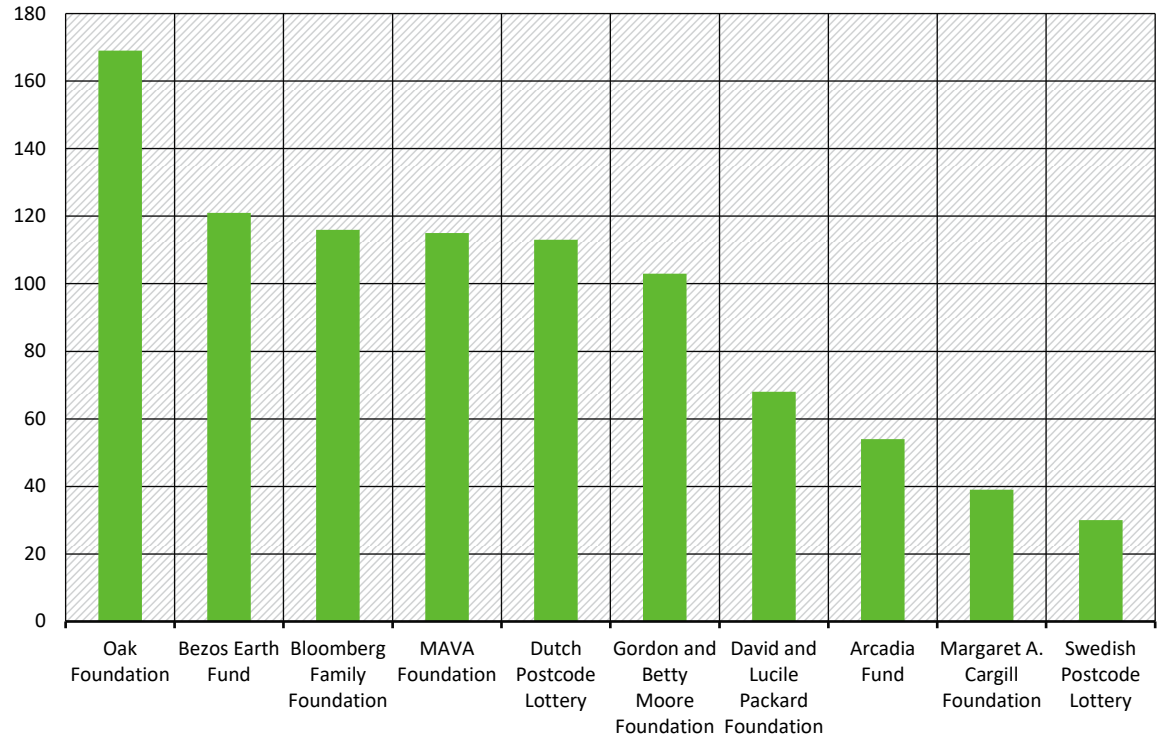
Philanthropic grants and donations are considered as a significant source of funding for mangrove restoration projects. By supporting community-based models and integrating scientific approaches, philanthropy can play a transformative role in advancing Blue Carbon conservation globally (World Bank 2023). Motivation to provide such funds is diverse and includes factors such as a sense of obligation or corporate social responsibility (CSR) reporting (Vanderklift et al. 2019). However, integrating philanthropic and voluntary funding into the broader policy framework to protect Blue Carbon ecosystems is complicated, as the long-term nature of these payments is not always guaranteed.

This type of funding for Blue Carbon projects may come from large philanthropic organizations (see Figure 4). In Latin America and the Caribbean, most funders are from the Global North, with a notable presence of Mexican funders. Funds are extended as grants and often support projects led by international NGOs, highlighting the importance of external funding in driving local conservation efforts (Grimm et al. 2022). On the other hand, some philanthropic funding

supports use of the voluntary carbon market, i.e. either by supporting the project design phase and contributing to overcoming the initial costs to allow projects to obtain revenues on the voluntary carbon market later on. An example for such an approach is the Vida Manglar project in Columbia. A Blue Carbon project located in the Cispatá Bay region of Colombia's Caribbean coast, which focuses on conserving and restoring mangrove ecosystems to mitigate climate change, enhance biodiversity, and support local communities.

Another design model, often listed in the context of philanthropic and voluntary funding, is termed project finance for permanence (PFP). PFP is a relatively new model to finance preservation projects. Projects funded by PFP secure upfront funding from a mix of private, public, and philanthropic sources to roll out preservation projects. Over time, financial responsibility shifts to the host country, ensuring long-term sustainability through state funding and local revenue sources. Projects based on this principle have already been financed in Canada, Belize and Peru, among others. PFPs are often used in the context of payment for ecosystem services (PES). In Bangladesh, PES schemes have been effective in managing mangrove forests sustainably. These schemes, supported by philanthropic grants, integrate participatory mechanisms and third-party monitoring to ensure equitable and efficient resource management (Razzaque, 2017).

Figure 4: Philanthropic contributions to the ocean economy in 2022 (in USD million)



Source: OECD (2024) - Data Platform on Development Finance for the Sustainable Ocean Economy.

2.7 Tourism entry and activity fees

Tourism-related fees are an important tool to fund ecosystem preservation, including particularly mangrove and kelp forests, usually as part of a marine protected area (MPA). The fees charged include simple entrance fees as well as fees for activities such as diving, scientific work or, if permitted, fishing. Visitor fees are often seen as one way to address the issue that many MPAs, though officially established, lack the financial means for adequate management,

boundary marking and enforcement of conservation regulations. In some cases, visitor or entry fees have effectively funded the main part of or even the entire budget of MPAs. For example, the Bonaire Marine Park in the Netherlands Antilles or the Gilotongan Marine Reserve in the Philippines - both of which paid all their operating expenses by raising visitor and activity fees, and even ran a profit. Or the Kota Kinabalu National Park in Malaysia, where visitor fees funded approximately 80% of the operating budget. Brown et al. (2023) found that entry fees had a positive effect on fish biomass in MPAs, suggesting that these fees improved conservation outcomes of protected ecosystems. However, this effect was only significant for MPAs with lower management effectiveness scores.

Estimating all funds raised by visitor fees in MPAs is complicated, as there were more than 16.500 MPAs established worldwide as of February 2025, many of which do not report their income structure. Bohorquez et al. (2023) estimated that the total funding for MPAs was between USD 52–143 billion, with visitor fees probably only contributing a small part.

The willingness to pay (WTP) of tourists for entering an MPA is crucial for the contribution entry fees can make to funding restoration activities. Gelcich et al. (2013) found that in one Chilean MPA 97% of all visitors where willing to pay an entrance fee, with an average WTP of USD 4.35 or USD 3.77. Activity fees for specific ecotourism activities, such as mangrove planting, bird watching, and snorkeling, have been successfully implemented in several regions. These fees are often tied to specific conservation goals, ensuring that the revenue generated is directly used for restoration efforts. A study in Gili Matra, Indonesia assessing the willingness to pay of international tourists, found that they on average would be willing to pay USD 21.46 per visit if these fees are used to support coral reef conservation (Diswandi et al. 2021).

Furthermore, several studies show that tourists and visitors are willing to pay to simply visit these places without extra activity and are willing to pay a premium to visit places with intact ecosystems in general and also with Blue Carbon habitats. In Karimunjawa National Park, Indonesia, tourists demonstrated a high willingness to pay for mangrove ecotourism, with the majority of respondents supporting conservation efforts (Azzahra et al., 2023). A study in Sinjai District, South Sulawesi, found that the annual value of mangrove tourism was approximately USD 32,000, highlighting the economic potential of mangrove ecotourism (Malik et al. 2024).

Box 3. Digital Payment Gateway for Tobago Cays Marine Park (TCMP) St. Vincent and the Grenadines

As part of the Sustainable Marine Financing Project, the Tobago Cays Marine Park (TCMP) introduced a digital payment system for tourism entry and mooring fees—enhancing revenue collection, transparency, and visitor management. Previously reliant on daily in-person cash collection by rangers, the system now allows visitors to prepay online through the TCMP website. Users input their vessel and trip details, review park rules, and receive a digital receipt with a QR code, which rangers verify upon arrival. The TCMP PAY system has modernized park operations by reducing cash handling, improving data collection for targeted outreach, and supporting financial accountability. This innovation might help to ensure that tourism revenues directly support conservation of critical habitats such as coral reefs, turtle nesting sites, and mangroves. The initiative was implemented with support from GIZ under Germany's Federal Ministry for Economic Cooperation and Development.

Source: (GIZ 2024).

Raising funds through visitor fees is not without problems, however. Most MPAs do not have easily defined exit and entry points at which the fee could be collected. Furthermore, tourism is

volatile and fluctuates with political stability, natural disasters and the world economy while preservation work needs constant funding. The social acceptance of a visitor fee could also be an issue, as some might believe that access to natural areas should be free of charge for everyone. However, acceptance can be greatly increased by making visitors aware that the revenues are meant for the operation of the MPA. Visitor fees will not be able to raise enough funds to finance the whole operation cost in most MPAs, as the WTP is too low. They can contribute, however, to diversifying income streams and reduce the management's reliance on domestic and international donors.

2.8 Debt-for-nature swaps

Debt-for-nature swaps (DNSs) are financial mechanisms in which creditors, typically from developed countries, agree to cancel external debts in return for the debtor commitment to biodiversity conservation or economic decarbonization. Those commitments could take many forms, including funding environmental projects within the country or, as is becoming more prevalent, designating new marine protected areas (MPAs) (Ochiolini 1990; United Nations Development Programme 2017).

The idea of DNS was first introduced by Thomas E. Lovejoy in an article in The New York Times in 1984 and the first DNS was signed in 1987 between Bolivia and a US-based environmental group (Lovejoy 1984). By 2017, the United Nations Development Program (UNDP) estimated that USD 2.6 billion was restructured by DNS, resulting in USD 1.2 billion in funding for conservation projects. The debt restructured by DNSs has since increasingly been used to create MPAs and investments in maritime preservation. As of 2024, DNS were used to create MPAs in Belize, the Seychelles, Barbados, Gabon and Ecuador. 2021 and 2023 saw the biggest DNSs to date with a DNS for USD 553 million in Belize in 2021 and one for USD 1.53 billion in Ecuador in 2023. All proceeds from the DNS in Belize were allocated to the blue economy, committing among other things to protecting 30% of its ocean territory by 2026. The protected area includes ecosystems like seagrass meadows, mangrove forests, and reefs (Xiaoyi und Hao 2024).

However, DNSs are not without their problems: potential corruption or political instability in the debtor country might call its commitment to the agreed-upon sustainability projects into question. In addition, the scope of the DNS completed to date is not nearly enough to solve the debt or climate adjustment problem in developing countries and even though the last years saw the largest DNSs to date, it is unlikely that DNS will ever address these problems on a meaningful scale. The World Economic Forum (2024) estimates that DNSs could free up USD 100 billion whereas the International Monetary Fund projects that mitigating climate change will require annual investment of at least USD 3-6 trillion. The combined potential of all DNS could fund a maximum of one thirtieth of the funds that are needed each year by 2050 (Ehlers 2022).

2.9 Blue bonds

Based on the concept of green bonds, blue bonds serve as a financial instrument to generate funds for investments in the blue economy in the broadest sense, including also marine preservation projects and therefore BC ecosystem projects. In general, blue bonds are similar to normal bonds in that they are debt instruments issued by governments or other actors, with the difference that the money raised must be invested in sustainable marine and maritime projects. As with normal bonds, the debt is repaid with interest, meaning that the investor expects a financial return, and due to the nature of the projects invested in, an environmental return can also be expected. Blue Bonds are thus a way for the private sector to invest in and profit from the blue sector, while at the same time serving as an instrument to raise the funds to support sustainable ocean development.

They are seen as a useful tool in the broad category of green finance because many developing island and coastal countries are uniquely vulnerable to the effects of climate change, particularly rising sea levels and more extreme weather events (KPMG 2023). In addition, these countries are often highly dependent on tourism and maritime industries such as fishing. Healthy oceans with high biodiversity are essential for both, but this foundation is increasingly threatened by climate change. Since developing countries can rarely finance adaptation from their own budgets, Blue Bonds provide the means to generate the funds for these projects.

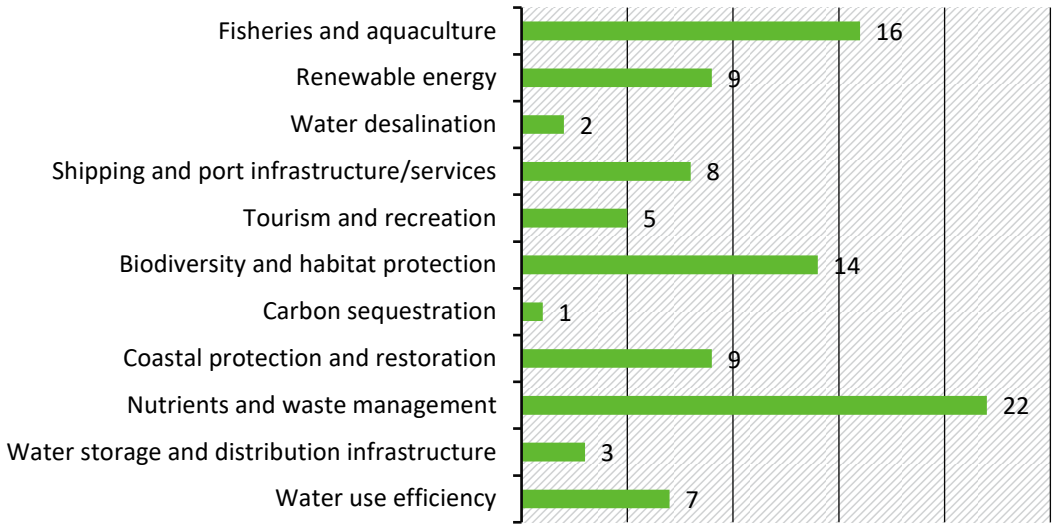
The world's first sovereign blue bond was issued by Seychelles in 2018, raising USD 15 million. These were invested in the expansion of the Seychelles' marine protected areas, sustainable fisheries, and the development of the Seychelles' blue economy. In 2023, as the first Pacific Island nation, Fiji issued a USD 8.7 million blue bond. Parts of the proceeds will be used for building nature-based seawalls (Government of the Republic of Fiji 2023). There was great interest in the bond, with total bids being three times as high as the issued amount (Fiji One News 2023).

Since 2018, the blue bond market grew rapidly to more than USD 2.8 billion in 2023 for a cumulative size of USD 7.2 billion estimated by Bloomberg (White 2024). Though this only captures a fraction of the green bond market, which in 2023 had a volume of USD 870 billion and a cumulative size of USD 4.4 trillion. The median value of 26 blue bonds issued between 2018 and 2022 was USD 123 million. This is smaller than in the green bond market where the median value of a deal was USD 500 million in 2021. Most blue bonds have been issued in United States Dollars with the Euro currently being underrepresented in the market. Among the 26 bonds issued between 2018 and 2022, 14 have been issued by international financial institutions (such as the World Bank or the Asian Development Bank), seven by private corporations and banks, two by environmental organisations and a further two by governments or domestic financial institutions (Bosmans und Mariz 2023).

The International Finance Corporation (IFC), part of the World Bank Group and the Asian Development Bank (ADB), broadly defines eight project categories in which blue bond funds can be invested, although it does not present this list as exhaustive. These categories are: Coastal Climate Adaptation and Resilience; Marine Ecosystem Management, Conservation and Restoration; Sustainable Coastal and Marine Tourism; Sustainable Marine Value Chains; Marine Renewable Energy; Marine Pollution; Sustainable Ports; and Sustainable Maritime Transport (Asian Development Bank / International Finance Corporation 2023).

According to the IFC, blue bonds play an increasingly important role in the funding of Blue Carbon projects (International Finance Corporation 2023). These mainly include the conservation and restoration of mangrove forests, saltmarshes and seagrass meadows. Carbon sequestration has however played a niche role when it comes to the thematic areas for which blue bond proceeds have been used. In the subset of 26 blue bonds issued between 2018 and 2022 assessed by Bosmans und Mariz 2023, only one bond specifically mentioned carbon sequestration. At the same time most bonds mentioned waste and water-waste management as well as sustainable fisheries and aquaculture as thematic areas into which bond issuers will invest bond proceeds (see Figure 5).

Figure 5: Thematic areas of use of proceeds for 26 blue bonds issued between 2018-2022



Source: Replicated from Bosmans und Mariz 2023, page 12.

As a relatively new concept, blue bonds face several challenges. First, eligibility requirements are not yet standardized, which increases the potential for "blue washing" and makes it difficult for investors to determine whether an issued blue bond is legitimate. For example, it is currently debated whether water and sanitation projects are part of the blue economy and can therefore be financed by blue bonds. Moreover, issuing blue bonds is relatively complicated, which is why smaller countries, especially developing countries, are usually able to do so with the help of multilateral development banks such as the World Bank. But if their green counterpart is any indicator, they can be expected to play a major role in the future of the blue economy, especially in developing countries.

As a subset of blue bonds, mangrove bonds are emerging as an additional mechanism to finance large-scale mangrove restoration and protection, particularly in urban and coastal settings where mangroves provide critical ecosystem services, such as storm surge mitigation, water filtration, and carbon sequestration (see box 4).

Box 4. Mangrove Bonds

The “M40 initiative” exemplifies a collaborative initiative in the mangrove bonds space. It seeks to increase the participation of private sector investors (banks, investors, re/insurance, corporates) in the restoration and protection of coastal ecosystems through the development of innovative mechanisms that engage the catalytic capital of DFIs and foundations. Concrete investment proposal includes the *Municipal Mangrove Bond Fund* which aims at pooling city-level investments into a blended finance vehicle capable of supporting both conservation and climate adaptation infrastructure (Earth Security 2021). The proposal builds on the *Miami Forever Bond*, a USD 400 million climate resilience bond passed by voters in 2017. While not exclusively dedicated to mangroves, this bond includes funding for green infrastructure and coastal protection projects, including mangrove restoration in Miami’s urban shoreline. Similarly, in Australia, coastal councils and state governments have begun exploring blue bond structures to support mangrove reforestation as a means to buffer urban communities from sea-level rise and extreme weather.

The M40 proposal envisions a hybrid repayment model combining public and private funding sources, including the monetization of mangrove carbon sequestration through voluntary carbon markets – effectively linking municipal bond finance with carbon credit revenues.

Source: (Earth Security 2021).

3 Advantages and disadvantages of carbon credits compared to other financing instruments

In this section, the advantages and disadvantages of carbon credits compared to other funding instruments are discussed. The discussion is structured along six aspects which play a role in determining the suitability of the instrument to raise funding for coastal ecosystem conservation and restoration activities.

3.1 Maturity

One important aspect for comparing advantages and disadvantages of carbon credits compared to other funding options is the maturity of the funding source. Here, the report conceptualises the **maturity** of a funding source in terms of the extent to which it is established, operational, and familiar to stakeholders involved in coastal ecosystem protection and restoration. This includes three main dimensions: (1) the **historical use** of the funding source—whether it has been employed for decades or is a relatively new innovation; (2) the **development and institutionalization** of mechanisms for delivering funds—such as established channels and regulatory frameworks for dedicated financial instruments; and (3) the **experience and familiarity** of implementing actors—such as national park services, local communities, and conservation NGOs—with accessing and managing resources from the funding stream. A mature funding source is thus generally characterized by a well-documented track record, clear implementing structures and governance arrangements, and widespread stakeholder competence in its use.

Blue Carbon activities have received funding via carbon crediting mechanisms since 2011 when the first Blue Carbon certification methodologies were available under the CDM and the VCS. Currently, there are four carbon crediting programmes that offer registration for Blue Carbon projects on the voluntary carbon market (Climate Action Reserve, Gold Standard, Plan Vivo and the Verified Carbon Standard (VCS)). While 17 projects were registered as of September 2024 (with the majority of 11 projects being registered under the VCS), 55 Blue Carbon Projects were under development, either in the project pipeline of Plan Vivo or of the VCS. All but one of these projects take place in mangrove ecosystems (Jennerjahn et al. 2025).

Transactions of carbon credits from Blue Carbon projects only make up less than one percent of overall transactions on the voluntary carbon market. Challenges related to quantifying the mitigation impact of Blue Carbon projects are an obstacle to rapid growth of such projects in the voluntary carbon market. However, interest in this project type is increasing (see Friess et al. 2022). Overall, there is more than a decade of experiences available with using carbon credits as an option to fund mangrove restoration or conservation as specific types of Blue Carbon activities. While crediting methodologies and associated crediting programmes are generally well established as mechanisms for delivering these funds, challenges remain related to quantifying mitigation impacts from Blue Carbon activities, particularly for saltmarsh or seagrass restoration projects. This may cause challenges in applying certification methodologies by project developers and raises concerns related to the integrity of resulting carbon credits, limiting the maturity of carbon credits as a source of funding for Blue Carbon activities. Additionally, complex property rights in coastal areas and unstable policy environments pose challenges for the implementation of projects funded via carbon markets (Vanderklift et al. 2019).

The degree to which implementing actors are familiar with accessing and managing funding provided via carbon credits varies. National Park services for example, may lack technical

expertise in carbon accounting and carbon markets, hindering their active participation in Blue Carbon projects without comprehensive capacity building programmes. Local communities, while essential stewards of coastal ecosystems, may face challenges related to limited awareness of Blue Carbon services and insufficient capacity to engage in carbon credit mechanisms as well (Rifai et al. 2023). Conservation NGOs typically play a pivotal role in bridging these gaps by providing technical support, facilitating capacity-building initiatives, and ensuring that Blue Carbon projects build on strong involvement of local communities. Successful examples, such as the Mikoko Pamoja project in Kenya, demonstrate the potential of community-led mangrove conservation linked to carbon markets, highlighting the importance of integrating local knowledge and ensuring that financial benefits reach vulnerable communities.

Climate contributions using other approaches than carbon credits as a relatively new concept is a less mature funding option than carbon credits for Blue Carbon activities. This is because adoption by potential private funders is still in the early stages. Consequently, no standardised framework is available for channelling funding through climate contributions. **Biodiversity credits** are also less mature than carbon credits due to the challenges associated with quantifying biodiversity benefits for marine ecosystems, setting baselines and verifying results. Consequently, their market size is still rather small (see section 2.3). **Debt-for-nature swaps** have increasingly been used to fund MPAs in recent years. While the concept is mature, various implementation challenges include complex negotiations, lacking standards, weak governance structures in debtor countries and limited oversight (Simeth 2025). Such challenges limit the extent to which DNS can be considered a well-established funding source. **Blue bonds**, a subset of green bonds, are an emerging financial instrument aimed at funding marine conservation. While they are gaining popularity, their maturity is still developing due to a lack of standardized eligibility requirements and complex processes for issuing and implementing such bonds.

Development cooperation is a mature funding option since there is a long history of funding environmental projects, including coastal conservation. A well-established system of institutions is in place for channeling bilateral resources to recipient countries, including bilateral development cooperation agencies. Additionally, development funding to Blue Carbon activities is provided through multilateral organisations. **Philanthropic grants** similarly constitute a mature funding option as they have been instrumental in environmental conservation of marine and coastal ecosystems in the past years. **Tourism-related fees** have been successfully used to fund marine conservation in some areas. The maturity of this funding source depends on the stability and attractiveness of the tourism sector, which can be affected by global events and environmental and political conditions.

While in general, **domestic public finance** for Blue Carbon activities is a mature funding source, funding flows are also variable, depending on national priorities and economic conditions. Developing countries have established Marine Protected Areas as a well-established approach to protect coastal ecosystems for several decades. Yet, while some countries allocate funds for marine conservation, others may lack the necessary financial resources or political will.

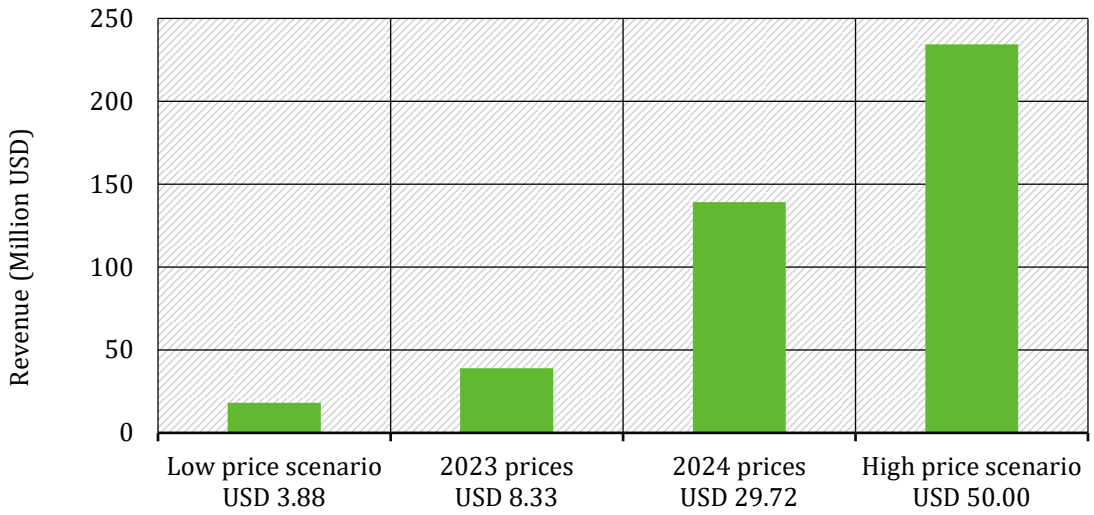
3.2 Scalability of financial flows

Proponents of carbon credits often highlight their scalability compared to public funding sources like development cooperation. Since buyers in voluntary carbon markets are primarily private-sector actors, these revenue streams are not constrained by national aid budgets or public expenditure limits.

Currently, Blue Carbon credits account for less than 1% of historical issuances on voluntary carbon markets. This might change, as over 50 projects are now under development. Despite this emerging pipeline, few studies have attempted estimates of the global revenue potential of Blue Carbon. One such study, focusing solely on mangrove conservation, estimated annual returns of up to USD 3.7 billion at a carbon price of USD 9.4 per tonne CO_2e. Achieving this would require projects covering 1.3 million hectares (Mha) of mangroves—roughly one-tenth of the current global mangrove area of 14.8 Mha (Zeng et al. 2021; Leal und Spalding 2024).

At present, reaching this scale of revenue seems unlikely in the near to medium term as the pace of project development is still relatively slow. For instance, as of September 30, 2024, the Verified Carbon Standard (VCS) methodology VM0033 – currently the methodology with the largest pipeline of projects under development – lists 22 projects under development. These are projected to generate a combined 4.7 million carbon credits annually, all from mangrove ecosystems. Depending on carbon prices, total annual revenues from these credits could range between USD 18.2 million and USD 234.3 million (see Figure 6). Price scenarios to determine this revenue range include recent market prices, a low-price estimate based on broader market trends, and a high-price projection modeled along estimates for Blue Carbon price developments provided by the International Finance Corporation (IFC).

Figure 6: Potential annual revenues of all projects currently developed under VM0033 under different price assumptions



Source: Estimated annual emission reductions and removals retrieved from VCS registry as of 30 September 2024. Carbon price assumptions are based on (Ecosystem Marketplace 2024) for the low price and 2023 prices scenarios, (Ecosystem Marketplace 2025) for the 2024 prices scenario and (International Finance Corporation 2023) for the high price scenario.

There are several observations to make from these figures: First, with an average price of USD 29.72 per carbon credit, Blue Carbon projects in 2024 fetched the highest prices among all nature-based project types transacted in the voluntary carbon market. Second, the volume of transacted credits remains low and decreased by 54% in 2024 compared with 2023 levels. Third, the average price at which Blue Carbon credits are transacted increased by about 257% from 2023 levels (Ecosystem Marketplace 2025), suggesting that demand might outweigh supply for these credits and that the low-price scenario therefore currently is not a likely course of price development for this project type. Fourth, even under the high-price scenario, the number of projects would need to increase at least tenfold to approach the USD 2.3 billion in annual investment returns projected by the study above.

The IFC highlights the difficulty to reach scale in individual projects as a major impediment to scaling global funding flows from Blue Carbon projects (International Finance Corporation 2023). Most projects in the VM0033 pipeline confirm this finding, as they are small to mid-sized projects with average estimated annual issuances ranging from 258 to 196,274 t CO_2e. There are however three projects in the pipeline with much larger estimated annual issuances which indicates, that scaling of Blue Carbon projects might be possible (see Table 1). The Delta Blue Carbon 2 project, a mangrove restoration, rehabilitation, and conservation project in the Indus Delta in Pakistan, for example, estimates annual issuances of 2 million credits per year. Applying 2024 price levels, this would translate into annual revenues from carbon credits of USD 60 million, while it could reach USD 100.6 million under the high-price scenario.

The three projects shown in Table 1 together make up 83% of estimated annual issuances under the VM0033 pipeline. Considering this, around 35-40 projects with a similar size as these three projects could be sufficient to reach the USD 2.3 billion in annual investment returns under the high-price scenario. As price volatility is high in carbon markets, it is difficult to predict which scenario would be the likely course of action. External factors such as consumer perception of the integrity of these credits and the development of future demand will have a strong influence on whether the 2024 price levels will sustain going forward. The figures presented here should therefore be interpreted with caution. They illustrate however that under current price levels carbon credits could raise considerable levels of funding and that it is likely that there is still an untapped potential to further scale revenues for coastal ecosystem protection from these projects.

Table 1: Estimated annual emission reductions of the three largest projects in the VM0033 pipeline and range of the remaining projects

Verra Project ID	Name	Country	Estimated Annual Emission Reductions tCO2e
2842	Restoring Mangroves in Mexico's Blue Carbon Ecosystems	Mexico	868,302
5063	Delta Blue Carbon 2	Pakistan	2,013,864
5023	Kupu-Kupu Project - Enhancing Livelihoods through Mangrove Restoration and Silvofishery in South Sulawesi	Indonesia	1,045,496
n/a	Remaining 19 projects in VM0033 pipeline	Various	258 – 196,274 (range)

Source: VCS Registry, Information as of 30 September 2024.

The scalability of other funding sources is equally complex as for carbon credits. In terms of volume, a main source currently supporting restoration and conservation of costal ecosystems is **bilateral and multilateral development cooperation**. Most of these flows are extended in form of Official Development Assistance (ODA). Between 2019 and 2023, overall ODA flows have increased by 33% in real terms (OECD 2025), showing that in principle governments have capacities and are willing to allocate more resources towards multilateral cooperation. Much of this increase has however been driven by responses to the COVID-19 pandemic and increasing aid flows to Ukraine after 2022. Nonetheless, ODA funding trends in recent years have increasingly favoured climate change adaptation and mitigation projects. Coastal ecosystems'

contribution to these climate themes is now much better understood, which can renew and increase donor interest in these projects in the future.

However, there are many factors that make the scalability of ODA flows for Blue Carbon projects uncertain. First, the global economic outlook continues to be uncertain and inflation, fiscal constraints and shifts in geopolitical priorities could reduce or reallocate ODA in the coming years. The OECD estimates that global ODA flows will decrease by 9-17% from 2024 to 2025 (OECD 2025). Second, competition for ODA resources likely becomes more severe in the future with Blue Carbon projects having to compete with other pressing needs such as poverty reduction, health crises or education. Third, with increasing competition, donor countries may be increasingly focussing on projects that align with measurable results. Blue Carbon projects might however be well positioned in this regard as they provide an opportunity for more comprehensive carbon accounting. However results of Blue Carbon projects only materialize over a long-time horizon and emission estimates are associated with uncertainties. Saplings planted in mangrove or seagrass restoration projects take a decade or more until they are fully grown. Project results therefore might materialize outside the time horizons many donor countries may seek for their ODA flows.

Domestic public finance faces similar constraints, with many governments operating under tight fiscal conditions and high debt levels. **Philanthropic grants and donations**, on the other hand, present a more promising outlook. Foundations and donors increasingly prioritize climate and biodiversity, and Blue Carbon project's co-benefits, such as biodiversity conservation, fisheries support, and coastal protection, can appeal beyond carbon metrics alone. **Climate contributions** using money-for-tonne-approaches could raise significant funding flows, considering that respective guidance recommends applying internal carbon prices ranging from USD 100-250 and up to EUR 300 to determine the size of contributions. These levels are much higher than the high-price scenario for carbon credits.

Compared to green bonds, the **blue bond** market is still nascent. The green bond market took around a decade to reach mainstream status. If the blue bond market would follow a similar trajectory, it would have the potential to mobilise resources at scale for coastal ecosystem protection and restoration measures. Resources could potentially surpass revenues from carbon credits. Current projections estimate that if the blue bond market indeed follows the trajectory of the green bond market it could reach USD 14 billion by 2030 (Stefanova et al. 2024). However, only a portion of their proceeds will go toward Blue Carbon-specific projects, so their relative scalability may be similar to that of carbon credits. If for example 1.5 % of the estimated USD 14 billion by 2030 would be allocated to Blue Carbon related activities this would amount to about USD 2.1 billion.

Debt-for-nature swaps, in theory, have high scalability potential – especially given current sovereign debt pressures in many coastal countries. Researchers have estimated that about USD 105 billion of external public debt has the potential to be swapped for nature and climate through a global initiative supporting such swaps (Patel 2022). Application of debt-for-nature swaps however remains limited to date with the value of swaps performed since 2020 being approximately USD 3 billion (Nedopil und Sun 2025). As with blue bonds, the overall scalability will depend on the amount of proceeds that will be allocated towards Blue Carbon related initiatives. But the instrument also faces significant implementation and negotiation hurdles such as high fees for specialist to structure such swaps.

Tourism entry and activity fees, by contrast, are inherently limited by the carrying capacities of ecosystems and tourists' willingness to pay. Nonetheless, research into six marine protected areas found that some could potentially could increase tourism-based income by several million

dollars per year (Bohorquez et al. 2023). While effective in certain areas, there are no studies available assessing scalability potential on a global level.

In summary, in terms of scalability, carbon credits likely perform better than some of the other financing sources such as domestic public finance and ODA. Other sources such as blue bonds and debt-for-nature swaps might, however, match or surpass the scalability potential of carbon credits.

3.3 Predictability and stability of financial flows

Carbon credits have a long-term investment horizon, which can be an advantage compared to other funding sources such as bilateral and multilateral development cooperation or philanthropic grants and donations. The carbon crediting projects currently developed for the voluntary carbon market have crediting periods ranging between 20-60 years (Jennerjahn et al. 2025). This is significantly longer than, for example, the typical 5–10-year project cycle of activities funded through ODA. While carbon credits therefore in principle can provide a long-term stream of flows, the voluntary carbon market is currently still characterized by a significant degree of fragmentation and high price volatility for certain market segments (Nunes 2024). Price volatility has been a long-standing issue in carbon markets and is often cited as an impediment to project development, for example in REDD+ projects (Pan et al. 2022), which also can challenge their success (Nathan und Pasgaard 2017). It also can threaten the discontinuation of whole portfolios of projects. After the collapse of the CDM market, for example, multilateral organisations such as the World Bank created dedicated purchase facilities to “rescue” carbon market projects which would have had to stop their mitigation activities because carbon credit prices were too low to cover operating expenses (Warnecke et al. 2017). While it is outside the scope of this report to assess the vulnerability of Blue Carbon projects for discontinuation of mitigation activities, it is likely that mangrove restoration projects are particularly vulnerable to price volatility in the first 5-10 years, which involve high expenses for replanting activities. Once mangrove forests have regrown, operating expenses likely decrease significantly and will mainly consist of costs for enforcing mangrove protection and carbon monitoring. **Biodiversity credits** might face similar challenges as carbon credits. Due to the low volume of credits currently traded it remains uncertain how reliable flows through this instrument will be.

Despite the shorter investment horizon, **bilateral and multilateral development cooperation**, on a global level, can create stable flows for coastal ecosystem conservation and restoration projects. Globally, ODA flows have been resilient and grown even in times of global economic recession (OECD 2025). While there is a degree of stability for overall ODA flows, availability of flows for a specific thematic activity may fluctuate. Donor interest in specific areas of cooperation often depends on political and strategic considerations. These may change however depending on the political priorities of the administration holding office. This might also affect availability of ODA flows for Blue Carbon projects in case donor priorities would shift away from climate change and carbon sequestration in the future. On the other hand, there are many strategic reasons to support coastal ecosystem conservation and restoration measures such as replanting of mangrove habitats. They increase resilience of coastlines against coastal erosion, provide important nursery grounds for fisheries and constitute habitat for biodiversity. Besides carbon sequestration, there might be several other reasons why donors likely remain interested in coastal ecosystem conservation and restoration, even if political priorities regarding carbon sequestration change. The same is true for **philanthropic grants and donations**. Funding priorities of foundations can shift overtime. At the same time, measures such as conserving and restoring mangrove and seagrass habitat have attained popularity, besides their benefits with regard to carbon sequestration.

Budgetary contributions from **domestic public finance** are currently the main source of income for many marine protected areas (MPAs). Case studies confirm that, historically, such flows have been a moderately to highly reliable funding stream for MPAs (Bohorquez et al. 2023).

Blue bonds, on average, currently have a medium-term investment horizon. Among the 26 blue bonds issued between 2018 and 2022, maturity ranges between 2-20 years, with the average maturity being 8.9 years (Bosmans und Mariz 2023). Predictability for individual projects can be high in the sense that in most bond issuances, the concrete projects to which the proceeds will be allocated will be included into the bond prospectus. This will give some level of certainty for projects on the amount of funding which they can expect. On the global level, predictability of flows again depends on priorities of governments. As there is not yet a universally accepted taxonomy which defines the type of projects that qualify as "blue", coastal ecosystem conservation and restoration measure compete with other thematic areas such as fisheries and tourism for blue bond allocation. In the Seychelles blue bond, for example USD 3 million were allocated to conservation related activities, while USD 12 million to activities related to the wider Ocean economy such as sustainable fisheries (March et al. 2024).

Debt-for-nature swaps can take a long-term investment horizon. For example, as part of the Belize's debt-for-nature swap, the government will make annual conservation commitments of USD 4.2 million over a 20-year duration via a dedicated Conservation Fund. These annual payments are in addition to a USD 23.5 million of upfront payments to the fund, which are also part of the debt swap (Grund und Fontana 2023). The swap also includes penalties for the government in case payments are not made, likely increasing the stability of flows.

Finally, the predictability and stability of flows from **climate contributions using other modalities than carbon credits** remain uncertain. Whether or not such contributions will more likely follow the short-to-medium term project logic of ODA and philanthropic contributions or take a more long-term approach is difficult to predict. As this form of climate contributions does not necessarily require verification of carbon sequestration before funding is made available, the concept may be more flexible to negotiate funding terms according to preferences and needs of project owners and companies that want to make the contribution.

3.4 Carbon accounting readiness

A unique feature of using carbon credits as a funding mechanism is the comprehensive monitoring required to quantify the climate mitigation impacts of coastal ecosystem conservation and restoration projects. The focus on CO_2e as a metric might increase the emphasis on ensuring mitigation outcomes of a funded activity. Although the conservativeness of existing quantification methodologies in many cases might not be guaranteed (Probst et al. 2024; Haya et al. 2023; West et al. 2020), carbon credits currently are the only funding source that systematically requires detailed measurement, reporting, and verification of greenhouse gas outcomes.

This level of monitoring is driven primarily by the need to issue credits that represent real, additional, and verifiable emission reductions or carbon removals—since these may be used by buyers to offset their own emissions or underpin climate contribution claims using a tonne-for-tonne approach. In contrast, other funding sources typically do not require such detailed climate impact assessments. Climate impact monitoring exists for **bilateral and multilateral development** cooperation, however in a much less granular fashion than for carbon credits. The integrated results management framework of the Green Climate Fund (GCF) for example includes a core indicator under which mitigation projects must report GHG emissions reduced, avoided or removed (GCF 2021). Annual monitoring reports of relevant projects provide such

information, but do not include detailed descriptions on the methodologies used to calculate reported figures. More elaborate information is provided by projects funded under the GCF REDD+ Results-based Payments Pilot. Here, payments are based on the number of emissions avoided and there is a detailed description how such numbers are calculated. Other multilateral funds, which primarily support mangrove restoration activities as a means for enhancing climate resilience do not comprehensively track the effect of these measures on GHG emissions and removals.

The issuance of **blue bonds** will likely be based on taxonomy approaches which define measures that qualify with the "blue" label rather than using detailed carbon monitoring for deciding on the allocation of the bond proceeds. Currently only two thirds of blue bond issuers release impact metrics, an amount which has been identified as an impediment to gain investor trust and confidence (Bosmans und Mariz 2023). More granular reporting on avoided emissions and carbon sequestration could help to further scale the blue bond instrument. As the example of the M40 initiative shows (see box 4 above) there might also be blue bonds that will use carbon credits as an instrument to raise funding for repaying the bonds. In these approaches, which blend blue bonds with carbon credits, detailed monitoring requirements will apply. All other funding sources do not involve monitoring climate impacts at the same level of detail as carbon credits do.

While carbon credits currently are the only source measuring mitigation impacts with high granularity, it must be noted that these measurements continue to be associated with high uncertainties (see section 0). It is therefore difficult to say whether carbon credits perform better in generating mitigation outcomes when compared with other funding sources. Carbon credits undisputable have advanced the scientific understanding about carbon flows in coastal ecosystems, yet further work is required to ensure that the approaches applied for carbon crediting result in conservative estimates which do not overestimate the climate impact of funded activities.

In summary, monitoring and reporting can be costly, and without the financial incentive provided by carbon credit sales, there is limited motivation to invest in high-precision measurement of climate mitigation outcomes. In principle, the monitoring mechanisms developed under carbon crediting can be used under any other funding source and there might be incentives beyond revenues from carbon credits for actors to do so. Multilateral climate funds for example could use more detailed measurements of the climate effect of their funded activities which are implemented for other strategic objectives. This could increase donor interest in these activities. Further, Ministries of the Environment might increase their bargaining position in annual budgetary negotiations if they would be able to present detailed measurements how restoration of protected areas contributes to the climate goals of the country. For tourism entry fees, detailed measurements appear unlikely to be feasible as the cost for these measurements might outweigh the revenues that they can raise. The same might be true for biodiversity credits, as certifying carbon impacts might add significant additional costs while CO_2e is not the main metric of interest for these credits.

3.5 Transaction costs

Using carbon credits as a funding instrument for coastal ecosystem conservation and restoration measures involves additional transaction costs compared with other funding streams that do not measure the carbon benefit of such activities. Transaction costs specific to carbon credits include project development costs, including baseline establishment and determination of additionality, monitoring costs and costs for validation, registration, verification, and issuance, amongst others (see Table 2 for details). There is little systematic research on the share of transaction costs on

overall project costs for carbon credits. Case study research in a small sample of four projects in the tropical forest sector estimated that transaction costs for these projects range between 0.3% to 270% of anticipated income from carbon credits (Pearson et al. 2014). The largest cost categories were insurance, including contributions to pooled buffer reserves for compensation of reversals as well as monitoring costs. Research into offsets from forest projects in the U.S. shows that transaction costs can be between less than USD 0.20 to up to USD 20 per hectare forestland depending on project size and verification methodology (Galik et al. 2015). Considering that these datapoints have been measured ten years ago, further research in transaction costs associated with using carbon crediting might be useful. Since the time these studies have been conducted, monitoring technologies used in carbon markets have evolved inter alia by deploying satellite-based monitoring of project areas, which might have impacts on overall monitoring costs.

Table 2: Overview of transaction cost categories in carbon crediting

Category of transaction costs	Description
Search costs	Identifying project location, partners and consultants
Project development cost	Conduct feasibility study, establish the GHG baseline, determine additionality , conduct environmental impact assessments
Negotiation costs	Obtain permits, arrange financing, marketing and contracting for carbon credits, negotiate purchasing contracts
Monitoring costs	Continual monitoring and verification of a projects GHG impact
Validation, registration, verification, and issuance costs	Cost for registration with a carbon crediting program, validation of project documentation and verification of avoided emissions and removals, issuance fees
Insurance costs	Project liability insurance, contribution to buffer pools

Source: Adapted from (Pearson et al. 2014).

All other financing sources also involve transaction costs albeit not to the same degree for monitoring the mitigation impact of the funded activities. **Biodiversity credits** will likely involve higher transaction costs than carbon credits. Measuring impacts of project activities on biodiversity is more challenging because this requires monitoring and verification of many different metrics not just the carbon impact. These metrics are often not yet fully defined and therefore associated with high uncertainties. For **climate contributions using other modalities than carbon credits** the opposite might be true. As they may require less detailed monitoring of mitigation impacts, transaction costs could be lower. **Bilateral and multilateral development cooperation** also involves transaction costs. For example, it is often channelled through national, regional or international agencies which implement the projects on the ground against a fee for their services. Like for carbon credits, project development involves feasibility studies and preparation of other project documentation. Since several years aid effectiveness is an important subject among donor and recipient countries. Between 2000-2019 the number of bilateral and multilateral agencies increased from 191 to 502. Recipient countries now often must deal with 60 or more donor entities. This fragmentation of delivery channels increased complexity of the global aid architecture and transaction costs due to more efforts required to coordinate between different donors and agencies (World Bank 2022). Funds channelled as **philanthropic grants and contributions** can involve less transaction cost than ODA flows if they follow more flexible funding models and rely on long-term partnerships with recipient

organisations. Costs can be high if they impose donor-specific reporting frameworks or target highly short-term projects which require high oversight for relatively small grant flows.

Domestic public finance and **tourism entry and activity fees** likely involve comparably small transaction costs when compared with the other funding sources. A main reason is that they are sourced locally and are not project-based. For domestic public finance, few costs might be associated with budgetary negotiations and ensuring financial accountability. Tourism entry and activity fees mainly involve investment cost to set up payment systems and fee collection mechanisms. Especially if these involve digital payments, transaction costs might be low. If fees are collected through staff members of protected areas, they might be higher but still low compared with transaction costs associated with the other sources discussed in this report.

The two more innovative sources**, debt-for-nature swaps** and **blue bonds** likely involve medium to high transaction costs. Negotiating debt swaps can take years and requires coordination across multiple parties (Belianska et al. 2022). The negotiations further require high legal and financial expertise which countries often must source externally through international consultants. The USD 553 million Belize debt-for-nature swap for example is estimated to involve USD 86 million allocated to intermediaries, as well as service providers such as re-insures, advisers and credit providers (White 2023). Transaction costs for blue bonds will be less pronounced than in debt-for-nature swaps, however, bond certification might be a cost factor for countries that lack local expertise to perform such services. In such cases they must rely on international expert firms to provide the required certification services.

3.6 Integrity risks

In the context of offsetting, the use of carbon credits as a funding mechanism introduces a critical trade-off. Each credit issued permits a corresponding tonne of CO_2 emissions elsewhere, making the environmental integrity of the credit essential. The term environmental integrity refers to the aim that a crediting mechanism must not lead to aggregate Greenhouse gas (GHG) emissions that are higher than they would have been without the use of the mechanism (Schneider und La Hoz Theuer 2019). If carbon credits used for offsets are issued without ensuring additionality, permanence, and conservative carbon accounting, the result may be a net increase in global emissions. In effect, society could be subsidising new coastal ecosystem protection and restoration efforts with higher levels of atmospheric CO_2 – a counterproductive outcome.

Integrity of carbon credits is also important in the context of climate contribution claims. It is important that claims are truthful and not misleading. This means that especially for contribution claims using the tonne-for-tonne approach, additionality, conservative accounting, and permanence of the mitigation impact of carbon credits are important considerations. Although there is not necessarily a direct impact on atmospheric emission levels when carbon credits with low integrity are used for climate contributions, it still negatively affects the robustness of these claims and undermines consumer trust in these emerging labels.

A separate report under this project found that integrity risks are material for Blue Carbon projects and relate to all aspects of integrity, including additionality, quantification, and non-permanence (Jennerjahn et al. 2025).

The following summarises the main findings of this report (see section 4 of the report):

- **Additionality**: Overall non-additionality risks for Blue Carbon projects are not more pronounced than for other types of projects. The main risks for individual projects arise from their intersection with protected areas and the potential availability of alternative

revenue streams. While these integrity concerns exist, there are two key measures that carbon crediting programmes can implement to further reduce non-additionality risks. First, they should require project developers to publicly disclose a comprehensive financial analysis, including a detailed breakdown of costs and a clear distinction between carbon market revenues and other funding sources. Second, carbon crediting programmes should require project developers to submit a notification of intent as soon as they decide to proceed with the project. This could help reduce uncertainties in cases where project documentation is submitted after the mitigation activities have already begun.

Quantification: Quantifying carbon benefits in coastal ecosystems is complex, and the results are inherently associated with uncertainties. Coastal ecosystems exhibit high spatial and temporal variability in carbon dynamics, making it challenging to develop standardized measurement approaches for carbon quantification methodologies. The main carbon pools are above- and belowground biomass as well as soil organic carbon, while key emission sources are microbial methane production and fossil fuel use. Potentially substantial overestimating risks are associated with the approaches to estimating baseline deforestation rates in the project subtype of mangrove *conservation* projects. Here, the analysis of the sample projects showed that these projects face similar issues of baseline uncertainty as REDD+ projects in terrestrial forests. The respective methodology offering registration for this subtype, VCS VM0007, does not appropriately account for this uncertainty. In contrast, it provides project developers with considerable flexibility in selecting reference areas and periods for determining baseline deforestation rate.

Mangrove *restoration* projects appear less affected by systemic baseline uncertainty. However, individual projects may overestimate carbon removals if they fail to account for the possibility that restoration might have occurred through alternative funding sources under the baseline scenario. This risk is particularly relevant in areas with a history of successful mangrove restoration activities. Measuring the effect of project activities on changes in carbon pools occurring between baseline and project scenario is also associated with uncertainty. The lack of long-term data on carbon fluxes, especially in restored ecosystems and for non-mangrove habitats like seagrasses and saltmarshes, makes the estimation of these changes challenging. For biomass carbon accounting, the main uncertainties result from the selection of appropriate allometric equations, the number of sample trees used to construct these equations, as well as location and placement of sample plot design for ex-post measurements of removals. Organic soils are by far the largest carbon pool of Blue Carbon ecosystems and at the same time the most difficult to monitor. Obtaining necessary data requires specialised expertise and access to laboratory equipment. Measurement is further associated with high costs and therefore field data are scarce and based on few samples. Moreover, soil carbon samples show high variations between different measurement plots in the same area. Overall, uncertainties around soil carbon accumulation can result in very high over-crediting risks due to the importance of the soil carbon stock for carbon accounting.

Non-permanence: Non-permanence is a further critical concern in Blue Carbon projects due to the inherent vulnerability of coastal ecosystems to both human and natural disturbances. Unlike engineered carbon removal solutions, durability of carbon sequestration depends on maintaining ecological integrity of the project area. However, factors such as extreme weather events, sea level rise, erosion, pollution, and land-use pressures pose ongoing risks of carbon reversals—that is, the release of previously sequestered carbon back into the atmosphere. While carbon crediting programmes require buffer reserves or risk discounting to account for such uncertainties, the adequacy and

transparency of these measures vary. Most Blue Carbon projects have a duration of 20-40 years and therefore do not qualify for permanent removals, which would require maintaining carbon stocks in these ecosystems for 100 years or more. Additionally, in the case of the VCS, monitoring by the project developer may cease after the end of the crediting period. Also, none of the crediting programmes seem to have liability mechanisms in place in case the programme ceased its operations. These challenges can undermine the integrity of Blue Carbon credits, particularly if these were used for offsetting claims. There is a need for stronger liability mechanisms, and continuous monitoring to ensure that claimed mitigation benefits are not lost over time. Yet, reversal risks can never be fully avoided for Blue Carbon projects. This is a finding that applies not only to Blue Carbon projects but all projects that monetize the carbon storage function from ecosystems.

Among the other financing sources **biodiversity credits** have integrity risks similar to carbon credits, albeit risks may not be related to atmospheric emission levels but to their impact on the overall extent of global biodiversity. Other sources may have risks to create pervasive incentives with negative impacts on the environment. For example relying on revenues from **tourism entry and activity fees** might create incentives to allow more visitors into an ecosystem than is ecologically healthy. **Blue bonds** can lead to funding harmful activities if there is no clear taxonomy that defines what activities have positive impacts for the oceans in a scientifically robust manner. Research for example found that in existing blue bonds some impact metrics are not in line with well-established norms such as the two-degree climate scenario, which raises a discussion over whether these bonds are sustainable (Bosmans und Mariz 2023).

4 Summary and conclusions

Governments around the world have been funding measures to conserve and restore coastal ecosystems since several decades. These ecosystems are of vital importance for biodiversity, providing critical habitats for numerous species. They also provide important services to key economic sectors such as fisheries and tourism, they help make coastal zones more resilient against erosion and sea-level rise. As such, the reasons why governments fund these measures are manifold. Governments can rely on the support of many partners to implement these measures: other governments – via bilateral and multilateral development cooperation, local and international non-governmental organisations, philanthropic foundations, and the private sector. While the motivation for providing support might be different among these actors, they all share a common interest in halting ecosystem loss and restoring degraded habitats.

Due to the large network of interested stakeholders, governments have access to a diversified portfolio of funding sources to support coastal ecosystem conservation and restoration. While domestic contributions have been the main source for such efforts to date, governments, particularly those with extensive coastlines or insular nations, have also leveraged additional foreign financing sources, including ODA, philanthropic grants, and revenues from tourism entry fees.

Until recently, carbon sequestration has not played a key role in governments' motivation to fund such measures, and in many cases it still does not. Albeit the large network of supporters, funding in many cases however has been insufficient to realise national ambitions to increase resiliency and preserve critical ecosystems. The ability to monetize the carbon storage function of coastal ecosystems via carbon credits therefore attracted the attention of governments and of many of the other stakeholders alike.

Unlike other sources, using carbon credits to raise funding for new measures to conserve and restore coastal ecosystems however faces a critical trade-off: If such credits are used for offsetting, each credit issued permits a corresponding tonne of CO_2 emissions elsewhere, making the environmental integrity of the credit essential. If credits are issued without ensuring additionality, permanence, and conservative carbon accounting, the result may be a net increase in global emissions. In effect, society could be subsidising new coastal ecosystem protection and restoration efforts with higher levels of atmospheric CO_2, which would be a counterproductive outcome.

Whether or not carbon credits can be considered as a suitable funding source for coastal ecosystem protection and restoration therefore depends on three factors. First, whether buyers use them for offsetting or other purposes such as contribution claims. Second, when used for offsetting, the likelihood that environmental integrity risks can be avoided and the importance that actors attach to the avoidance of such risks. For some stakeholders, revenues from carbon credits might just be a welcome new funding stream for urgent conservation and adaptation priorities, which may outweigh concerns over the impact on atmospheric emission levels – as these are perceived more abstract and with less immediate consequences. For other stakeholders, the risks that using carbon credits for offsetting can lead to an increase in overall atmospheric emission levels outweigh potential benefits, as higher emission levels will negatively impact the health of coastal ecosystem through rising sea levels and other adverse effects of climate change.

Next to the use case, and the weighing of associated risks, the availability of alternatives – i.e. the possibility to scale up flows from other sources also plays a role in considerations whether to deploy carbon credits as a source or not.

This report attempted to inform such considerations by systematically discussing the advantages and disadvantages of carbon credits compared with other funding sources available to fund coastal ecosystems conservation and restoration. These are the report's main findings regarding carbon credits:

- **Maturity:** On a global level, carbon credits are a mature funding instrument. With over 20 years of experience and carbon crediting projects having been implemented in almost every country of the world. The complexity of the instrument and its associated risks for the atmosphere and environment in the context of offsetting are well known, as are approaches which can avoid them or minimize and manage their effects where full avoidance is not possible. Further, there is a large international network of specialists and firms that reliably can provide the different services required for carbon crediting such as methodology and project development as well as validation and verification of project results. While Blue Carbon is a comparatively new project type, much of the accumulated expertise can be used for developing and verifying these projects. Here carbon credits have a comparative advantage when compared to biodiversity credits which are at the early stage of their development and some conceptual and operational details not yet being defined. Carbon credits are likely also more mature than debt-for-nature swaps and blue bonds. Domestic public finance, bilateral and multilateral development cooperation, philanthropic grants, and contributions as well as tourism entry and activity fees on the other hand are likely more mature than carbon credits, especially at the local level. There is ample experience in using these sources for coastal ecosystem protection and restoration.

- **Scalability of financial flows:** Carbon credits, regardless of whether they are used for voluntary offsetting or contribution claims mobilise funding from a different pool of resources than the traditional funding sources deployed for coastal ecosystem protection. Scaling financial flows through voluntary carbon markets is not restricted by the same barriers that prevent scaling of domestic public finance or bilateral and multilateral development cooperation, for which scalability hinges on fiscal space of governments. Further, carbon credits do not require payback or interest payments, which restricts the scalability of sources such as blue bonds or debt-for-nature swaps for countries with limited fiscal space and lack of access to capital markets.

- **Predictability and stability of flows:** The carbon credit market continues to be fragmented and different prices apply for different market segments and project types. Furthermore, carbon prices for the same project type frequently fluctuate between years. This also applies to carbon credits from Blue Carbon projects. The average price at which Blue Carbon credits were transacted in 2024, for example increased by about 257% compared to 2023 levels. Historically, price instability has been a significant concern for projects funded by carbon credits and some projects had to be rescued with public funding after the collapse of the CDM market. Continued price volatility makes it difficult for projects to estimate the volume of future revenues that they will be able to receive through carbon credits. Other funding sources might currently perform better in this aspect, although all face some form of predictability issues but to a lesser degree. If the voluntary carbon market reached a more concentrated state with high price stability, carbon credits could potentially be a very stable source of income. This is related to the long-term investment horizon of carbon credits. Current projects have crediting periods between 20-60 years, which is much longer than for the other funding sources assessed in this report. Development cooperation and philanthropic grants often follow project cycles of 5-10 years. Also current blue bonds and dept swaps have investment horizons of about 20 years. Budgetary contributions are even more short-term as in most cases contributions must be negotiated on an annual basis.

However, payments for carbon credits are only provided ex post upon verification of achieved mitigation results, while most funding sources provide support on an ex-ante basis, providing security and upfront funding to implementing actors with potentially limited budgets.

- **Carbon accounting readiness:** Carbon credits are the only funding source which currently requires project owners to perform high-resolution measurements of the mitigation effect of funded activities. The greenhouse gas emission monitoring frameworks built for carbon crediting projects surpass those of projects funded through any of the other sources in terms of comprehensiveness and granularity. These projects therefore also make an important contribution to advance scientific understanding of the carbon fluxes in coastal ecosystems. At the same time, experience with quantifying mitigation impacts of activities aiming to conserve and restore terrestrial ecosystems has shown that current ecosystem-related measurement frameworks built for carbon credits often return estimates with very high uncertainty. This reflects that it is very difficult to measure the effect of project activities on some carbon pools such as soil organic carbon. Other sources such as development cooperation and philanthropic grants feature indicators to track emission reductions and removals in their result management frameworks. Monitoring is however much less granular and relies on more basic approaches. It is most likely that other funding sources have not adopted the measurement infrastructure built for carbon credits because it is costly and creates additional burden for project development and implementation. In principle, any funder will be interested in the impact of funded activities on GHG metrics even though it might not be a primary motivation to start a restoration activity. It might be worthwhile to explore whether approaches used in carbon crediting could be adopted in the context of other funding sources. This would however require a careful cost-benefit analysis considering the transaction costs involved.

- **Transaction costs:** Because of their comprehensive and granular GHG measurement framework, carbon credits likely have higher transaction costs than some of the other funding sources, which rely on more basic approaches to measure GHG impacts of funded activities or do not measure them at all. Overall, there is however little information available on monitoring and certification costs for carbon crediting projects that target the conservation and restoration of coastal ecosystems. It is therefore not possible to make estimates about the extent of average transaction costs of Blue Carbon projects vis-à-vis other funding sources. Further research in this area is recommended. Among the other funding sources, debt for climate swaps likely have the highest transaction costs as their complexity requires involvement of many actors as well as engagement of highly specialised advisors.

- **Integrity risks:** Integrity risks are material for carbon credits from Blue Carbon projects. Research summarized in a separate report under this project shows that approaches for the quantification of effects of Blue Carbon projects on key carbon pools such as biomass and soil organic carbon are associated with high uncertainties (Jennerjahn et al. 2025). The report further showed that conservation projects likely have higher risks than restoration projects. It also showed that the design choices that some of the restoration projects made might be suitable to address several of the key quantification related risks. Even with these adjustments some key risks, such as the non-permanence of the avoided emissions and removals as well as the inadequacy of current mechanisms to address and compensate them remain. These risks are prevalent for any nature-based carbon credits and not necessarily specific to Blue Carbon projects. Among the other sources assessed for this report, only biodiversity credits have similar environmental integrity risks, albeit risks may not be

related to atmospheric emission levels but their effect on the overall extent of global biodiversity. Yet, other sources may equally have risks to result in problematic outcomes for the environment. For example, relying on revenues from tourism entry and activity fees might create incentives to allow more visitors into an ecosystem than is ecologically healthy. Blue bonds can lead to funding harmful activities if there is no clear taxonomy that defines what activities have positive impacts for the oceans in a scientifically robust manner. Research found for example that in existing blue bonds some impact metrics are not in line with well-established norms such as the two-degree climate scenario, which raises a discussion over whether these bonds are sustainable (Bosmans und Mariz 2023).

In summary, carbon credits are one among several funding sources available to fund coastal ecosystem conservation and restoration measures. An advantage of carbon credits is that they mobilise resources from a different funding base than traditional sources, as buyers on voluntary carbon markets are mainly private sector actors. They further do not involve repayments and interest payments, which make them attractive for governments which have limited fiscal space and lack access to capital markets – both needed for deploying other innovative sources such as blue bonds and debt-for-nature swaps. Yet, payments for carbon credits are only made ex-post which can pose a burden to project implementation as the upfront costs need to be covered from different sources initially.

A disadvantage of using carbon credits is the material environmental integrity risks that apply if these credits are used for offsetting. They might lead – if not properly addressed – to higher overall atmospheric emission levels. Whether these risks can be appropriately addressed for any nature-based carbon credits remains uncertain mainly due to the non-permanence risks associated with avoided emissions and removals. Risks to overestimate the mitigation impact of funded Blue Carbon activities can partially be addressed for the subset of restoration activities through measures such as forgoing accounting of increases in soil organic stocks – a measure which also would reduce the transaction costs for these projects. Conservative carbon accounting can also de-risk investments into Blue Carbon projects as it will be a tool to ensure that the high-quality perception of these credits which is currently prevalent in the markets remain.

The suitability of using revenue from carbon credits therefore strongly depends on the integrity of the certificates used and the use case itself. Using them for offsetting carries high risks that more emissions will remain in the atmosphere than would have been the case without their use for this purpose. This risk does not exist when used for climate contributions. However, even in this case, the quality of the certificates is crucial to avoid undermining the credibility of the contributions.

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A Appendix

Table 3: Adaptation Fund support for coastal ecosystems (in USD million)

Project title	AF grant	Blue carbon related activities
Increasing socio-ecological resilience in the Uruguayan coastal zone and strengthening the adaptive capacity of its infrastructure: REACC COSTAS	10.00	Coastal wetland restoration
Strengthening the Adaptive Capacity of Coastal Communities of Fiji to Climate Change through Nature-Based Seawalls	5.71	Mangrove afforestation
Enhancing Climate Change Resilience of Coastal Communities of Zanzibar	1.00	Mangrove afforestation
Enhancing the Resilience of Belize's Coastal Communities to Climate Change Impacts	4.00	Avoided mangrove deforestation/ restoration
Reducing vulnerability and increasing resilience of coastal communities in the Saloum Islands (Dionewar and Fadial)	1.35	Mangrove restoration
Enhancing the Climate Resilience of vulnerable island communities in Federated States of Micronesia	9.00	Mangrove protection
Adaptation to the Impacts of Climate Change on Peru's Coastal Marine Ecosystem and Fisheries	6.95	Resilience of coatsal marine ecosystems
Conservation and Management of Coastal Resources as a Potential Adaptation Strategy for Sea Level Rise	0.69	Mangrove restoration
Belize Marine Conservation and Climate Adaptation Initiative	6.00	Mangrove protection
Reduction of Vulnerability to Coastal Flooding through Ecosystem-based Adaptation in the South of Artemisa and Mayabeque Provinces	6.07	Mangrove restoration
Implementation Of Concrete Adaptation Measures To Reduce Vulnerability Of Livelihood and Economy Of Coastal Communities In Tanzania	5.01	Mangrove restoration
Climate Change Adaptation Programme in the Coastal Zone of Mauritius	9.12	Mangrove restoration

Source: https://www.adaptation-fund.org/projects-programmes/project-information/ , Information as of 30 May 2025.

Table 4: GCF support for coastal ecosystems (in USD million)

ID	Project title	GCF financing	Co-financing	Blue carbon related activities
FP003	Improving the resilience of vulnerable coastal communities to climate change related impacts in Viet Nam	7.61	0.55	Mangrove restoration
FP013	Improving the resilience of vulnerable coastal communities to climate change related impacts in Viet Nam	20.55	4.97	Mangrove restoration
FP015	Tuvalu Coastal Adaptation Project (TCAP)	29.52	11.01	Mangrove restoration
FP084	Enhancing climate resilience of India's coastal communities	24.98	8.00	Mangrove protection
FP122	Blue Action Fund (BAF): GCF Ecosystem Based Adaptation Programme in the Western Indian Ocean	43.42	86.85	Mangroves, seagrass, saltmarshes restoration
FP125	Strengthening the resilience of smallholder agriculture to climate change-induced water insecurity in the Central Highlands and South-Central Coast regions of Vietnam	32.33	26.94	Mangrove, seagrass conservation/ restoration
FP157	Coastal Resilience to Climate Change in Cuba through Ecosystem Based Adaptation - "MI COSTA"	38.00	11.20	Mangrove, seagrass conservation/restoration
FP180	Global Fund for Coral Reefs Investment Window	23.93	20.37	Mangrove, seagrass restoration
FP206	Resilient Homestead and Livelihood support to the vulnerable coastal people of Bangladesh (RHL)	125.00	375.00	Reduced mangrove deforestation
FP213	The Blue Green Bank (BGB)	42.20	7.79	Mangrove afforestation
FP247	Local Climate Adaptive Living Facility Plus (LoCAL+) – West Africa (Burkina Faso, Ivory Coast, Mali and Niger)	36.40	9.53	Mangrove conservation/ restoration
FP250	Achieving emission reduction in the Central Highlands and South-Central Coast of Viet Nam to support National REDD+ Action Programme goals (RECAF)	47.83	9.09	Ecosystem conservation
SAP025	Adaptation of agricultural production systems in Coastal Areas of Northwest Guinea-Bissau	70.00	40.00	Mangrove, seagrass restoration
SAP029	Ecosystem-based Adaptation (EbA) for Reducing Community Vulnerability to Climate Change in Northern Pacific Small Island Developing States (SIDS)	9.81	0.15	Mangrove restoration
SAP036	Sierra Leone Coastal Resilience Project (SLCRP)	8.90	1.05	Mangrove conservation/restoration

Source: https://www.greenclimate.fund/projects, Information as of 30 May 2025.